ANALELE
UNIVERSITĂŢII DIN CRAIOVA

VOL. XXIII (LIX) – 2018

✓BIOLOGIE

✓HORTICULTURĂ

✓ TEHNOLOGIA PRELUCRĂRII PRODUSELOR AGRICOLE

✓INGINERIA MEDIULUI

ANNALES OF THE UNIVERSITY OF CRAIOVA

CRAIOVA – 2018
Editura UNIVERSITARIA

ANNALS OF THE UNIVERSITY OF CRAIOVA – DOLJ
A.I.Cuza Street, No. 13, Code 200585 – Craiova, Romania

ISSN 1453 – 1275

Sections:

HORTICULTURE

FOOD PRODUCTS PROCESSING TECHNOLOGY

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

COMPARATIVE ANALYSIS OF TOTAL ANTIOXIDANT POTENTIAL OF FOUR PURPLE POTATO GENOTYPES AND SEVERAL BERRIES FRUITS

Bădărău Carmen Liliana[1,2*], Ştefan Floriana Maria[1], Tican Andreea[1]

[*]National Institute of Research and Development for Potato and Sugar Beet, BraŞov
[2] Transilvania University from BraŞov, Faculty of Food and Tourism
* *Correspondence author. E-mail*: carmen.badarau@potato.ro

Keywords*: purple potato, berries, antioxidant capacity, polyphenols, flavonoids.*

ABSTRACT

Potato tubers with purple flesh contain high levels of antioxidants as do some of many berries fruits. This study evaluated the total antioxidant activity (TAC) of four potatoes genotypes with purple colored flesh tubers in comparison with cranberries, blueberries, blackberries and raspberries. The potential antioxidant activity (estimated by ABTS method and DPPH scavenging activity) of the purple potato tubers were closed to that obtained for raspberries. Compared to other rich sources of polyphenols like the berries, the purple potato consumption has as special advantages the bioavailability and economic considerations (lower price).

INTRODUCTION

In terms of total phenols, total flavonoids and other food antioxidants (vitamin C, carotenoids) are associated with total antioxidant capacity (TAC) (Kalita & Jayanty, 2014). However, the TAC consumed by an individual depends on the type and amount of food intake. Therefore, the estimation of TAC provides valuable information on potential health benefits (Wang et al., 1996; Ezekiel et al., 2013). Moreover, the marketing of so called superfoods is commonly based on their antioxidant potential. In fact, a superior antioxidant activity with health benefits has been claimed for a number of antioxidants foods on in vitro antioxidant assays. There is a great variability in the phenolic compounds and the antioxidant activity in the commercial fruits (Lim et al., 2007; Wu et al., 2004; Borges et al 2010). Cranberries, blackberries, black blueberries, raspberries are considered to be superfood because of their antioxidant activity. Because of their diverse range of valuable phytonutrients (as anthocyanins, pro-anthocyanins, phenolic acid and flavonoids), these berries have beneficial effects on human health including anti-neurodegenerative, anti-inflammatory, antidiabetic and anti-obesity effects (Duthie et al., 2000; Wang et al., 1996; Kalita & Jayanty, 2014].

In particular, as in the case of the fruits tested in this paper, potato antioxidants have been shown to have favorable impacts on several measures of cardio-metabolic health, including lowering blood pressure, improving lipid profiles and decreasing markers of inflammation (Valcarcel et al., 2015; Duthie et al., 2000; Wang et al., 2004). This impact could be strong especially for people where potato is the most important food crop and therefore would be of interest to consumers and producers (Valcarcel et al., 2015). New potato cultivars whit high level of antioxidant compounds is considered a realistic approach to increasing dietary antioxidant intake (Navarre et al., 2011; Perla et al., 2012; Lachman et al., 2005).

The main objective of this research work was to assess their potential antioxidant capacity (using two methods ABTS and DPPH) in purple potato tubers (four cultivars) and in cranberries, black blueberries, blackberries and raspberries.

MATERIAL AND METHODS

The following potato genotypes with strong colored flesh were studied:
-'Albastru Violet Galanesti '('Blue Purple of Galanesti')
-'Blue Congo', 'Blue de la Manche', 'Patraque Auvergne'

The berries fruits: cranberries (*Vaccinium myrtillus* L.), black blueberries (*Ribes Nigrum* L.), blackberries (*Rubus fruticosus* L.) and raspberries (*Rubus idaeus* L.) were purchased from commercial market.

In the Figure 1 there were presented the extractions obtained from the samples tested (berries and purple flesh tubers from the genotypes studied).

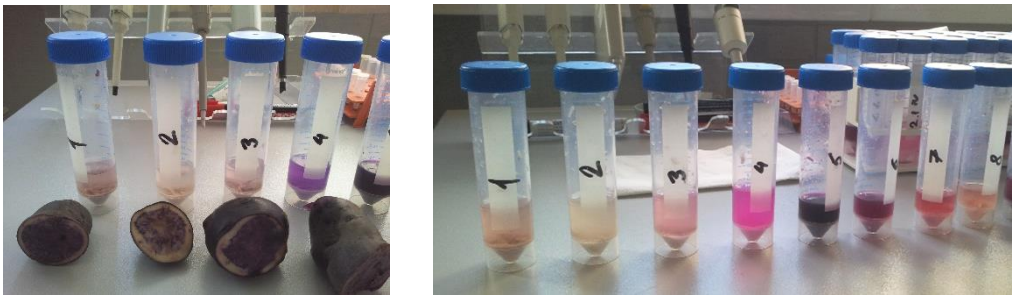


Figure 1. Purple flesh potato tubers and samples extracts.

Extraction

Antioxidant compounds were extracted from the material mentioned above. One gram of freeze dried food material was weight into a falcon tube and 10 ml of aqueous 96 % ethanol was added. The mixture was homogenized for 5 min. (Vortex), centrifuged at 10000 rpm for 10 min. and filtered through Whatman (Number 400) filter paper (Kalita & Jayanty, 2014).

DPPH assay. Volumes 20µl of the extracts were added to 20µl of distillated water in a 96 –well bottom microplate. 200µl of 120mg/l DPPH radical solution (using ethanol as a solvent) was then added and mixed thoroughly. The absorbance was measured using a plate reader (TecanSun Rise, software Magellan) at 515nm after keeping the plates in the dark for 30 min. A control with 20 µl of ethanol (no extract) was also included in each plate. The DPPH radical scavenging activity was calculated with the following formula (Kalita & Jayanty, 2014):

$$DPPH\ radical\ scavenging\ activity\ (\%) = [(A_{control} - A_{sample})/ A_{control}] \times 100\ (\%)$$

where A is the absorbance (of the control and samples) at 515 nm.

ABTS assay. This assay was performed by adopting the method of Arnao et al. (2001). The stock solution included an 8 mM ABTS radical solution and a 3mM potassium persulfate solution. The working solutions was prepared by mixing the two stock solutions in equal quantities and allowing them to react for 12 h at room temperature in the dark. The solution was then diluted by mixing 1 ml ABTS radical solution with 60ml ethanol to obtain an absorbance of approximately 1 unit at 724 nm using the microplate reader. Sample extract (150 µl) was allowed to react with 2850 µl of the ABTS solution for 2 hours in the dark. The ABTS antioxidant capacity was expressed in µmol Trolox equivalents (µmol TE) /g.

Statistical interpretation. The experiments were carried out in triplicates and statistical analysis was performed by one way analysis of variance (ANOVA) at $p< 0.05$ significance level using. Also, Duncan's multiple range test were used.

RESULTS AND DISCUSSIONS

DPPH radical-scavenging activity

The reduction capability of DPPH radical was determined by decrease in absorbance at 517 nm induced by antioxidants (included in the samples studied). Figure 2 presents the DPPH scavenging activity of the ethanol extracts of berries and potato tubers.

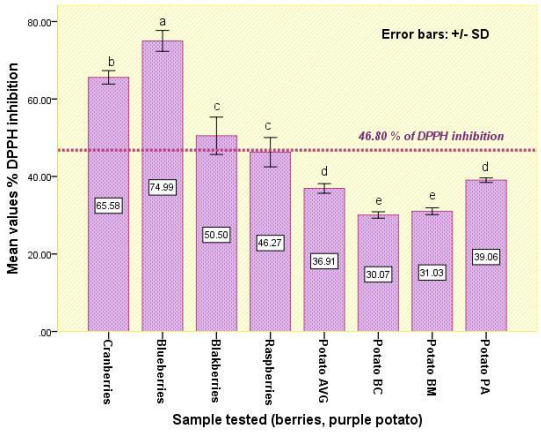


Figure 2. Antioxidant activity of cranberries, blueberries, blackberries, raspberries and different purple potato tubers (AVG = Albastru Violet de Galanesti – cv. 'Blue Purple of Galanesti'; BC = cv. 'Blue Congo'; BM = cv. 'Blue de la Manche'; PA = cv. 'Patraque Auvergne') by DPPH assay. Values not followed by the same letter are significantly different (P=0.05) according to Duncan's test. Abbreviations: DPPH=2, 2-diphenyl-1-picrylhydrazyl; SD=standard deviation.

As shown in this figure, the blueberries had the highest level of % DPPH inhibition, followed by cranberries, blackberries, purple potato AVG (Blue Purple of Galanesti), Patraque Auvergne, Blue Congo and Blue de la Manche (with significant variations $p<0.05$).The raspberries samples had close values of DPPH scavenging activity with some purple potato varieties

ABTS scavenging activity

The DPPH assay was used for evaluate the free radical-scavenging ability of the extracts. But the DPPH antioxidant activity depends upon a lot of factors (reaction time, kind of the phenolic compounds and the redox potential of the extracts. ABTS free radicals are more active than DPPH free radicals and unlike reactions with these radicals occur in less than a millisecond. The analysis is based on the reduction of the blue green ABTS radical by hydrogen-donating antioxidants and the decomposition of the ABTS radical is observed by the determining the absorption at 600 nm. Figure 3 shows the ABTS radical cation-scavenging activity of the ethanol extract of berries fruits and purple potato tubers samples. The blueberries samples had the highest ABTS value (244.0± 5.291 □mol TE/g) than the other samples extracts.

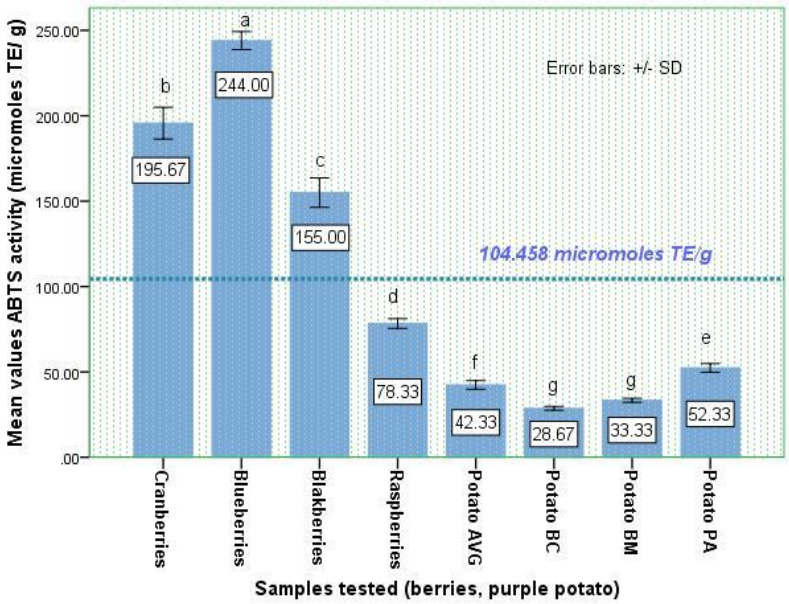


Figure 3. Antioxidant activity of several berries (cranberries, blueberries, blackberries, raspberries) and different purple potato tubers backed (AVG = Albastru Violet de Galanesti –Blue Purple of Galanesti; BC= Blue Congo; BM= Blue de la Manch; PA= Patraque Auvergne) by ABTS assay. Values not followed by the same letter are significantly different (P=0.05) according to Duncan's test.

The ABTS antioxidant potential was in the following order; blueberries > cranberries > blackberries >raspberries > potato cv. 'Patraque Auvergne' > potato cv. 'Blue Purple of Galanesti' > potato cv. Blue de la Manche > potato cv. 'Blue Congo'. There were significantly differences between the food samples tested. The antioxidant capacity estimated by ABTS assay for potato tubers from cv. Patraque Auvergne and Blue Purple of Galanesti was closed to that of the raspberries.

A huge number of articles are available regarding the antioxidant capacity of different fruits and vegetables. Wu et al. (2004) estimated the antioxidant potential of more than 100 types of foods, fruits, nuts, vegetables and dried spices consumed in the USA. Borges et al. (2010) studied the antioxidant activity of some European commercial juices. A critical analysis of the poliphenol and the antioxidant capcity of potato tubers measured by ORAC and DPPH methods was performed by Pillai et al (2013). There was found a high antioxidant potential in purple fleshed potato tubers. Compared with other vegetables, this potential was even higher. Similar results regarding the comparable antioxidant capacity of purple flesh tubers and some berries fruits and grape are reported by Madiwale et al. (2012).

A study in USA estimated that potatoes were the third highest contributor to the daily intake of phenolic compounds, after oranges and apples, with a daily intake consumption of 171 g day^{-1} (Chun et al., 2005). These properties of potatoes could be greater if the cultivars with high antioxidant level become popular for the people. Unfortunately, the Romanian genotype 'Blue Purple of Galanesti', (reported in this study with an antioxidant capacity level closed to that of the raspberries) is not accepted with pleasure by the consumers because the tubers are small, elongated and with deep eyes. Maybe in the future, the potato breeders correct these quality parameters by developing new cultivars with functional food characteristics (Bădărău et al., 2017).

CONCLUSIONS

Significant differences between the samples of the food tested were observed for the antioxidant potential measured by both methods (DPPH and ABTS scavenging activity). Higher antioxidant capacity were found in cranberries, black blueberries and blackberries and close value for raspberries and several intense colored fleshed potato tubers. Among the potato studied, the genotype 'Blue Purple of Galanesti' and the cv. 'Patraque Auvergne' (all with blue skin and purple flesh) had higher values percentage of DPPH inhibition and ABTS radicals scavenging activity, these value were closed to that obtained for raspberries samples. These properties of purple flesh potatoes could be greater if these cultivars with high antioxidant potential level become popular for the people. Therefore, colored potatoes contribute to the daily intake of antioxidants and their consumption thereby may have positive effects on the human health.

ACKNOWLEDGMENT

This work was supported by the project ADER 2.1.1. "Obtain new potato varieties adapted to climate change and higher economic efficiency in the management of water resources and establish specific technological packages current market requirements and request farmers".

REFERENCES

Amao M.B., Cano A., Acosta M., 2001, The hydrophilic and lipophilic contribution of total antioxidant activity, Food Chemistry 73, 239-244.

Bădărău C.L., Stefan F.M., Stroe F., Canja C.M, 2017, Total phenolic content in several potato cultivars (Brasov, 2015-2016*).* Annals of the University of Craiova-Agriculture, Montanology, Cadastre Series 47 (1), 12-18.

Borges G., Mullen W., Crozier A., 2010, Comparison of the polyphenol composition and antioxidant activity of European commercial fruit juices. Food Functional 1, 73-83

Chun O.K., Kim D.O., Smith N., Schroeder D., Han J.T., Lee C.Y., 2005, Daily consumption of phenolic and total antioxidant capacity from fruit and vegetables in the American diet. Journal of Sciences and Food Agriculture 85, 1715-1724.

Duthie G.G., Duthie S.J., Kyle J.A., 2000, Plant polyphenols in cancer and heart disease: implications as nutritional antioxidants. Nutrition Research Reviews 13, 79-106

Ezekiel R., Singh N., Sharma S., Kaur A., 2013, Beneficial phytochemicals in potato – a review. Food Research International 50, 487-496.

Kalita D. and Jayanty SS., 2014, Comparison of polyphenol content and antioxidant capacity of colored potato tubers, pomegranate and blueberries, Food Processing & Technology, 5(8), 1-7.

Lachman J. and K. Hamouz, 2005, Red and purple colored potatoes as significant antioxidant source of human nutrition – a review. Plant, Soil and Environment 51, 477-482.

Lim Y.Y., Lim T.T., Tee J.J., 2007, Antioxidant properties of some tropical fruits: a comparative study. Food Chemistry 103, 829-838.

Madiwale G.P., Reffivari L., Stone M., Holm D.G., Vanmala J., 2012, Combined effects of storage and processing on the bioactive compounds and proapoptotic properties of color fleshed potatoes in human colon cancer cells. Journal of Agricultural and Food Chemistry 60, 11088-11096.

Navarre Du R.A., Pillai S.S., Shakys R., Holden M.J., 2011, HPLC profiling of phenolic in diverse potato genotypes. Food Chemistry 127, 34-41.

Perla V., Holm D.G., Jayanty S.S., 2012, Effects of cooking methods on polyphenols, pigments and antioxidant activity in potato tubers. LWT-Food Science and Technology 45,161-171.

Pillai SS., Navarre Du R.A, Bamberg J., 2013, Analysis of polyphenols, anthocyanins and carotenoids in tubers from *Solanum tuberosum group phureja, stenotomum* and *andigena*. American Journal of Potato Research 90, 440-450

Valcarcel J., Reilly K., Gaffney M., O'Brien N.M., 2015, Antioxidant activity, total phenolic and total flavonoid content in sixty varieties of potato (*Solanum tuberosum* L.) grown in Ireland. Potato Research 58, 221-141.

Wang H., Cao. G.H, Prior RL., 1996, Total antioxidant capacity of fruits. Journal of Agricultural and Food Chemistry 44, 1996, 701-705.

Wu X., Beecher G.F., Holden J.M., Haytowitz D.B., Gebhardt S.E., 2004, Lipophilic and hydrophilic antioxidant capacity of common foods in the United States. Journal of Agricultural and Food Chemistry 52, 4026-4037.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓*Biology*
✓*Horticulture*
✓*Food produce processing technology*
✓*Environmental engineering*

RESEARCHES ON THE ENOLOGICAL POTENTIAL OF THE SAUVIGNON CULTIVAR IN HILLS WINE ZONES OF OLTENIA

Băducă Cîmpeanu C.[1], Mazilu Mihaela Nicoleta[2]

[1]University of Craiova, Faculty of Horiculture
[2]University of Craiova, Faculty of Horiculture, Master Vine-Wine Expertise
Correspondence author. E-mail: *cbaduca@gmail.com, mazilu.mihaela92@gmail.com*

Keywords*: grapevine, climatic changes, vineyard, ripering*

ABSTRACT

The Sauvignon variety enjoys a good reputation on the international wine market, being one of the most popular varieties for quality white wines worldwide. In the vineyards in the hilly area of Oltenia, the variety finds climatic conditions and soil that allow it to put its high quality potential well. Research carried out in the 2014-2017 period in 6 wine-growing areas in the hilly area of Oltenia shows that grapes maturation took place in very good conditions, so that the values of the main chemical constituents of the grapes (sugars, organic acids, flavors) fully suitable for obtaining high-quality wines. The qualitative potential of the variety in the 6 wine years studied was also well emphasized by the values of the analyzed technological indicators, starting with the yield, which had average values between 6.7 and 7.5 tons / ha.

INTRODUCTION

The Sauvignon Blanc wines have undoubtedly achieved worldwide notoriety, largely due to their aromatic character easily recognizable by many consumers around the world (Stoica Felicia, 2015). The main aromatic markers of these wines are known and have been the subject of many studies during the last 20 years. The varietal thiols at the base of the fruity typicality as well as 3-isobutyl-2-methoxypyrazine (IBMP) largely responsible for the more or less marked vegetable nature of these wines, have been particularly studied.

These compounds are of varietal origin and yet the scientific knowledge on vineyard practices influencing their content in wines are still limited (Suklje Katja e.a., 2016). Sauvignon wines have characteristic aromas that are often very intense. The specialists of this grape, experienced winemakers or enlightened amateurs, distinguish many shades, herbaceous to fruity sometimes even animal or empyreumatic, reminiscent of green pepper, ivy, tomato leaf, boxwood, broom, blackcurrant bud, the smell of tomcat, asparagus, grapefruit, white peach, passion fruit and finally wood smoke (Dubourdieu D., 1996).

Methoxypyrazines are present in the grapes of certain Vitis vinifera varieties including Sauvignon blanc and contribute herbaceous/green aromas to wine. Environmental factors such as light exposure and temperature can influence methoxypyrazine levels, and viticultural interventions such as canopy manipulation have the ability to reduce methoxypyrazine accumulation in grapes (Gregan S. and Jordan B., 2016).

In the Sauvignon Blanc variety, precursors were detected both in the skin and the pulp, while in Melon B., only *S*-3-(1-hexanol)glutathione was detected in pulp, any other precursors being exclusively found in skin. During an industrial pressing cycle,

extraction of thiol precursors was enhanced at the end of the cycle (highest pressures), thus producing more varietal thiols in the resulting wines (Roland Aurélie e.a., 2011).

Formation of wine thiol precursors is a dynamic process, which can be influenced by vineyard and winery processing operations. With the aim of increasing thiol precursor concentrations, a study of the effects of storing machine-harvested Sauvignon blanc grapes prior to crushing and pressing was undertaken on a commercial scale. 3-Mercaptohexan-1-ol (3-MH) precursors, 2-S-glutathionylcaftaric acid (grape reaction product, GRP), glutathione (GSH) and a number of C6 compounds were assessed at several time points during the experiment.

The concentration of the cysteine precursor to 3-MH doubled within 8 h and tripled after 30 h while the GSH and cysteinylglycine precursors increased in concentration roughly 1.5 times. (E)-2-Hexenal and GSH levels decreased as thiol precursors, GRP and C6 alcohols increased during storage.

Principal component analysis revealed that precursors contributed to most of the variation within the samples over the storage period, with additional influence, primarily from GSH and GRP, as well as (E)-2-hexenal and (Z)-3-hexen-1-ol. Early storage time points were associated with higher concentrations of GSH and some unsaturated C6 compounds while longer storage times were most closely associated with higher thiol precursor and GRP concentrations (Capone Dimitra e.a., 2012).

During recent years, Sauvignon winemaking methods have undergone many changes—including a return to barrel fermentation of musts originating in the best *terroirs* as well as on-lees aging of new wines, whatever the fermentation method (barrel or tank).

Current Chardonnay and Sauvignon winemaking methods are very similar, but malolactic fermentation is rarely practiced on Sauvignon wines (Ribéreau-Gayon P. e.a., 2006). The viticultural factors influencing the thiol content in the wines are better and better identified. Similarly, it is now accepted that a good sanitary condition of the harvest is the first step necessary to obtain thiols in the wines.

The terroir of course plays an incontestable role since a low to moderate hydric stress favors the presence of precursors. From an oenological point of view, the extraction of the precursors during the pre-fermentation operations is favored by the maceration and the stubulation on mud (Geffroy O. e.a., 2010).

Thiol compounds responsible for tropical fruit associated aroma have been extensively studied over the last 20 years. The occurrence of their non-aromatic precursors in grapes and musts is reported largely mainly for the cultivar Sauvignon Blanc. The presence of these thiols as precursors or free molecules in grape, juice, and wine has been reported in several different varieties, suggesting that they are more or less ubiquitous both for Vitis spp. and interspecific hybrids.

The biosynthetic pathways resulting in these compounds are yet to be completely elucidated, but, in the meantime, industry needs to improve technological knowledge to better manage winemaking steps to enhance the variety-dependent aroma of wine (Román T. e.a., 2018).

MATERIAL AND METHODS

The study conducted between 2014 and 2017 had the following objectives:

- Establishing the values of the main constituents of grape composition at the technological maturity stage, in the vineyards: Drăgăşani, Vâlcea county; Sâmbureşti, Olt County; Segarcea and Cetate, Dolj county; Oreviţa-Stârrmina center Vânju Mare and Gârlă Drâncei center Oprişor, Mehedinţi County;

- Determination of the productivity parameters (kg/ha), the relative content in sugars (g/L), the yield in must on the primary winemaking (L/100 kg grapes), fermentable sugars in the obtained must (kg/ha) after the alcoholic fermentation (L/ha) at harvest;

- Establishing the values of the main constituents of Sauvignon wines obtained in winemaking as: S.C. Măr - Olt Hill (Isărescu Wine House, Drăgăşani Vineyard, S. Sâmbureşti - Bolovanu, Segarcea - Dolj Crown Domains, SC Viti-vinicola Vânju Mare - Mehedinţi.

The analyzes carried out on 3-4 samples for each wine year and zone concerned the contents in: alcohol (vol %), total acidity (g/L in H_2SO_4), volatile acidity (g/L in H_2SO_4), glycerol (g/L, residual sugar (g/L), low extract (g/L), ash (g/L). The specific flavor of Sauvignon wine was noted as follows:

xxxx - Specific intense flavor, persistent for a considerable time at tasting;

xxx - Sauvignon's distinctive flavor;

xx - Discrete flavor with the necessary presence of Sauvignon variety.

RESULTS AND DISCUSSIONS

From the aspect of the sugars, acidity and aroma content of the grapes, which essentially determines the quality of the wines, the years 2014, 2015, 2016 and 2017 proved to be favorable for Sauvignon, generally on all the main hillocks in Oltenia.

The carbohydrate contents of fairly high and limited variability over the years and the wine-growing centers are the guarantee of obtaining wines with constant alcoholic strengths between 12 and 13.5 % vol. The size of this constituent is between 214 g/L (Cetate, 2015) and 225 g/L (Cetate, 2017). The overall difference of only 11 g/L signifies the uniform behavior of the Sauvignon variety in the six large vineyards in the geographical area between Olt, Danube and Southern Carpathians.

Acidity, the second constituent of considerable importance for the compositional and organoleptic balance of the wines obtained, presents in all cases good and very good contents. Over the years and vineyards, the acidity content was between 3.97 g/L (Segarcea, 2014) and 4.93 g/L (Drăgăşani, 2016), the differences being insignificant (0.96 g/L in H_2SO_4).

The semi-aromatic character of the Sauvignon variety is clearly evidenced by the terpenic or sulphurous flavors, present in significant proportions in the grapes of all 6 vineyards, with an extra mark for the grapes in the center of the Olt Hill of Drăgăşani. Smaller flavors in the Cetate and Oprişor areas provide the specificity of the semi-aromatic category wine. Certainly it stands out, in terms of specific flavors of Sauvignon, the renowned center of the Olt Hill in the Drăgăşani vineyard.

In the vintages 2014, 2015, 2016 and 2017, the Sauvignon variety proved to be particularly advantageous in the wine-growing areas of Oltenia (Table 2 and 3) in terms of oenological productivity and yield.

In the target vineyards, apart from the Cetate, these parameters showed higher values in 2016, a normal year without climatic "accidents". Lower production in 2017, which determines the values of the other parameters, was due to the temperatures below 00C, which occurred in April, which destroyed much of the fruitful shoots. The grape production was between 6230 kg/ha (Cetate, 2017) and 8010 kg/ha (Drăgăşani - Olt Hill, 2016), the difference being 1780 kg/ha. With regard to general media, the differences in grape yields are narrowing. Thus, with the highest average yield, the Segarcea vineyard was recorded, with 7498 kg/ha, followed by the insignificant difference between the vineyard Oreviţa and Vânju Mare, with 7483 kg/ha. With the lowest average grape production is the Cetate center in Dolj County.

Given the relative sugars content, ranging from 214 g/L to 225 g/L for all vintage years and vineyards, all other yield parameters place the Sauvignon variety with a

considerable degree of profitability, which is justified by the average yield in must Primary vinification ranging from 67.4 % (Oreviţa) and 68.3 % (Drăgăşani), 68.4 % (Cetate).

Table 1

The main oenological quantities of Sauvignon grapes in the main hillocks of Oltenia, to technological maturity, for the period 2014-2017

Parameters	Vintage / Mean	Vineyard					
		Drăgăşani – Dealul Olt	***Sâmbureşti – Bolovanu***	***Segarcea***	***Cetate***	***Oreviţa – Vânju Mare***	***Golul Drâncei - Oprişor***
Sugars, g/L	**2014**	226	224	221	220	223	217
	2015	219	220	218	214	220	218
	2016	220	222	223	219	226	219
	2017	224	220	220	225	219	221
	Mean	*222,3*	*221,5*	*220,5*	*219,5*	*222*	*219*
Total acidity, g/L H_2SO_4	**2014**	4,05	4,02	3,97	4,24	4,11	4,14
	2015	4,11	4,16	4,02	4,18	4,09	4,11
	2016	4,93	4,86	4,32	4,66	4,36	4,55
	2017	4,91	4,71	4,26	4,51	4,62	4,60
	Mean	*4,50*	*4,46*	*4,14*	*4,40*	*4,30*	*4,35*
Flavours	**2014**	xxx	xxx	xxx	xx-xxx	xxx	xx-xxx
	2015	xx-xxx	xx-xxx	xx-xxx	xx-xxx	xx-xxx	xxx
	2016	xxx	xxx	xxx	xx-xxx	xx-xxx	xx-xxx
	2017	xxx	xxx	xxx	xx	xxx	xxx
	Mean	*xxx*	*xxx*	*xxx*	xx-xxx	*xxx*	xx-xxx

Based on the production and yields, the volume of the wort obtained varied between 4224 L/ha (Cetate, 2017) and 5591 L/ha (Drăgăşani, 2016), with an average of 4632 L/ha (Cetate) and 5067 L/ha (Segarcea).

The quantities of fermentable carbohydrates were 932 kg/ha (Cetate) and 1230 kg/ha (Drăgăşani - Olt Hill) with a total average of 1016 kg/ha in the Cetate area and 1120 kg/ha in the vineyard Oreviţa - Vânju Mare. Of the carbohydrates contained in the must, the absolute alcohol was averaged between 598 L/ha (Cetate) and 659 L/ha (Oreviţa - Vânju Mare). In conclusion, the average data of the synthesis shows the certainty of almost uniform "behavior" in all the main hillocks of Oltenia, but at the superior oenological level and the parameters of production and yield, important elements both qualitatively and economically.Under normal conditions, the variety generally provides yields ranging from 7.5 t/ha to 8.0 t/ha where carbohydrate is about 220 g/L when slightly overcrowded. However, yields that do not fall below 67.6 % on average reach up to 69 %, making it possible to obtain volumes of must between 4224 L/ha and 5591 L/ha, where the sugars occupy 950 kg/ha and 1230 kg/ha.

Table 2

Values of productivity and yield parameters of grapes of the Sauvignon variety grown in the main hillside vineyards in Oltenia, 2014-2017

Vineyard	Vintage	Yeld kg/ha	Sugars in grapes g/L	Yield in must L/100 kg grapes	Must L/ha	Sugars in must kg/ha	Absolutely obtained alcohol L/ha
Drăgăşani, Dealul Olt - Vâlcea	2014	7100	226	67,3	4778	1080	635
	2015	7325	219	67,1	4915	1076	633
	2016	8010	220	69,8	5591	1203	724
	2017	6990	224	68,9	4816	1079	635
	Media	*7356*	*222*	*68,3*	*5025*	*1116*	*657*
Sâmbureşti, Bolovanu - Olt	2014	7150	224	67,3	4812	1078	634
	2015	7100	220	67,5	4793	1016	598
	2016	7550	222	68,9	5202	1155	679
	2017	6850	220	67,2	4603	1013	596
	Media	*7163*	*221,5*	*67,7*	*4853*	*1066*	*627*
Segarcea - Dolj	2014	7520	221	67,1	5046	1115	656
	2015	7400	218	67,3	4980	1086	639
	2016	7750	223	67,9	5262	1173	690
	2017	7320	220	68,0	4978	1095	644
	Media	*7498*	*220,5*	*67,6*	*5067*	*1117*	*657*
Cetate - Dolj	2014	6950	220	67,0	4657	1025	603
	2015	7010	214	69,9	4900	1049	617
	2016	6880	219	69,0	4747	1039	611
	2017	6230	225	67,8	4224	950	559
	Media	*6768*	*219,5*	*68,4*	*4632*	*1016*	*598*
Oreviţa – Vânju Mare Mehedinţi	2014	7200	223	67,4	4853	1082	636
	2015	7180	220	66,9	4803	1057	622
	2016	7990	226	68,0	5433	1228	722
	2017	7560	219	67,2	5080	1113	655
	Media	*7483*	*222*	*67,4*	*5042*	*1120*	*659*

CONCLUSIONS

With its high oenological potential, the Sauvignon variety gives more and more wine to the great hillside vineyards of Oltenia and especially to the Drăgăşani vineyard. Significant results are offered by the Sauvignon variety and in the vineyards: Sâmbureşti (Olt), Segarcea and Cetate (Dolj), Oreviţa - Vânju Mare and Golul Drâncei - Oprişor (Mehedinţi).

The oenological quantities presented at the technological or harvesting maturity refer to:

- frequent sugar contents of more than 215 g/L;
- acidity, generally above 4.0 g/L (in H_2SO_4), being in a particularly balanced ratio to sugars;
- Grape yields in the over-sizing stage were generally between 6.5 t/ha and 8.0 t/ha, without the carbs falling below 214 g/L, reaching even 225 g/L;
- 67 % to 69 % must yields between 4200 and 5600 L/ha, with fermentable sugars ranging from 950 to over 1200 kg/ha.

REFERENCES

Capone Dimitra, Black C., Jeffery D., 2012. Effects on 3-Mercaptohexan-1-ol Precursor Concentrations from Prolonged Storage of Sauvignon Blanc Grapes Prior to Crushing and Pressing. *Journal of Agriculture and Food Chemistry, vol. 60, nr. 13, pag.* 3515–3523.

Dubourdieu D., 1996. Les arômes: Facteurs de qualité - Les arômes du Sauvignon - Valorisation par la vinification. Revue des Œnologues, nr. 79, pag. 18-20.

Geffroy O., Fauveau Céline, Bajard Sparrow Céline, Dufourcq T., 2010. Influence de l'utilisation d'enzymes de macération sur la teneur en thiols variétaux de vins de Sauvignon blanc produits dans les vignobles du Sud-Ouest. Revue des Œnologues, nr. 136, pag. 19-20.

Gregan S., Jordan B., 2016. Methoxypyrazine Accumulation and O-Methyltransferase Gene Expression in Sauvignon blanc Grapes: The Role of Leaf Removal, Light Exposure, and Berry Development. Journal of Agriculture and Food Chemistry, vol. 64, nr. 11, pag. 2200–2208.

Ribéreau-Gayon P., Dubourdieu D., Donèche B., Lonvaud Aline, 2006. Handbook of Enology. Volume 1. The Microbiology of Wine and Vinifications. 2nd Edition. John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, England.

Roland Aurélie, Schneider R., Charrier Fr., Cavelier Fl., Rossignol M., Razungles A., 2011. Distribution of varietal thiol precursors in the skin and the pulp of Melon B. and Sauvignon Blanc grapes. Food Chemistry, vol. 125, nr. 1, pag. 139–144.

Román T., Tonidandel T., Larcher R., Celotti E., Nicolini G., 2018. Importance of polyfunctional thiols on semi-industrial Gewürztraminer wines and the correlation to technological treatments. European Food Research and Technology, vol. 244, nr. 3, pag. 379–386.

Suklje Katja, Antalick G., Coetzee Z., Lisjak K., Deloire A., 2016. Modification du profil aromatique des vins de Sauvignon blanc au vignoble. Nouvelles perspectives. Revue des Œnologues nr. 161, pag. 24-27.

Stoica Felicia, 2015. The main parameters and indicators that define the quality and authenticity of white wines from vineyard Drăgăşani - Romania, Carpathian Journal of Food Science and Technology, vol.7, nr. 4, pag. 139-144.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

EXPERIMENTAL STUDY ON GRANULOMETRY OF CLEANED MATERIALS WITH THE CYLINDRICAL SELECTOR

Banica Mihai[1*], Șugar Ioan Radu[1], Giurgiulescu Liviu[2]

Faculty of Engineering, Technical University of Cluj-Napoca
Faculty of Sciences, Technical University of Cluj-Napoca
**Corresponding author, E-mail:* Mihai.Banica@cunbm.utcluj.ro

Keywords: *cylindrical selector, granulometry, bootstrapping*

ABSTRACT

The cylindrical selector is a slightly inclined cylinder, provided with alveoli of the shape close to the hemisphere, with a diameter slightly larger than that of the particles. Separation is based on the difference in the moment of drop in the alveoli. The aims of the present paper are to reduce the loss by using granulometric analysis and statistical analysis.

INTRODUCTION

The first stone mills appeared in the Neolithic (3000BC), they were initially handled by the force of human arms and then ran by animals, simultaneously switching from the consumption of boiled grains to the consumption of baked cakes made from broken grains (Tisan, 2009), (Tucu, 2007).

In the case of the cylindrical selector, separation is based on the difference in the moment of drop in the alveoli. During rotating the cylinder, the longest particles of larger size first separate, evacuating with a conveyor, while the shorter particles remain longer in the alveoli, falling later. The degree of separation of the grain mixture on the fractions depends on the level at which the upper edge of the collector gutter is fixed (Balc et al., 2016).

In terms of the intended purpose of separation, cylindrical selectors are classified into: long grains selectors and short grains cylinders. In long grains, the alveoli separate the main product mass, which may represent 95.98 % of the mixture. In the case of short grains, the alveoli separate 13 % of the mixture, the productivity being much higher.

Cylindrical selectors are provided with a cylindrical selector knob. It has the role of separating smaller bodies than wheat grains - wheat breaks, small grains of wheat - from the mixture of foreign bodies resulting from the first selector. The amount of foreign bodies resulting from the main selector may not exceed 10-15 % of its capacity. Depending on the amount of foreign bodies resulted from the first selection, the control selector is calculated, which is generally 1/3 (a third) of the main selector and a smaller diameter.

The separation process is influenced by the following factors: the loading mode; the shape and size of the sieve; the length of the particle road path on the screen; the speed and character of the material movement; the speed and character of the material movement; the thickness of the material layer; the state of the material (dry or wet).The loading has to be done at a uniform flow and layer corresponding to the productivity of the sieve used for the process.

The trior plate is made of stainless steel for the food industry.

Figure 1. Trior plate
(http://www.rmig.com/ro/produse/perfora%C5%A3ii+rm/pl%C4%83ci+trior+rm)

Alveolar cylinders are used to separate seeds according to their length for seed standardization. The cylinders can be adjusted in many ways and with a proper adjustment a high degree of grain cleaning can be achieved. The Indentation Cylinder - SELECTOR - is used to sort all granular materials such as wheat, oats, fine grains to separate sunflower seed and beet seed strains and to separate unwanted long or short product impurities.

The grain size may vary between 1.0 mm and 24 mm. The product moves from the case to the inside of the rotating cylinder, the lid of which is provided with unobserved alveoli depending on the nature of the cleaned product. The grains that are incorporated into the alveoli will be transported and, after a certain distance, will be unloaded from a spire to the outlet valve. All the grains that are larger than the alveoli will remain inside the shredder and will be transported to the exit of the casing. Depending on the degree required, the output product will be sorted according to roundness or length.The extraction of foreign bodies from the cereal mass is carried out in the pre-cleaning and cleaning units of the milling units. Cylindrical selectors can be classified as: slow, fast and ultrafast. The slow selectors have peripheral speed at the cylindrical casing with alveoli of 0.3÷0.4m/s and the ultrafast ones between 0.7÷1s. Slow selectors are used less and less because of their low processing capacity and their large gauge.

Fast and ultra-fast selectors. To increase the machining capacity of the cylindrical selectors, their speed has been increased to 1.3÷1.4m/s, reaching the rapid and ultra-fast selectors. The dust collector tray is located in the centre of the cylindrical casing at both types of selectors. The difference between them is the use of shaker blades that shatter the cereal lens and increase the contact surface between the grain and the alveolar shell at the ultra-fast selectors (Alexandrescu et al., 2016), (Medan & Basarman, 2017).The factors that negatively influence the ground product are: mineral and vegetal dust create an unfavourable environment for the normal development of the work; worsening the quality of finished products; the dark colour of many foreign bodies can print a dark colour to the flour obtained from grinding.

By their content in various chemical compounds, the foreign bodies that are crushed can print out unpleasant tastes or odours to the flour. There is a category of so-called "harmful" foreign bodies whose presence in the cereals that have to be grinded lead to the production of finished products containing a number of toxic chemicals such as saponin alkaloids etc.; the flour resulting from their milling will contain a low gluten content, which will result in the production of a dough which, in fermentation, spreads unevenly, decreases rapidly and the resulting bakery products will be inferior. By transporting foreign bodies with the mass of the product, increases the electricity

consumption; sparks may occur when contacting parts of the work organs of the various cleaning equipment, with the risk of an explosion; advanced wear of the working parts of the cleaning and grinding machinery can occur, as these foreign bodies enter the stones and metallic impurities. Taking all of these into consideration, the necessity and obligation of seed cleaning and sorting is to be imposed in order to ensure optimal storage and marketing conditions for consumption or as sowing material (Sorica, 2011).

To determine the granulometry of the material, MAS 54.H maize cultivated by Maïsadour Semences was used. Mas 54.H is a hybrid with a very good level of silo production.

Figure 2. MAS 54.H

Four-point determinations were made from the cobs on four different plots of the parcel. There were taken a series of grains from the corn cobs and the gram size (grammes) of the grains was measured. Size measurements were made with a digital caliper of 0.01 mm RM selector plates are made of steel or stainless steel. The installation productivity increases due to the fact that the RM selector plates minimize the space between the alveoli to allow the maximum hourly flow rate.

STATISTICAL ANALYSIS AND BOOTSTRAPPING

The measurements were made on four corns, picked from four different points of the parcel. From each corn, one row of grains was taken, and the gram size of the grains was measured. The measurement was carried out with a digital calliper with an accuracy of 0.01mm.

QI Macros Add-In for Excel (KnowWare International, Inc.) was used for the statistical analysis:

1. Normality test concerning the samples: we used *Anderson Darling's p-value* and *Critical Value Method, α=0.05*. Result: *the samples have a non-normal distribution*;

Table 1

Results of measurements

Sample1	Sample2	Sample3	Sample4
9.18, 10.26, 10.36,	9.49, 10.20, 11.49,	8.89, 9.84, 10.50,	9.14, 10.72, 10.16,
10.76, 10.42, 10.68,	12.08, 11.84, 11.77,	10.37, 11.31, 11.86,	11.05, 10.73, 11.84,
10.79, 12.23, 12.02,	12.03, 11.55, 12.23,	11.65, 11.31, 10.99,	11.63, 12.48, 12.74,
11.90, 11.99, 11.23,	12.58, 12.38, 12.65,	11.94, 12.41, 12.00,	11.66, 12.56, 12.39,
11.55, 12.52, 11.79,	12.26, 12.52, 12.32,	12.33, 12.45, 12.73,	12.60, 12.04, 12.98,
10.83, 12.64, 12.63,	11.79, 12.19, 12.09,	12.87, 12.58, 12.55,	12.01, 12.89, 12.64,
12.21, 11.93, 12.23,	11.64, 11.53, 12.52,	12.74, 12.01, 12.19,	13.09, 12.56, 12.44,
12.45, 12.40, 12.25,	11.99, 11.27, 11.16,	12.04, 12.22, 11.85,	13.19, 12.37, 12.33,
12.18, 12.22, 11.91,	11.97, 11.57, 11.89,	12.55, 12.44, 12.06,	12.43, 12.45, 11.66,
10.37, 11.45, 11.47,	11.78, 11.46, 11.39,	11.94, 12.40, 11.70,	12.11, 11.34, 11.38,

11.89, 10.64, 10.23, 8.74	11.30, 10.78, 10.41, 10.34, 9.54, 8.77	11.51, 10.79, 10.78, 10.27, 8.78	11.11, 11.59, 11.66, 11.36, 10.89, 10.65, 10.32, 9.53, 8.79
34	**36**	**35**	**39**

2. Test for "equality" of variances concerning the samples: because the data comes from a non-normal distribution, we used *Levene Test for Equality of Variances, α=0.05*. Result: the *p-value=0.699>0.05*, so *the variances are the same*;

3. Test for "equality" of means concerning the samples: for the same reasons we used a non-parametric test, *Tukey Test*, *α=0.05*. Results: Sample1 vs. Sample2: *p-value=0.500>0.054* (*Total End Count=2<7*); Sample1 vs. Sample3: *p-value=0.250>0.054* (*Total End Count=4<7*); Sample1 vs. Sample4: *p-value=0.094>0.054* (*Total End Count=6<7*); Sample2 vs. Sample3: *p-value=0.250>0.054* (*Total End Count=4<7*); Sample2 vs. Sample4: *p-value=0.094>0.054* (*Total End Count=6<7*); Sample3 vs. Sample4, *p-value=0.156>0.054* (*Total End Count=5<7*), *so the means are the same*;

4. Test for "equality" of medians concerning the samples: we used the non-parametric *Kruskal-Wallis Test*, *α=0.05*. Results: Sample1 vs. Sample2 vs. Sample3: *p-value=0.471>0.05*; Sample1 vs. Sample2 vs. Sample4: *p-value=0.377>0.05*; Sample1 vs. Sample3 vs. Sample4: *p-value=0.358*>0.05; Sample2 vs. Sample3 vs. Sample4: *p-value=0.490*>0.05, so the *medians are the same*;

5. Because the means, dispersions and medians of the samples are the same (they do not differ significantly), we can conclude that *the samples* are *extracted from the same population and can form a single sample*;

6. Grouping of data: the calculation of the number of intervals was done with *Rice formula*, $r=2\cdot n^{1/3}$, for n=144 and resulted 10.483≈10 intervals and the magnitude of intervals of h=0.445mm intervals; h*=0.5mm was adopted; the result of the grouping is shown in Table 2;

Table 2

Group by size classes

Class	(8.5;9.0]	(9.0;9.5]	(9.5;10]	(10;10.5]	(10.5;11]	(11;11.5]	(11.5;12]	(12;12.5]	12.5;13]	(13;13.5]
C.M.	8.75	9.25	9.75	10.25	10.75	11.25	11.75	12.25	12.75	13.25
Abs. freq.	5	3	3	13	13	16	32	37	20	2

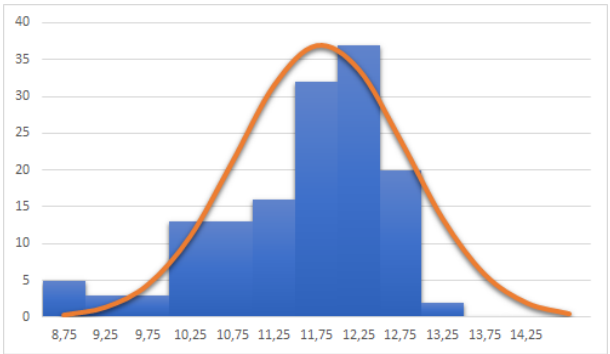


Figure 3. Absolute frequencies of the sample vs. Normal probability function

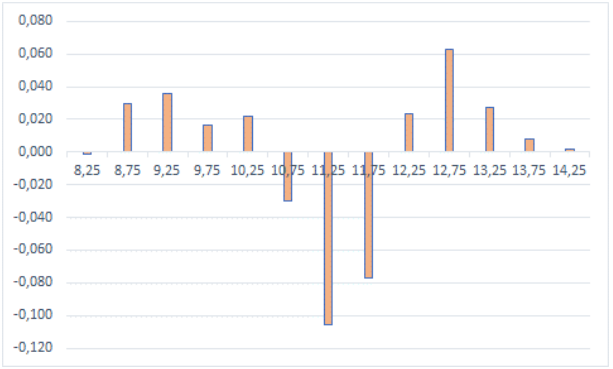


Figure 4. Difference between the cumulative frequencies of the sample and the normal distribution function

7. Applying the Kolmogorov-Smirnov test (Tascu et al., 2008) results: $\max|F_n(x)-F_0(x)|=0.106<1.36/SQRT(144)=0.1133$, so the sample grouped in classes has a Gaussian distribution.

For estimating some maize grain statistical values, we have considered the *Bootstrap technique*. We used the "bootci" function from MATLAB (MathWorks, Inc.). For our application, the syntaxes are:

- [CImean]=bootci(20000,{@mean,x},'type','norm','alpha',0.05,'stderr',std(x))
- [CIstdev]=bootci(20000,{@std,x},'type','norm','alpha',0.05,'stderr',std(x))
- [CImax]=bootci(20000,{@max,x},'type','norm','alpha',0.05,'stderr',std(x))
- [CImin]=bootci(20000,{@min,x},'type','norm','alpha',0.05,'stderr',std(x))

Table 3

Results of Bootstrapping

Confidence level *(P=1–α)*	**Confidence interval**			
	Mean [mm]	**Stdv [mm]**	**Max. [mm]**	**Min. [mm]**
P=0.95	(11.402; 11.729)	(0.881; 1.143)	(13.072; 13.422)	(8.637; 8.809)
P=0.99	(11.351; 11.782)	(0.837; 1.184)	(13.014; 13.480)	(8.622; 8.826)

According to these results, with a probability of 0.95 (95 %), the maximum considered value of maize grains of MAS 54.H, cultivated on the parcel analysed, is between 13.0717mm and 13.4216mm and with a probability of 0.99 (99 %) is between 13.0140mm and 13.4799mm.

The meshes of the sieve will need to be designed/adjusted according to the resulting data.

CONCLUSIONS

Granulometric analysis and bootspaping can reduce losses by using seed coulters corresponding to the size of the seeds.

By default, it reduces the consumption of energy consumed and increases the cleaning capacity.

The method can also be used in other corn varieties as well as wheat, barley, oats, rye, rice, sugar beet.

REFERENCES

Alexandrescu M., Cotetiu A., Daraba D., 2016, Correlations Regarding Lubricant Film Thickness to the Narrow Sliding Radial Bearing Working under Hard Shocks, Scientific Bulletin Series C : Fascicle Mechanics, Tribology, Machine Manufacturing Technology; Baia Mare Vol. 30, pp. 2-5.

Balc G., Sugar I.R., Gaspar F., 2016, Maşini şi instalaţii pentru industria alimentară, Vol.II, Editura Risoprint, Cluj-Napoca.

Medan, N., Basarman, A.P., 2017, Optimizing the Equation of Impact Forces Produced by Water Jets Used in Sewer Cleaning. Magazine of Hydraulics, Pneumatics, Tribology, Ecology, Sensorics, Mechatronics, no. 2, ISSN 1453-7303, pp. 56-61.

Sorica F.C.M., 2011, Contribuţii la studiul procesului de condiţionare a cerealelor, Teza de doctorat, Universtatea Transilvania, Braşov.

Tascu, I., Pop, M.S., et al., 2008, Probabilități și statistică. Teorie și aplicații, ISBN 978-973-751-753-1, Editura Risoprint, Cluj-Napoca.

Tisan V., 2009, Utilaje în Industria Alimentară, Editura Risoprint, Cluj-Napoca.

Tucu D., 2007, Panificaţia. Sisteme tehnologice şi structuri productive, Editura Orizonturi, Universitare Timişoara.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

ASSESSMENT OF THE INFLUENCE OF THE FACTORS VARIETY AND GREEN PRUNING TREATMENTS ON THE AVERAGE GRAPE YIELD BASED ON THE MATHEMATICAL - STATISTICAL ANALYSIS

Belberova Yordanka*, Tsvetanov Emil, Simeonov Iliyan

Institute of Viticulture and Enology – Pleven
* *Correspondence author. E-mail*: dani_desus@abv.bg

Keywords: *vine, variety, yield, green pruning, two-factor analysis of variance*

ABSTRACT

The objective of the study was to determine the degree of influence of the factors variety and green pruning on the average grape yield per vine by means of two-factor analysis of variance. The trial was carried out at the Experimental Base of IVE – Pleven in the period 2014 – 2016, with Storgozia and Muscat Kaylashki varieties. Factors A variants were the variety, and factor B - the vine green parts procedures, which were as follows: B_1 - control - no summer hedging; B_2 – topping in June; B_3 – cluster thinning – removal of 1/3 (30 - 35 %) of the clusters in total for the variant; B_4 – topping in July; B_5 – defoliation in the cluster zone, B_6 – variant with the most flower clusters. As a result of the analysis, it could be concluded that in 2014 and 2016, the dominant impact on grape yield had the green pruning treatments while in 2015 the influence of the genetically determined fertility of the particular variety was dominant. If these results were referred to the climatic characteristics of the separate trial years, and considering the fact that all three years were wet, it might be argued that in cool years the influence of the green pruning treatments was dominant on the grape yield, and in hotter years the influence of the particular variety fertility dominated.

INTRODUCTION

Agricultural crops productivity, including grapevine has depended mainly on the genetic potential of the variety, the weather conditions during the vegetation period and the applied agricultural and technical practices (Simeonov, 2013).

The biological potential of the different vine varieties has been quite varied and underlies the scientific foundations of vine growing technologies. The produce could be improved by applying adequate procedures and maintaining optimal technological conditions. Therefore, the implementation of modern technologies that were economically efficient could ensure a sustainable raise of grapes production, both in quantity and quality (Ciobanu et al, 2012).

Most researches have been focused on the independent influence of the agricultural and technical factors on grapevine growth and development and its productive potential (Stoev and Lilov, 1957; Hale and Weaver, 1962; Todorov and Zankov, 1965; Popov et al., 1972; Kurtev et al., 1979; Schneider, 1985; Radulov, L. 1988; Iacono and Sparacio 1999; Hunter and Roux, 2000; Pisciotta et al., 2007; Pastore et al., 2011).

The contemporary development of research in all fields of plant-growing has increasingly led to the widespread use of complicated experimentation. That, on the one hand, was determined by the need to reduce the time, the place and the means for carrying out research experiments, and on the other as many scientific conclusions as

possible to be reached. In field trials, this development of research concerned not only the number of the tested variants and the actions of the individual factors, but also the need to study the degree of action of the specific factors (Barov and Naydenova, 1969).

The objective of the study was to determine the degree of influence of the factors – variety and green pruning on the average grape yield per vine.

MATERIAL AND METHODS

A trial was set in the years 2014, 2015, 2016 at the Experimental Base of IVE – Pleven in vineyards of Storgozia and Muscat Kaylashki varieties. It was set in four repetitions of 10 vines or 40 vines per variant. The soil type in the trial plantation was leached chernozem, formed on clayed loess (Krastanov and Dilkova, 1963).

The weather characteristics of the years were determined by the mathematical statistic methods (Sirakov, 1981).

The variants of the trial were, as follows:

- Factor A (Variety):

A_1 – Muscat Kaylashki – medium ripening white wine variety, obtained through interspecific hybridization by crossing Muscat Hamburgski x Villard Blanc 12375 (Roychev, 2012).

A_2 – Storgozia – medium ripening red wine variety, obtained through interspecific hybridization by crossing Bouquet x Villard Blanc 12375 (Roychev, 2012).

- Factor B (Green pruning treatments): B_1 - control - no summer hedging; B_2 – topping in June; B_3 – cluster thinning – removal of 1/3 (30 – 35 %) of the clusters in total for the variant; B_4 – topping in July; B_5 – defoliation in the cluster zone, B_6 – variant with the most flower clusters.

The results were statistically processed by two-factor analysis of variance (ANOVA) (Dimova and Marinkov, 1999). The significance of the assessment and the power of impact of the factors were calculated by Plohinski method (Lakin, 1990).

RESULTS AND DISCUSSION

The climate elements had a strong and significant impact on the quantity and quality of grape yield each particular year. Summarized weather characteristics of each of the study years (2014 – 2016) regarding the precipitation probability and the average air temperatures are presented in Table 1.

Table 1

Probability (P %) of precipitation and average air temperature for the period 2014 – 2016

Years		2014	2015	2016
$N_{(V-IX)}$	%	14 (Very wet)	17 (Very wet)	35 (Wet)
$T^{o}_{(V-IX)}$		97 (Very cool)	29 (Hot)	56 (Average cool)

P – probability, N – precipitations, T° - average air temperature

With a view of the average air temperatures, 2014 could be defined as very cool, 2015 – hot, and 2016 an average cool year. As for the sum of the precipitation, the years 2014 and 2015 were very wet and 2016 – wet.

Table 2 presents the data on the average grape yields per vine, per variety and depending on the various green pruning treatments.

Table 2.

Impact of the green pruning on the average yield per vine depending on the variety

Variants		Average grapes yield per vine, kg		
A – Variety	**B** – Green pruning	2014	2015	2016
A_1 – Muscat Kaylashki	B_1 (control)	3.300	1.202	2.738
	B_2	3.700	1.584	1.794
	B_3	4.075	1.339	1.604
	B_4	3.275	1.180	2.413
	B_5	6.563	1.518	2.138
	B_6	8.769	1.521	3.634
A_2 – Storgozia	B_1 (control)	5.964	4.261	3.331
	B_2	5.392	4.016	3.094
	B_3	5.462	2.829	2.689
	B_4	6.045	4.360	2.684
	B_5	6.206	4.430	2.795
	B_6	8.326	6.488	4.775

The results from the analyses of variance on the impact of the factors variety (A) and the green pruning treatments (B) on the yield per vine per years are presented in Tables 3, 4 and 5 and are discussed separately for each year of the trial.

Table 3.

Analysis of variance on the impact of the factors: variety (A), green pruning (B) on the yield per vine for the year 2014

Source of variance	SS	df	MS	F	F crit (5 %)	Power of impact (%)
Variety (A) *** (0.1 %)	19.83	1.00	19.83	13.63	4.14	9.59 ** (1 %)
Green pruning (B) *** (0.1 %)	103.39	5.00	20.68	14.21	2.50	50.0 *** (0.1 %)
Correlation * (5 %)	19.92	5.00	3.98	2.74	2.50	9.63 n.s. (< 5 %)
Errors	48.01	33.00	1.45			23.22

Significant at: 5 % - (*); 1 % - (**); 0.1 % - (***) и < 5 % - (n.s) – not significant

In 2014, the dominant influence on the grape yield per vine had the factor green pruning (B) with a proven degree of impact of 50.0 %, while the power of impact of the factor (A) variety and the correlation between both factors were of a similar order of magnitude - 9.59 % and 9.63 %, respectively (Table 3).

Table 4 presents the power of impact of the factors in 2015. Contrary to the previous year, in 2015, the dominating factor of impact on grape yield was the fertility of the individual variety (A) by 76.44 %, while the factor (B) green pruning and the correlation between the factors had an impact of 10.97 % for the green pruning and 9.18 % for the correlation between both factors.

Table 4.

Analysis of variance on the impact of the factors: variety (A), green pruning (B) on the yield per vine for the year 2015

Source of variance	SS	df	MS	F	F crit (5 %)	Power of impact (%)
Variety (A) *** (0.1 %)	108.50	1.00	108.50	812.66	4.14	76.44 *** (0.1 %)
Green pruning (B) *** (0.1 %)	15.57	5.00	3.11	23.33	2.50	10.97 n.s. (< 5 %)
Correlation * (5 %)	13.03	5.00	2.61	19.52	2.50	9.18 n.s. (< 5 %)
Errors	4.41	33.00	0.13			3.10

Significant at: 5 % - (*); 1 % - (**); 0.1 % - (***) и < 5 % - (n.s) – not significant

Table 5.

Analysis of variance on the impact of the factors: variety (A), green pruning (B) on the yield per vine for the year 2016

Source of variance	SS	df	MS	F	F crit (5 %)	Power of impact (%)
Variety (A) *** (0.1 %)	8.49	1.00	8.49	19.71	4.14	17.08 *** (0.1 %)
Green pruning (B) *** (0.1 %)	22.04	5.00	4.41	10.23	2.50	44.34 *** (0.1 %)
Correlation n.s. (< 5 %)	1.56	5.00	0.31	0.72	2.50	-
Errors	14.22	33.00	0.43			28.60

Significant at:: 5 % - (*); 1 % - (**); 0.1 % - (***) и < 5 % - (n.s) - not significant

The results of the mathematical and statistical analysis of the data for the year 2016 were similar to those of 2014, as the impact of factor (B) green pruning dominated by 44.34 % and the impact of factor (A) variety was 17.08 %. The impact of the correlation between both factors was statistically not significant.

With a view of the results obtained during the period 2014 – 2016, we believed that the work in this trend should continue so that additional data from a larger number of different weather characteristics could be collected in order to confirm or not these results and the respective conclusions.

CONCLUSIONS

As a result of the analysis, it could be concluded that in 2014 and 2016, the dominant impact on grape yield had the green pruning treatments while in 2015 the influence of the genetically determined fertility of the particular variety was dominant. If these results were referred to the climatic characteristics of the separate trial years, and considering the fact that all three years were wet, it might be argued that in cool years the influence of the green pruning treatments was dominant on the grape yield, and in hotter years the influence of the particular variety fertility dominated.

REFERENCES

Barov, V., Naydenova P., 1969, Statistical methods in field and vegetation trials. Zemizdat, Sofia, p. 284.

Ciobanu, F., Pop N., Iliescu M., Babeş A., Bunea I., Ardeban A. E., Lung M. L., Tripon A. F., 2012.Special green works influence on yield quantity and quality at grape varieyies for flavoured and semi-flavoured wines from S. C. D. V. V. blaj. Bulletin UASVM Horticulture, 69 (1), pp. 110 – 115.

Dimova, D. Marinkov E., 1999, Experimental work and biometry. Academic Publishing House of Higher Institute of Agriculture Plovdiv, p. 263.

Hale, C. R., Weaver R. I., 1962, Hulgardia, v. 33, 3.

Hunter J. J., Roux D. J. le, 2000. Canopy management effects on yield, labour input and growth compensation – new canopy composition perspectives. Acta Horticulturae, 2000, pp. 81 – 89.

Iacono F., Sparacio A., 1999, Influence of topping on productivity of cv. Cabernet Sauvignon (Vitis vinifera L.) cultivated in a hot and dry environment. Vignevini, vol. 26, № 3, pp. 90 – 93.

Krastanov, S., Dilkova, 1963, The soils in the experimental field of the Institute of Viticulture and Enology - Pleven. Institute of Soil Science N. Pushkarov, Sofia, 60.

Kurtev P., Tsankov B., Todorov H., 1979, Viticulture. Hristo G. Danov, Plovdiv.

Lakin G., 1990, Biometrics, Higher School, Moscow, p. 350.

Pastore C., Zenoni S., Tornielli G. B., Alegro G., Dal Santo S., Valentini G., Intrieri C., Pezzotti M., Filippetti I., 2011, 3 Increasing the sourse/sink ratio in Vitis vinifera (cv. Sangiovese) induces extensive transcriptome reprogramming and modifies bery ripening. BMC Genomics, Vol.12, Suppl. 2, pp. 631 – 653.

Pisciotta A., Barbagallo M. G., Lorenzo R. di, Vetere R. lo, Hunter J. J., 2007, Effect of Tipping and Topping on shoot uniformity: preliminary results on single cordon trained Cabernet Sauvignon and Merlot. Acta Horiculturae, 2007, pp. 175 – 178.

Popov T., Nikov M., Magriso Yu., Pavlov N., 1972, Agrotechnics of vine. Hristo G. Danov.

Radulov L., 1988, Green pruning – an important factor for higher grape yields. Lozarstvo I Vinarstvo, No. 2, p. 9 – 11.

Roychev V., 2012. Ampelography. Academic Publishing House of the Agrarian University, Plovdiv, p. 576.

Schneider C., 1985, Influence de la suppression des entre couers de souches de vigne sur la microclimat lumineux et la recolte. Connaissance de la Vigne et du Vin. 19:17 – 30.

Simeonov, I., 2013, Comparative evaluation of the indicators for yield from clones of Muscat Vrachanski variety. Selskostopanska Nauka, issue 3-4, 39-45.

Sirakov, D., 1981, Statistical methods in meteorology, University Publishing House “St. Kliment Ohridski” - Sofia, p. 269.

Stoev, K., Lilov D., 1957. To the physiology of vine green pruning. Scientific Papers Institute of Viticulture and Enology, Pleven, No. 1, 21-37.

Todorov H., Zankov Z., 1965. Formation of the leaf surface from vine lateral shoots and its impact on grapes quality and quantity. Gradinarska i Lozarska Nuka, year. II, No. 5, p. 631-641.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

EFFECT OF STIMULANTS ON THE CAPACITY OF ROOTING OF THE *SAMBUCUS NIGRA* L. CUTTINGS FOR CONSERVATION IN GERMPLASM COLLECTIONS

Bizera Mihaela[1]*, Mîndrilă Gheorghiţa[2], Papachatzis Alexandros[3], Botu Mihai[2,4]

[1]University of Craiova, Faculty of Horticulture, IRVA Doctoral School, Craiova, Romania
[2]University of Craiova, Faculty of Horticulture, Department of Horticulture and Food Science, Craiova, Romania
[3]Technological Educational Institute of Thessaly, Larissa, Greece
[4]University of Craiova - SCDP Vâlcea, Rm. Vâlcea, Romania
* *Correspondence author. E-mail*: bizeramihaela@yahoo.com

Keywords*: Elderberry, selections, clonal propagation, rooting products*

ABSTRACT

In this experiment, the effect of rooting stimulants on Sambucus nigra cuttings was evaluated. As rooting stimulants the following products were used: Radistim no. 2 (powder used for the rooting of hardy and semi-hardwood cuttings); Atonik, at a concentration of 0.25 ml/l and IBA (indolylbutyric acid), at a concentration of 0.5 mg/l. Cuttings were harvested from 4-5 year old plants, splitted in 5 groups depending on size and planted in a plastic tunnel on November 1st, 2017. The measurements were carried out on July 1st, 2018 and focused on the number of roots, roots length, number of shoots and length of shoots. The best results in terms of rooting have been obtained with the 4th variant (V4), with size of cuttings of 20-30 cm, treated with Radistim.

INTRODUCTION

Elderberry (*Sambucus* spp.) is a species that is found in both the spontaneous flora, and also cultivated in orchards, having a wide range of uses (Charlebois et al., 2010). Between the species of *Sambucus* genus, *Sambucus nigra* L. (black elder) is well known in Europe and in our country. If we consider the other sub-species, then its areal expands to Asia, Africa and North America (Botu, 1988).

Black elderberry has many uses, in horticulture, as ornamental shrub, and a food source for wild animals and humans (Valles et al. 2004; cited by Charlebois et al., 2010). Elderberry has also an ecological role, stabilizing the soil and the river banks (Paquet and Jutras, 1996; cited by Charlebois et al., 2010). Elderberries are rich in antioxidants and can be used as food or medicine (Prior, 2003; Willcox et al., 2004; Scalbert et al., 2005; Zafra-Stone et al., 2007; Seeram, 2008; cited by Charlebois et al., 2010).

The great diversity of elderberry existing in the spontaneous flora allows selection of valuable genotypes, which will be promoted in culture, or will be introduced in the germplasm collections, as potential sources of valuable genes for breeding programs. The genotypes selected *in situ* will be propagated, in this respect the identification and promotion of effective vegetative propagation methods are needed.

Research on the influence of stimulants for rooting both for elderberry and other species was carried out by Maughan et al. (2018), who tested the influence of

naphthylacetic acid (NAA) on rooting. Boyer and Graves (2009) studied the effect of 3-indolilbutiric acid (IBA) in a concentration of 3000 ppm and of naphthylacetic acid (NAA) on the hardwood cuttings of *Nyssa aquatica* and *Nyssa ogeche*, achieving a 93 % rooting of cuttings.

Sabo (2011), in her PhD thesis, experimented the influence of Radistim influence on rooting several species like *Ligustrum vulgare*, *Buxus sempervirens* and *Taxus baccata*, on different growing substrates. The best results in terms of rooting and shoots growth were obtained in case of tip cuttings treated with Radistim 2.

Murtić et al. (2015) have examined the influence of different concentrations (0.2; 0.4; 0.8 and 1.5 mg/l) of 3-indolilbutiric acid (IBA) on rooting of *Sambucus nigra* cuttings. The concentration of 0.8 mg/l of IBA influenced the most the parameters examined (fresh root mass, number of adventitious roots and leaf surface).

Researchers from the National Clonal Germplasm Repository (NCGR) in Corvallis - Oregon (U.S.A.) observed that for rooting cuttings of *Sambucus racemosa* L. in greenhouse conditions, no stimulation is required (Flessner and Trindle, 2003).

Gudeva et al. (2017) conducted a study on the influence of hormones in the process of rhizogenesis of *Sambucus nigra* L. cuttings planted in a tunnel covered with plastic foil. Only 14 % of the cuttings treated with IAA and 10 % of the cuttings treated with BAP have rooted.

In this study, we have tested the effect of various stimulants (IBA, Atonik and Radistim 2) on cuttings' rooting and development of elderberry shoots.

MATERIALS AND METHODS

The biological material used in the experiment consisted of hardwood cuttings harvested on November 30, 2017, in Nicolae Bălcescu locality in Vâlcea County, from *Sambucus nigra* L. shrubs, of 4-5 years old.

Elderberry hardwood cuttings were obtained from the middle part of the annual growth and were sized to the length of internode, having a basal node and one on top. Depending on the length and diameter of internode cuttings, the cuttings were divided into 5 groups of different sizes (Figure 1):

Group I: length of 30-35 cm and a diameter of 1.5-2.0 cm;
Group II: length of 25-30 cm and a diameter of 1.0-1.5 cm;
Group III: length of 20-30 cm and a diameter of 0.8-1.0 cm;
Group IV: length of 20-25 cm and a diameter of 0.6-1.0 cm;
Group V: length of 20-30 cm and a diameter of 0.5-0.8 cm.

The experiment was designed as bifactorial type, with 4 types of treatment (V1-V5 variants) and 5 groups of cuttings' sizes. Each variant was composed of 45 hardwood cuttings and was divided in 3 replications. The experiment was set in the trial fields of the Faculty of Horticulture at the Didactical and Experimental Station of Banu Mărăcine, near Craiova. The cuttings were held between November 1, 2017 - July 1, 2018. Cuttings were planted in a plastic tunnel, at 25 cm between rows and 10 cm between plants in the row (Figure 2).

Before planting, the soil was mobilized and peat and perlite were added in a ratio of 1:1 on the trench where the cuttings were planted in rows.

Cuttings were treated in advance with simulators, one of the variants (V1) did not benefit of any stimulant treatment. The basal part of the hardwood cuttings was dipped during 20 minutes into stimulant solutions of IBA and Atonik (Table 1).

Table 1

The stimulants used in the experiment

Encoding variants	Treatment type	Exposure time (minutes)
V1	Untreated	-
V2	IBA (0.5 mg/l)	20'
V3	Atonik (0.25 ml/l)	20'
V4	Radistim 2	-

IBA was applied on the variant V2, at a concentration of 0.5 mg/l. Atonik was applied on variant V3, at a concentration of 0.25 ml/l. In case of variant V4, the basal part of the cuttings was distempered with Radistim 2. After the treatments, the hardwood cuttings were placed in the trench where peat and perlite were added in advance and then covered with the same mixture.

During the growing season, maintenance work has been applied: soil mobilization through the rows of cuttings, weed removal, phytosanitary treatments, irrigation and tunnel ventilation.

Observations were carried out after 242 days from planting and referred to: number of rooted cuttings, number of roots per cutting, root length, number and length of shoots on the cuttings.

MS Excel software was used for data analysis of variance (ANOVA) and DSAASTAT ver. 1.514 (2015) for Duncan's Multiple Range Test at significance level of $p<0.05$. DSAASTAT is an Excel VBA Macro developed by Onofri (2007).

RESULTS OBTAINED

The elderberry hardwood cuttings, treated with stimulant substances and planted in the trial, were examined 242 days after planting. The results obtained were different depending on the treatment used and the size of the cuttings.

Thus, the highest average number of roots (21.1) were obtained at the hardwood cuttings from Group IV (length of 20-25 cm and 0.6-1.0 cm in diameter) treated with Atonik, at a concentration of 0.25 ml/l (V3) (Table 2, Figure 3).

The highest value of the mean length of the roots of 28.607 cm were observed in the case of cuttings from the group III (length of 20-30 cm and a diameter of 0.8-1.0 cm), cuttings treated with Radistim 2 (V4) (Table 3).

The highest values of the mean length of the shoots of 41.497 cm were observed in the case of cuttings from the group III (length of 20-30 cm and diameter of 0.8-1.0 cm), cuttings treated with Radistim 2 (V4) (Table 4 and Figure 4).

Table 2

Data recorded for the *Sambucus nigra* L. hardwood cuttings regarding the mean number of roots counted after 242 days after treatment

Variants	Group I	Group II	Group III	Group IV	Group V	*Mean*
V1 (untreated)	4.423	3.100	5.427	7.247	3.467	*4.7327*
V2 (IBA)	5.723	3.473	7,193	8.983	4.473	*5.9693*
V3 (Atonik)	7.583	5.367	8.327	21.100	11.543	*10.7840*
V4 (Radistim 2)	10.137	7.213	10.533	10.900	15.247	*10.8060*

Table 3

Data recorded for the *Sambucus nigra* L. hardwood cuttings regarding the mean length of roots (mm) after 242 days after treatment

Variants	Group I	Group II	Group III	Group IV	Group V	*Mean*
V1 (untreated)	6.003	5.117	7.293	7.477	7.733	*6.7247*
V2 (IBA)	8.563	8.583	15.050	9.643	12.583	*10.8847*
V3 (Atonik)	10,500	11.567	21.007	20.590	15.440	*15.8207*
V4 (Radistim 2)	15.347	15.697	28.607	15.613	18.420	*18.7367*

Table 4

Data recorded for the *Sambucus nigra* L. hardwood cuttings regarding length of the shoots (cm) after 242 days after treatment

Variants	Group I	Group II	Group III	Group IV	Group V	*Mean*
V1 (untreated)	7.450	8.583	6.673	7.323	9.193	*7.8447*
V2 (IBA)	1.553	15.463	12.317	13.390	18.410	*14.2267*
V3 (Atonik)	6.433	18.410	16.517	23.097	21.440	*19.1793*
V4 (Radistim 2)	3.613	19.150	41.497	24.583	33.157	*28.4000*

The greatest number of shoots, after 242 days from the treatment with stimulants for rooting cuttings, was observed in the case of cuttings from group V (length of 20-30 cm and a diameter of 0.5-0.8 cm), treated with Radistim (V4) (Table 5).
The differences between the variants were statistically analyzed using the Duncan's Multiple Range Test (Table 6).

Between V1 variant (untreated) and V2 variant (cuttings treated with IBA) not significantly difference (at $p<0.05$) were recorded, as well as between V3 variant (cuttings treated with Atonik) and V4 variant (cuttings treated with Radistim 2), regarding the average number of roots obtained after 242 days from the treatment with stimulant rooting cuttings. The results obtained in the cases of V3 and V4 variants (10.784 roots/cutting and 10.806 roots/cutting) were significantly different from V1 and V2 (4.733 roots/cutting and 5.969 roots/cutting).

Table 5

Data recorded for the *Sambucus nigra* L. hardwood cuttings regarding number of shoots after 242 days after treatment

variants	Group I	Group II	Group III	Group IV	Group V	*Mean*
V1 (untreated)	0.653	0.737	0.870	1.343	1.180	*0.9567*
V2 (IBA)	1.207	1.200	1.020	1.657	1.640	*1.3447*
V3 (Atonik)	1.497	1.637	1.637	2.297	2.030	*1.8193*
V4 (Radistim 2)	2.740	2.083	2.137	2.363	3.027	*2.4700*

Each of the four variants were significantly different ($p<0.05$) in terms of the effect of the rooting stimulating substances on the root length at 242 days from the treatment of the hardwood cuttings. The lowest average length of the roots was 6.725

cm observed for V1, and the higher average length of 18.737 cm, was observed for the V4 variant.

Table 6

The interpretation of the differences obtained regarding the use of rooting stimulating products on elderberry hardwood cuttings

Before planting		After 242 days after planting			
Variants	Number of cuttings	Average number of roots	Average root length (mm)	Average number of shoots	Average length of shoots (cm)
V1 (untreated)	135	4.733 a	6.725 a	0.957 a	7.845 a
V2 (IBA)	135	5.969 a	10.885 b	1.345 a	14.227 b
V3 (Atonik)	135	10.784 b	15.821 c	1.819 b	19.179 c
V4 (Radistim 2)	135	10.806 b	18.737 d	2.470 c	28.400 d

Means within each column having different letters are significantly different according to Duncan's Multiple Range Test (at $p < 0.05$)

V1 and V2 variants were not significantly different on the average number of shoots. V3 and V4 variants were significantly different between them but also to V1 and V2. The highest number of shoots was observed in the V4 variant (2.470 shoots/cutting).

Differences were statistically significant ($p<0.05$) in all 4 variants concerning average shoot length. The lowest average length of the shoots recorded was 7.845 cm for V1 and the largest of 28.400 cm for V4.

CONCLUSIONS

In conclusion, the treatment with Radistim 2 (V4) proved to be the most effective in the experimental conditions, more effective than Atonik (V3) regarding the average length of the roots, shoot number and length of shoots. Between the treatments with Radistim 2 (V4) and with Atonik (V3) no significant differences were obtained regarding the average number of roots.

Treatments with Radistim 2 (V4) and with Atonik (V3) produced significant results comparatively with the treatment with IBA (V2) and the untreated variant (V1).

REFERENCES

Botu, I., Mihăescu, O., Turcu, E., Ioachim E., 1988. Socul negru. Centrul de material didactic şi propagandă agricolă. Redacţia de propaganda tehnică agricolă, Bucureşti.

Boyer, N.Z, Graves, W.R., 2009. NAA is More Effective Than IBA for Rooting Stem Cuttings of Two *Nyssa* spp. Journal of Environmental Horticulture: September 2009, Vol. 27, No. 3, pp. 183-187.

Charlebois, D., Byers, P.L., Finn, C.E., Thomas, A.L., 2010. Elderberry: botany, horticulture, potential; 213-280. In: Janick. J., Horticultural reviews. Volume 37. Wiley-Blackwell. http://naldc.nal.usda.gov/download/47014/pdf.

Flessner, TR., Trindle, J.D.C., 2003. Propagation protocol for vegetative production of container *Sambucus racemosa* L. plants (2-year 1-gallon containers); USDA NRCS - Corvallis Plant Materials Center, Corvallis, Oregon. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 6 January 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

Gudeva, L.K., Trajkova F., Mihajlov, L., Troicki, J., 2017. Influence of Different Auxins on Rooting of Rosemary, Sage and Elderberry. Annual Research & Review in Biology 12(5): 1-8, 2017; Article no.ARRB.33162 ISSN: 2347-565X, NLM ID: 101632869

Maughan, T., Black, B.L., Rupp, L.A., Yost, M.A., 2018. Propagation techniques for *Sambucus cerulea* (blue elderberry). Native Plants Journal 19.2 (2018): 80-89.

Murtić, S., Čivić, H., Avdić, J., Ašimović, Z., Kobilica, K., 2015. The influence of indolebutyric acid on rooting and quality parameters of elderberry cuttings (*Sambucus nigra* L.). Radovi Poljoprivrednog Fakulteta Univerziteta u Sarajevu (Works of the Faculty of Agriculture University of Sarajevo) 60.65 (2) (2015): 31-36.

Onofri, A., 2007. Routine statistical analyses of field experiments by using an Excel extension. Proceedings 6th National Conference Italian Biometric Society: "La statistica nelle scienze della vita e dell'ambiente", Pisa, 20–22 June 2007, 93–96.

Sabo, G.M., 2011. Research regarding the biology and planting material production technology at some woody species used for hedges and trimmed forms. Teza de doctorat USAMV Cluj-Napoca (in Romanian).

DSAASTAT ver. 1.514 (2015) www.casaonofri.it/repository/DSAASTAT.xls

Figure 1. Size groups (Gr. I–V) of the elderberry hardwood cuttings used in the experiment

Figure 2. Elderberry hardwood cuttings planted in the tunnel

Figure 3. Rooted cuttings of V3, Gr. IV elderberry hardwood cuttings

Figure 4. Shoots from one elderberry hardwood cutting of V4, Gr. III

ANNALS OF THE UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

QUALITY CONTROL OF SOME CANNED TOMATOES

Ramona Căpruciu[1], Lascu Nicolae[1]

[1]University of Craiova, Str. A.I Cuza, No. 13, Craiova
Corresponding author: E-mail address: ramona_capruciu@yahoo.com

Keywords*: paste and juice tomato, quality parameters*

ABSTRACT

This study aims to perform qualitative analysis of paste and juice tomato, food products with a wide use in the food industry. Organoleptic determinations of juice and tomato paste has led to satisfactory results that are consistent with standard. In this respect, characteristics such as the general appearance of the samples, the color, the smell and the taste, the consistency, the presence of the impurities in the mass of the product were followed. The analysis of organoleptic properties on the two products under study completes the series of laboratory qualitative analyzes. From this point of view, the main quality parameters were determined: salt content by the Mohr method, the soluble substance (soluble extract) by the refractometric method and titratable acidity by titrimetric method. For tomato paste, the values of the parameters were in the standard values. Tomato juice is found to be above the standard for acidity and salt content.

INTRODUCTION

From the category of sterilized canned vegetables, the highest demand in the season but especially in the off season is the tomato paste with a great importance in human nutrition because it has a high nutritional value and can be the basis of obtaining a diversified food category (Apaiah et al. 2001, Apaiah and Barringer, 2001, Wilhelm et al. 2001, Perkins-Veazie et al. 2007, Ding et al., 2016, Dinu et al. 2016). Also, tomato juice is an important source of energy that ensures normal daily activity and maintains health through the intake of nutrients. The quality of the raw material and the application of modern methods of production such as vacuum concentrating to temperature and time parameters, as well as qualitative monitoring during storage, result in higher quality tomato products (Apaiah et al. 2001, Sarca, 2004, Gordon et al. 2010, Makroo et al., 2016, Jayathunge et al.,2017, Bruno et al. 2018). The main quality parameters of tomato and juice paste are color, consistency and flavor, the parameters that can influence the buyer in the buying decision and can also represent quality standards (J.A. Barreiro et al. 1997, Hayes et al. 1998, Adekunte et al. 2010). The value of tomato products is given by the multitude of nutrients that play an antioxidant, vitamin or mineralizing role for the body (Buttery et al. 1990, Kehili et al. 2017, Hyeong et al. 2018). Degradation processes can occur in sterilized products due to several factors, the increase in acidity being a signal of degradation in the case of tomato products (Qiu et al. 2018).

MATERIAL AND METHODS

The material used consisted of samples of pasta and tomato juice.

On the samples were made in the laboratory organoleptic and physico-chemical determinations in order to establish the quality of the products purchased from the

supermarket. During the taking and formation of samples for organoleptic determination the general appearance was examined visually, and elementary samples were compared in terms of aspect, color, smell, taste for the purpose of determining as accurate as possible.

Determination of sodium chloride by the Mohr method

The principle of the method consists in titrating the chlorine ions from the neutralized aqueous extract of the sample to be analyzed with silver nitrate in the presence of potassium chromate as an indicator. Preparation of the sample: 20 g of sample (tomato paste / tomato juice) is homogenized with the mechanical homogenizer. It respects the method of work required by the method. The salt content is calculated using the relevant calculation formula and is expressed in %.

Determination of the soluble substance (soluble extract) by the refractometric method

Principle of the method: Determine the refractive index at 20 °C and deduct from it the content of soluble substances expressed as sucrose by means of a conversion table. Working mode: On the fixed prism of the refractometer, drop 2-3 drops of the prepared sample with a rod and close the prisms immediately to prevent evaporation of the sample. Move the eyepiece until the markings overlap with the line separating the two fields. Then, depending on the refractometer used, read directly either the percentage of soluble substances or the refractive index. Two determinations shall be made on the same sample. Determination was carried out at 20 ± 0,5 °C on the undiluted sample, the percentage of soluble substances being read directly on the scale of the apparatus.

Determination of titratable acidity by titrimetric method

Principle of the method: Titrate the sample to be analyzed with sodium hydroxide in the presence of phenophthalein as an indicator. Procedure: From the prepared filtrate, take 50 cm^3 by pipette, place in a conical flask, add a few drops of phenophthalein solution and titrate with sodium hydroxide until pink, which persists for about 30 seconds. Two determinations are made from the same test sample. The total acidity may be expressed in g of citric acid and multiplied by the equivalent of the corresponding acid (0,070). The result is the arithmetic mean of the two parallel determinations that do not differ by more than 2 % (relative value) from the average (Ionică, 2014).

RESULTS AND DISCUSSION

The qualitative analysis of the two types of food obtained by sterilization is due precisely to the fact that they are some of the most consumed food in any season. The quality control of the products studied, some of the most used foods on the sterilized canned vegetable segment, becomes necessary in order to obtain finite quality products. All the elements that make up the sensory analysis of both tomato paste and tomato juice are regulated by the stasis, under conditions of admissibility. Organoleptic analysis shows that juice and tomato paste preserved by sterilization in the jar (table 1) is in line with the standards in force regarding: color, smell, taste, consistency, general appearance. Tomato paste organoleptically analyzed corresponds to the standard in terms of color, taste and smell and general appearance.

Table 1

Organoleptic determinations of juice and tomato paste

Name characteristics	*Actual analyzes*	
	Juice of tomato	*Tomato paste*
The appearance of the product	Homogeneous fluid without suspension or other fragments. It shows phase separation	Uniform, dense, smooth table without foreign objects or signs of alteration
Color	Red brick, specific	Intensive red, brick-like, uniform throughout the product
Smell and taste	Pleasant, sweet, odorless and foreign taste	Specific, sweet, tasteless and foreign odor: smoked, burnt, fermented, mold, tasteless or bitter
Cşonsistency	Liquid	Normal, pasty, tied
Impurities	Absence	Absence

The determination of the physico-chemical properties (Table 2) for the analyzed products (tomato paste and tomato juice purchased from the market) is necessary for quality assurance and also helps to establish the nutritional value demanded by consumers.

The total acidity expressed in malic acid relative to the total dry substance has high values in tomato juice compared to tomato paste (12 g/100 cm^3 vs. 8.3 g/100 cm^3), which may indicate a product at the beginning of a process degradation. Salt is a qualitative factor needed to preserve and preserve the properties of a product. The study found a higher salt content in tomato juice, surpassing the values required by the standard. The tomato paste has been matched to the norms provided in the standard for all parameters analyzed. This may mean a masking of a manufacturing problem (inappropriate raw material), which may lead to increased acidity during storage.

Laboratory analyzes found that tomato paste had a lower content of sodium chloride than tomato juice (1.3 % versus 2.5 %) which had this parameter above the limit allowed by Stas (figure 1).

Table 2

Determination of physico-chemical characteristics for tomato paste and juice

Type canned food	*Physico-chemical characteristics*			*Observations*
	Soluble dry substance (% refractometric) at 20˚C min.	Total acidity (expressed as malic acid) relative to dry matter soluble (g/100 cm^3, max.)	Sodium chloride (%, max.)	
Tomato paste	28	8.3	1.3	According to STAS
Juice of tomato	5.0	12	2.5	Acidity above STAS (admissible 10); sodium chloride above the STAS value (admissible conditions of 1.0 %)

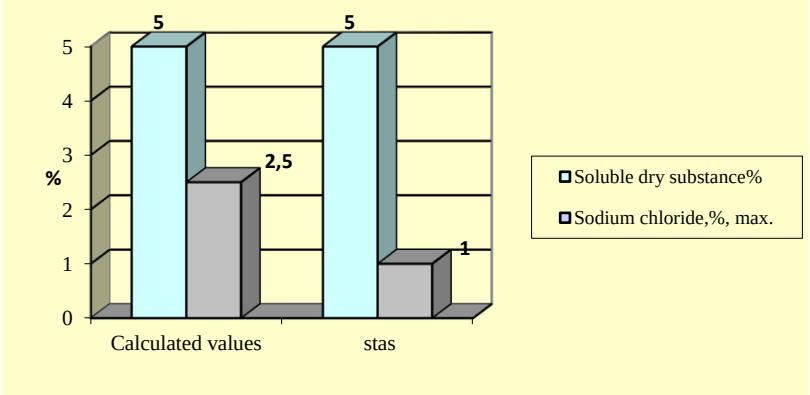


Figure 1 Determination of soluble dry matter content and sodium chloride for tomato juice

A high content of soluble dry substance was recorded in tomato paste (28 % versus 5.0 % in tomato juice).

CONCLUSIONS

Tracking qualitative parameters for sterilized canned vegetables is important because it is an important segment of the food industry, being widely used in the preparation of many culinary products, being used and appreciated both from a taste and a wealth of nutrients.

After the organoleptic analysis, it was found that both the general appearance and the color, the taste and the smell, the consistency of the pasta and tomato juice studied were in the parameters required by the standard in force.

With regard to qualitative analysis by physicochemical determinations, no quality deviations were found for tomato paste, which means that the stages of production have been respected, starting with the reception of raw materials up to the packaging and storage of finished products. The soluble dry matter content was standard. The total acidity expressed in malic acid relative to the total dry substance is high in the tomato juice (much higher than those given under the conditions of the standstill), which may indicate a product at the beginning of an altering process with all the evidence is valid.

Laboratory analyzes found that tomato paste had a low sodium chloride content compared to tomato juice having this parameter above the limit allowed by Stas. All of these have led to the addition of excess sodium chloride to increase product stability and increase consumption.

REFERENCES

Adekunte A.O., Tiwari B.K., Cullen P.J., Scannell A.G.M., O'Donnell C.P., 2010, Effect of sonication on colour, ascorbic acid and yeast inactivation in tomato juice, Food Chemistry, Volume 122, Issue 3, 1 October 2010, Pages 500-507.

Apaiah, R. K., Barringer, S. A., 2001, Quality loss during tomato paste production versus sauce storage. Journal of Food Processing and Preservation, 25: 237–250.

Apaiah, R. K., Goodman, C. L. And Barringer, S. A. 2001, Quality differences between fresh pack and remanufactured tomato sauce. Journal of Food Processing and Preservation, 25: 431–445.

Barreiro, J.A., M.Milano, A.J.Sandoval, 1997. Kinetics of colour change of double concentrated tomato paste during thermal treatment Journal of Food Engineering Volume 33, Issues 3–4, Pages 359-371.

Bruno Andreina, Miriana Durante, Pier Paolo Marrese, Danilo Migoni, Maura N. Laus, Elisabetta Pace, Donato Pastore, Giovanni Mita, Gabriella Piro and Marcello S. Lenucci, 2018. Shades of red: Comparative study on supercritical CO 2 extraction of lycopene-rich oleoresins from gac, tomato and watermelon fruits and effect of the α-cyclodextrin clathrated extracts on cultured lung adenocarcinoma cells' viability, Journal of Food Composition and Analysis, 65, (23).

Buttery Ron G., Roy Teranishi, Louisa C. Ling, and Jean G. Turnbaugh, 1990. Quantitative and sensory studies on tomato paste volatiles Journal of Agricultural and Food Chemistry 38 (1), 336-340

Ding Xiaoxiao, Ying Guo, Yongnian Ni and Serge Kokot, 2016. A novel NIR spectroscopic method for rapid analyses of lycopene, total acid, sugar, phenols and antioxidant activity in dehydrated tomato samples, Vibrational Spectroscopy, 10.1016/j.vibspec.2015.10.004, 82, (1-9).

Dinu M., Rodica Soare, M.Gruia, 2016, Bioactive compounds and antioxidant activity in commercial cultivars of tomato (Lycopersicum esculentum L.).16th International Multidisciplinary Scientific GeoConference SGEM Conference Proceedings, ISBN 978-619-7105-66-7 / ISSN 1314-2704, Book 5 Vol. 2, pp.149-156.www.sgem.org.

Gordon E. Anthon And Diane M. Barrett, 2010, Changes in tomato paste during storage and the effects of heating on consistency of reconstituted tomato paste, Journal of Texture Studies p.1-17.

Hayes W.A., Smith PG, Morris AE, 1998, The production and quality of tomato concentrates Food Sci. Nutr. 557-64

Hyeong Sang Kim and Sun Jin Hur, 2018. Effects of in vitro Human Digestion on the Antioxidant Activity and Stability of Lycopene and Phenolic Compounds in Pork Patties Containing Dried Tomato Prepared at Different Temperatures, Journal of Food Science, 83, 7, (1816-1822).

Ionică M. E., 2014, Metode de analiză şi control al calităţii fructelor şi legumelor proaspete şi divers prelucrate. Editura Universitaria Craiova, Editura Prouniversitaria Bucureşti, ISBN 978-606-14-0867-2 ISBN 978-606-26-0121-8.

Jayathunge K.G.L.R., Alexandros Ch. Stratakos, Oliver Cregenzán-Albertia, Irene R. Grant, James Lyng and Anastasios Koidis, 2017. Enhancing the lycopene in vitro bioaccessibility of tomato juice synergistically applying thermal and non-thermal processing technologies, Food Chemistry, 221, (698).

Kehili Mouna, Marianne Kammlott, Sirine Choura, Ayachi Zammel, Carsten Zetzl, Irina Smirnova, Noureddine Allouche and Sami Sayadi, 2017. Supercritical CO2 extraction and antioxidant activity of lycopene and β-carotene-enriched oleoresin from tomato (Lycopersicum esculentum L.) peels by-product of a Tunisian industry, Food and Bioproducts Processing, 102, (340).

MaKroo H., Navin K Rastogi, Brijesh Srivastava, 2016 Enzyme Inactivation of Tomato Juice by Ohmic Heating and Its Effects on Physico-Chemical Characteristics of Concentrated Tomato Paste, Researchgate, DOI: 10.1111/jfpe.12464

Perkins-Veazie P., Warren Roberts & Julie K. Colins, 2007, Lycopene Content Among Organically Produced Tomatoes, Journal of vegetable science, Vol 12, Issue 4, Pag. 93-106

Qiu Jun, Jan-Eise Vuist, Remko M. Boom and Maarten A.I. Schutyser, 2018. Formation and degradation kinetics of organic acids during heating and drying of concentrated tomato juice, LWT - Food Science and Technology, 10.1016/j.lwt.2017.08.081, 87, Pag. 112-121.

Sarca Gh., 2004, Materii prime vegetale. Depozitare şi păstrare. Editura Universitați din Oradea.A

Wilhelm Stahl, Ulrike Heinrich, Sheila Wiseman, Olaf Eichler, Helmut Sies, Hagen Tronnier 2001. Dietary Tomato Paste Protects against Ultraviolet Light–Induced Erythema in Humans, The Journal of Nutrition, Volume 131, Issue 5, Pag. 1449–1451.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE QUALITATIVE ASPECTS ON SOME SPECIALTIES OF BREAD WITH SEEDS

Ramona Căpruciu[1]*,Totâlcă Laurenţiu[1] Cristina Cuţă[2]

[1]University of Craiova, Faculty of Horticulture Str. A.I Cuza, No. 13, Craiova
[1]MScStudent,University of Craiova, Faculty of Horticulture Str. A.I Cuza, , Master Food Safety and Consumer Protection, Str. A.I. Cuza No. 13, Craiova
[2]MScStudenUSAMV Bucharest, Faculty of Biotechnologies, Master Biotechnology and Food Safety, Str. Bulevardul Mărăşti No. 59
Corresponding author: E-mail address: ramona_capruciu@yahoo.com

Key words*: flour, baking system, bread, seed, quality*

ABSTRACT

Making bread products based on two types of flour: Type 480 and Type 650 with the addition of flaxseed and sunflower seeds and baking them in different baking systems as well as tracking their technological and nutritional behavior, are issues that are the subject of this study. The objectives set for the study are the realization of two bread specialties by flour 480 and flour 650 with flaxseed and sunflower seeds as well asorganoleptics and physico-chemical analysis and organoleptics of studied bread specialties in order to determine their quality.

INTRODUCTION

The quality of the bread is given by the organoleptic, physicochemical and microbiological properties of the finished product, as well as by the type of flour and yeast as the main raw material and water, salt and other elements as secondary raw materials. A special importance is given to the raw and auxiliary raw materials used in the doughs industry from the bakery industry, as they can influence the quality of the products obtained (Matuda et al., 2005, Leonte and Arus 2006, Burluc et al., 2011, Doblado-Maldonado et al., 2012, Woosung et al., 2014, Mi end Sang, 2017). Also, the method of baking and other elements of the technological flow of production can influence the main qualitative parameters of the bread: general appearance, crust appearance, volume, porosity, etc. (Primo-Martín et al., 2008, Banu et al. and Le-Bail, 2009, Shehzad et al., 2010, Upadhyay et al., 2012, Căpruciu, 2013), items of particular importance for the consumer.

MATERIALS AND METHODS

The material used consisted of two samples of commercially available flour, yeast, water, salt, flax seeds and sunflower seeds.

Determination of flour

Ash content is an important quality indicator for flour. Determination of ash was achieved by incineration in a calcination furnace at a temperature of 550 ° C, the choice of calcination temperature having a decisive influence on the ash content, because at too high temperatures the alkaline chlorides partially volatilize and the ash melting prevents the burning of the last coal residues included in the molten mass. Ash content C was reported for dry matter.

Determination of bread

Determination of humidity: Apparatus: thermoregulable oven, weighing ampoules, technical balance with the accuracy of 0.01 g. Working mode: Weigh approximately 5 g of the sample in an aluminum vial, place the bread sample vial uncovered in the oven heated to 130 ^{0}C and keep for 60 minutes. Remove the ampoule from the oven and place it in the exchanger containing CaCl2 after cooling to room temperature (30 - 60 min) then weigh the ampoule at the analytical balance.

Calculation: $U = \frac{m_1 - m_2}{m_1 - m_0} \cdot 100$ [%]

Where: m1 = mass of the ampoule to be analyzed before drying in g; m2 = mass of sample ampoule after drying in g; m0 = mass of the weighing ampoule, in g.

Determination of Acidity Reagent: 0.1N NaOH solution, phenolphthalein Procedure: Weigh 25 g of the core from the sample to be accurate to 0.01 g and place in a 500 cm3 glass-stoppered flask. Add 3075 cm3 of a volume of 250 cm3, shake for 3 minutes, add the rest of the water in the cylinder and mix, bringing all the sample particles on the vessel walls and on the wand into the liquid. Leave for 5 minutes. From the decanted solution pour 50 cm3. The 50 cm3 of the filtrate is introduced into a clean Erlenmayer vessel. Add 3 drops of 1 % phenolphthalein solution. Titrate with 0.1 N NaOH until the appearance of the pink color persists for 1 minute. Calculation: according to calculation method.

Determination of porosity of bread specialties Method principle: Determine the total volume of the voids in a known core volume, knowing its density and mass. Materials and equipment used: bread sample for analysis; well-sharpened cylindrical punch, preferably brass (see figure below); sharp knife; technical balance, weights; oil, to lubricate the punch cutter; a 20 cm ruler with a 1 mm division value. Determination of porosity consisted in weighing 3 cubes of core cut from three slices of 2 cm thick bread. The height of the cylinder is calculated as the arithmetic mean of the 2-3 measured heights. The diameter of the cylinder is calculated as the arithmetic mean of the two measured diameters. Core density generally has the following values: ρ = 1.21 g / cm3 for wheat flour; ρ = 1.26 g / cm3 for semi-white wheat bread; ρ = 1.31 g / cm3 for wheat flour and for bakery specialties; Calculation: According to calculation method. As a result, the arithmetic mean of two determinations made from the same analytical sample is taken. The difference between the results of two parallel determinations carried out by the same operator within the same laboratory shall not exceed two percentage points in absolute value.

RESULTS AND DISCUSSIONS

In order to achieve the two types of bread taken in the study, the flour used to form the doughs was analyzed. The data obtained are consistent for baking (Table 1).

The production recipe for the two bread specialties is identical, following changes in the quality of the dough and the finished product under similar temperature and humidity conditions during kneading and baking processes. The products thus obtained are distinguished by their external and in sectional appearance, by volume, porosity, crust color, etc.

Table 1

Analysis of the physico-chemical characteristics of the flour samples studied

Name Characteristics	*Flour Probes*	
	F1	*F2*
Moisture %	14.00	12.00
Acidity (cm^3 NaOH/100g)	3.50	2.70
Ash content relative to dry matter %	0.65	0.48

Legend: F1, F2 - Flour samples taken in the study

Obtaining the bread specialty from flour 650 with seeds

Ingredients: flour 650: 30 %, maia, 100g sunflower seeds, 300ml water, 15g salt, dough hydration: 77.7 %, dough: bread to 1kg tray). The steps followed in order to make the bread specialty from flour 650 with seeds sunflower and flax seeds consisted of: all ingredients were brought to the worktop at 30 C 1 hour before the start of the process (direct method). The dough was prepared: 30g of yeast to which 10 g of fermentable sugar, 300 g of flour 650 and 140 ml of water at 40 C were added. All of these ingredients were mixed and kneaded for 5 minutes. The vessel was sealed and kept at 40 ° C until the composition of the dish (the proper dish) reached the lid. The next step was the weighing of flax seeds and sunflower. A boiling water was added to the flax seed in a stainless steel vessel with lid and the vessel was covered to prevent evaporation. The seeds stood in the bowl until all the water was absorbed, increasing in volume (15 minutes). The seeds were mixed after cooling with water to form the dough. The flour was warm at least 1 hour prior to dough formation was introduced into a larger vase over which the previously formed mixture was added. The actual kneading process that lasted for 15 minutes followed. At half the kneading time dough, salt was introduced. In this way, the dough was passed to the raisinged, in a room with a temperature of 50-60°C, until the dough reached twice the initial volume, the period being about 1 hour. After raising, the dough is divided into two equal parts and is subjected to modeling. After modeling, the dough pieces were handled as follows: For the electric baking method, the dough pieces thus formed were placed in trays where another 10 minutes were left for final fermentation at a temperature of 50-60 °C, after which they were placed in the oven. For the baking method, the dough pieces were placed directly on the hearth at a distance of 20 cm from each other in order to avoid organoleptic defects (soldering and crackling).When cooked in electric oven where the temperature was controlled, the dough was initially kept at 80 °C in order to complete the yeast fermentation process with total carbon dioxide removal which resulted in a rheological dough formation. For 15 minutes at 80 °C the dough increased in volume. After 15 minutes, the temperature was raised by another 20 °C for 10 minutes to complete the baking process, during which time the baking of the core took place and the color of the crust was formed. The bread thus formed was removed from the oven, left for 5 minutes in trays to facilitate removal. The last step consisted in the gradual cooling of the bread until inside the core, the temperature recorded was similar to the room temperature (about 4 hours after being removed from the oven). After cooling, the two bread specialties obtained by baking in electric furnace were subjected to organoleptic and physico-chemical analyzes to determine the quality.

Obtaining the bread specialty from flour 480 with seeds

Ingredients: flour 480: 30 %, maia, 100 g hydrated seeds, 100 g sunflower seeds, 300 ml water, 15g salt, 80.1 % dough hydration: 1 780 g (two 1 kg loaves). Flax seeds were kept for about 15 minutes in boiling water for intense hydration, the process being the same as obtaining the specialty of 650-type flour bread with flax seed and sunflower seeds. The steps followed in order to make the bread specialty of 480 type flour with sunflower and flax seeds are also the same as obtaining the specialties of bread from 650 type flour V. Laboratory physicochemical analyzes (Table 2) reveal differences in the quality of bread specialties analyzed according to the type of flour and the method of baking.

Tabel 2

The physico - chemical properties of studied bread specialties

Specialitate	Baking method	Acidity (grade Thörner)	Humidity %	Porosity %
The bread specialty from flour 650 with seeds	On the hearth	3,6	51,8	60
	In the electric oven	3,4	53,6	53
The bread specialty from flour 480 with seeds	On the hearth	2,8	42,9	81
	In the electric oven	2,6	43,8	68

Thus, with regard to acidity, it is noted that the specialty from 480-type wheat flour has a much lower acidity than the specialty from 650-type wheat flour with seeds. From this determination it can be said that the specialty from 480-type flour bread with seeds is suitable for a longer storage and consumation period than specialty from 650-type flour with seeds.

Table 2 shows that even in the baking mode of the studied specialties it differentiates in acidity, even within the same type of specialty, the differences being not very high. For example, the bread specialty from flour 480 type with seeds has a higher acidity than the specialty from the flour 480 type with seeds in the electric oven (2.8 vs. 2.6 degrees Thörner).

Proportion is also retained in the of 650 flour bread specialty, with higher degrees of acidity (3.6° Thörner acidity for the 650-type flour bread specialty with baked seeds on the hearth and 3.4 degrees Thörner acidity for bread specialty from the 650-grade flour with the roasted seeds in the electric furnace). And the determination of humidity highlights the specialty from type 650 flour with seeds, the one baked in an electric furnace with the highest humidity. It is closely followed by the specialty from type 650 flour baked on the hearth (51.8 %).

As for the from 480 type bread meal, the moisture content recorded in the core after baking and cooling is lower than in the other assortment, the differentiation being also the result of the baking method (42.9 % on the hearth and 43, 8 % in the electric furnace). Determination of moisture and acidity shows that a specialty of 480-type flour bread with seeds is retained for a longer period of time. Determining porosity in the bread industry is an important indicator of quality.

The higher the porosity values, the more dense the bread core, this element being a minus point at the time of the mastication. Table 2 shows that the specialty of bread by flour 650 type in the oven in the electric furnace represents the smallest percentage of porosity, the dense aspect of the core being also observed after the measurements, the volume being flattened. On the other hand, there is the specialty from flour 480 type with high-porosity seed on the hearth, which has resulted in a large pores visible through the uneven gaps in the core section. Satisfactory percentages presented the specialty from flour 480 type with roasted seeds in the electric furnace (68 %), followed by the specialty from 650-type flour with 60 % raw seed.

CONCLUSIONS

There are different aspects regarding the qualitative characteristics, as follows:

The pores of 650 type flour bread made on the hearth were very small, resulting in a dense porosity. At the specialty breads from 480 type flour obtained on the hearth the pores were large, resulting in a high porosity. In the bread from the type 650 flour obtained in the electric oven the pores were of medium size, the core having a medium density porosity. In the bread specialty of 480 type wheat flour, the pores were of normal size, giving a normal breadth of bread, which resulted in a normal, characteristic volume.

Concerning acidity, it is noted that the specialty of 480-type flour bread has a much lower acidity than the specialty from 650-type flour bread with seeds, concluding that the first assortment is suitable for a longer shelf life and to slicing. It is also noted that the way of baking the studied bread specialties distinguishes both acidity and humidity and porosity within the same type of bread, the differences being very high in some cases.

Determination of humidity highlights the bread specialty from the 650-type flour with the seeds baked in an electric furnace, followed closely by the bread specialty of the 650 flour on the hearth, assortments that are proposed for immediate consumption, increasing the shelf life leading to their depreciation. Determination of moisture and acidity shows that the specialty from 480 type flour with seed on the hearth is kept for a longer period, the disadvantage being the presence of high porosity.

By performing a quality ranking, following the organoleptic and physico-chemical determinations, the situation of the bread specialties taken in the study is the following:

I - Bread specialty of 480 type flour with seeds baked in the electric oven;

II - Bread specialty of the 650 type flour with seeds baked on the hearth;

III - Bread specialty of 480 type flour with seeds baked on the hearth;

IV - bread specialty of the 650 type bread with baked seeds in the electric oven.

Although for the III place the specialty exhibits excessive porosity, it is preferred to the IV place, where the low porosity led to a dense core with sticky conglomerate formation during the mastication.

REFERENCES

Banu Constantin, 2009, Tratat de industrie alimentară, Tehnologii alimentare, Editura ASAB, Bucureşti.

Burluc R. M., C. Vizireanu, O. Barna., 2011. Research on Buckwheat Flour Utilisation in Bread Making, Journal of Environmental Protection and Ecology, XII, No.3, 930-934, ISSN 1311-5065 Volume: 12 Issue: 3.

Căpruciu Ramona, 2013. Implicarea biotehnologiilor în industria alimentară. Editura Sitech. Craiova.

Doblado-Maldonado Andres F., Oscar A. Pike, Jess C. Sweley, Devin J. Rose, 2012, Key issues and challenges in whole wheat flour milling and storage, Journal of Cereal Science 56 (2012) Pag. 119-126.

Leonte M., Alisa Arus, 2006. Study concerning the influence of salt addition on bread's quality Journal of Agroalimentary Processes and Technologies, XII(2), 325-33.

Matuda, T. G., Parra, D. F., Lugão, A. B., Tadini, C.C., 2005. Influence of vegetable shortening and emulsifiers on the unfrozen water content and textural properties of frozen French bread dough. Lebensmittel Wissenschaft und-Technologie, 38, 275.

Mi Jeong Kim, Sang Sook Kim, 2017. Utilisation of immature wheat flour as an alternative flour with antioxidant activity and consumer perception on its baked product, Food Chemistry Volume 232, Pages 237-244.

Primo - Martín C., H. de Beukelaer R. J. Hamer T. Van Vliet, 2008, Fracture behaviour of bread crust: Effect of ingredient modification, Journal of Cereal Science, Volume 48, Issue 3, Pages 604-612.

Shehzad A. H.Chiron G.Della Valle K. Kansou A. Ndiaye A. L. Réguerre, 2010, Porosity and stability of bread dough during proofing determined by video image analysis for different compositions and mixing conditions, Food Research International, Volume 43, Issue 8, Pages 1999-2005.

Upadhyay Rutuja, Debjani Ghosal, Anurag Mehra, 2012, Characterization of bread dough: Rheological properties and microstructure, Journal of Food Engineering, Volume 109, Issue 1, Pages 104-113.

Woosung Bae, Bon Lee, Gary G. Hou and Suyong Lee, 2014. Physicochemical characterization of whole-grain wheat flour in a frozen dough system for bake off technology, Journal of Cereal Science, 60, 3, (520).

Zúñiga Rubén, Alain Le-Bail, 2009, Assessment of thermal conductivity as a function of porosity in bread dough during proving, Food and Bioproducts Processing, Volume 87, Issue 1, Pages 17-22.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

SUITABILITY OF CLIMATIC AND BIOCLIMATIC FACTORS FOR TABLE GRAPES IN SIMNICU DE SUS VINEYARD

Cichi Daniela Doloris[1]*, Capruciu Ionela Simona[2]

University of Craiova, Faculty of Horticulture, Horticulture & Food Science Department
[2] MSc. Vine-Winemaking Expertise, University of Craiova, Faculty of Horticulture
* *Correspondence author. E-mail*: danielacichi@yahoo.com

Keywords*: table grapes, climat, phenological stages*

ABSTRACT

This paper provides research results considering the suitability of climatic resources of the Simnicu de Sus vineyard for the table grapes varieties with early and mid-season ripening. The different climatic parameters and indices with influence on the growing and development of vine were used and calculated. Additionally, the vulnerability evaluation in different winter conditions, the influence of climatic conditions on the phenological characteristics and on the bio-productive potential of the table grape varieties were been measured. The need for growing-season sum of daily average temperatures above base temperature (GDD_{10}) of the four varieties of table grapes provide valuable information on the timing of each phenological stage of individual grapevine varieties, but also on the organization of annual wine-growing activities.

INTRODUCTION

The success of the production of table grapes depends not only on the cultivar's performance but also on growing conditions and local climate.

Climate has a pronounced effect on grape and wine composition and quality (Bucur G.M. et al. 2017, Mosetti D. et al. 2016). Mesoclimate can differ between vineyards within a region and depends on factors such as slope, altitude, surrounding vegetation (Marais J. et al.1999, Irimia et al. 2013).

The variability of annual climate conditions influences vegetative growth (Costea D.C., 2006, Mărăcineanu L.C., 2011), phenology (Fraga H. et al. 2016, Van Leeuwen C., 2004), physiology of vine (Dinis L.T. et al. 2014, Greer D.H., 2012), phytosanitary status of vine (Bunea C.D. et al. 2013) and on the vintage variability (Băducă C. et al. 2011 and 2012, Costea D.C. et al. 2010, Teslić N. et al. 2018).

The current study was conducted during the 2015-2017 period, in a V-VII years old vineyard placed in Șimnicu de Sus. Șimnicu de Sus vine growing area is part of *Dealurile Craiovei vineyard*, in *Dealurile Munteniei and Olteni*ei viticultural region (South-West of Romania). Geographically, the studied vineyard is located between the parallels of 44°24'23'' Northern latitude and is crossed by the meridian of 23°48'09'' Eastern longitude.

MATERIAL AND METHODS

Four table grapes varieties of *Vitis vinifera* L. have been studied, Cardinal and Victoria with early season ripening, Muscat de Hamburg and Alphonse Lavallée with mid-season ripening. They were grafted on *Berlandieri x Riparia,* Oppenheim 4 selection

rootstock, with planting distances of 2.2 x 1.2 m, semi-tall training, *Guyot* pruning and an average load of 12-14 buds / m^2.

The experience was organized on the randomized block method with 4 variants representing the studied varieties, 5 vine of each variant, in two repetitions. Maintenance work on the soil and plants were applied uniformly to all

studied varieties.

The climatic indices with influence on the growing and development of vine were used and calculated: annual mean temperature; the Sum of active temperatures (∑ta = sum of daily average temperatures ≥ 10ºC during April 1st to September 30th); the Sum of average temperatures (SAT = (Tmax + Tmin)/2, of mean daily temperatures ≥10ºC from the period 1st Apr – 31st Oct., Jones G.V. et al., 2000); growing degree-day (GDD_{10}) used to predict the vine's capacity of maturing in the northern hemisphere (Amerine M. A, 1980) and calculated using the formula GDD= [(Tmax + Tmin)/2 -10] from the period 1st Apr – 31st Oct. Sunshine duration (hours, April 1st to September 30th), annual rainfall and growing season rainfall, de Martonne aridity index (De Martonne E., 1926), bioclimatic index (Constantinescu G., 1967) and Huglin`s heliothermal index (Huglin P., 1978) were also used and calculated.

Regarding the influence of winter conditions on table grapes varieties, the following parameters were used: level of minimum critical temperatures, the duration and intensity of frost, wind speed and direction. In order to determine the vulnerability of table grapes varieties under critical temperature during winter, the method described by Cichi et al., 2016 was used. The weather data comes from the weather station of Craiova Airport, located 8 km away from the wine-growing area (*http://romanian.wunderground.com/history/airport/LRCV).*

Observations and determinations during the active vegetation period were focused on agrobiological characteristics (proportion of fertile shoots, the absolute and relative fertility coefficients, relative and absolute productivity Index) and phenological characteristics.

For statistical analysis XLSTAT-Pro for Microsoft Excel was used.

RESULTS AND DISCUSSIONS

The sum of the active temperatures (SAT) is considered to be one of the most important thermal parameters in viticulture. SAT is used to assess the viticultural area in correlation with the varieties' ability to ensure the ripening = ability of grapevine varieties and shows variation limits > 2000°C... > 2900°C (Szymanowski M. et al. 2007). We appreciate that from the point of view of the heliothermal resources (STA, SAT, GDD_{10} and hours of insolation) in Simnicu Sus area were favourable conditions for ripening both of table grape varieties with early ripening and table grapes varieties with middle and late ripening (Table 1).

With regard to the table grape varieties requirements, with an annual rainfall of 339.04 mm, of which 141.2 mm during the active vegetation period (1 April to 30 September) the climatic year 2016 is *suboptimal* in terms of the amount of rainfall. Close to the lower limit for grape vine (250 mm minimum rainfall required for unirrigated grapevine growing), the year 2015 (with 434 mm annual rainfall of which 274.5 mm during the growing season) was *moderately optimal* in terms of the amount of rainfall. In relation to the calculated values of *the De Martonne aridity index* for the conventional vegetation period in the grape vine, in the area studied (Table 1), the climate is classified as follows: *semiarid* - in 2015 ($\mathbf{I_{ar}^{DM}}$ = 9.19) and *arid* - in 2016 ($\mathbf{I_{ar}^{DM}}$ = 4.73).

Under the conditions of our country are considered to be restrictive the values $\mathbf{I_{bcv}}$ between 4-6, when it means the existence of low heliothermal resources on the background of high-water resources (Oşlobeanu M. et al. 1991) or higher than 15.0 if

there are no irrigation possibilities. Under the conditions of the vineyard year 2016 the *bioclimatic index of vineyard* (I_{bcv}) exceeded the value of 15, the calculated value being of 22.81 units on the background of increased heliothermal resources and of suboptimal water resources, thus requiring irrigation as a technological measure for the optimal realization of the cultivation of table grapes varieties.

Table 1

Evaluation of suitability of climatic and bioclimatic factors for table grapes in Simnicu de Sus vineyard

Year 2015			Year 2016	
Climatic parameters/ Index	Value	Class	Valori	Class
Annual mean temperature (ºC)	12.54	High favorability	12.12	High favorability
SAT (Sum of average active temperatures, April 1st to October 30th)	3798	High favorability	3710	High favorability
∑ta (Sum of daily average temperatures ≥ 10ºC, April 1st to September 30th)	3565	High favorability	3614	High favorability
Sunshine duration (hours, April 1st to September 30th)	1678	High favorability	1631	High favorability
Annual Rainfall (mm)	436.6	Moderately optimal	339.04	Suboptimal
Rainfall in the growing season (mm, April 1st to September 30th)	274.5	Moderately optimal	141.2	Suboptimal
Martonne Index (I_{ar}^{DM})	9.19	Semiarid climate	4.73	Arid climate
Bioclimatic index Ibcl (Constantinescu)	11.90	High favorability	22.81	Restrictions - irrigation is required
Huglin`s heliothermal index (IH)	2503	IH5- Warm climate	2488	IH5- Warm climate

In relation to the Huglin heliothermic index (IH) in 2015 and 2016, Şimnicu de Sus viticulture area is in the IH 5 - *warm climate class*, which indicates the existence of rich heliothermal resources, which ensure the ripening of the late varieties.

The critical winter conditions during the two dormant seasons (Table 2 and Table 3) caused considerable loss of buds to all table grape varieties studied. The results concerning the buds freezing damages of table grapes during the dormant seasons 2015/2016 and 2016/2017 they are presented as mean ± standard deviation, for variability assessment. Among the varieties, the highest values of the percentage of non-viable buds, following the dormant season of vine of 2015-2016, were recorded in Cardinal variety (63.26 % primary killed buds and 35.38 % secondary killed buds) and Alphonse Lavallée (61.28 % primary killed buds and 37.19 % secondary killed buds). After the dormant season 2016-2017, the largest buds losses were recorded in Cardinal variety (62.31 % primary killed buds and 36.57 % secondary killed buds) and Victoria (60.16 % primary killed buds).

Table 2

The critical minimum temperatures in air during the dormant seasons 2015/2016 and 2016/ 2017 *

Dormant season	Absolute minimum temperature (° C)					
	-15.0… -18.0 ° C		-18.1… -22.0 ° C		-22.1… -24.0 ° C	
	Day	Tma	Day	Tma	Day	Tma
2015/2016	20.I 21.I 23.I 24.I 25.I	- 18.0 - 18.0 - 18.0 - 18.0 - 18.0	19.I	-19.0		
2016/2017	8.I 10.I 12.I	- 16.0 - 18.0 - 16.0	9.I	- 19.0		

* Processing weather data *http://romanian.wunderground.com/history/airport/LRCV*
Tma- absolute minimum temperature

Table 3

Duration and intensity of freezing*

Day	Duration of freezing	Temperature (°C)	Cold Wind (°C)	Wind direction	Wind speed min.-max. (m/s)
2017 Year					
8 January	9h 00min.	-14.0...-16.0	-21.0 ...-24.2	W/ WSW	3.6 - 6.7
9 January	5h 30min.	-14.0...-19.0	-20.0 ...-24.7	E/ NNE	1.0 - 2.1
10 January	9h 00min.	-14.0...-19.0	-19.0 ...-23.5	N/ NNE	0.5 - 1.5
12 January	11h 00min.	-11.0...-16.0	-16.7 ...-21.6	SW/ WSW	2.1 - 4.6

* Processing weather data *http://romanian.wunderground.com/history/airport/LRCV*

The triggering and the duration of the main phenophases of the annual biological cycle are variable from year to year, being influenced by the biological particularities of each variety, as well as by the climatic factors (temperature, insolation, rainfall, relative humidity). Table 5 shows the corresponding time periods with the phenological data for the 4 grapevine varieties selected for the current study, as well as growing grade-day (GDD_{10}) needed for each phenological stage.

Table 4

Buds freezing damages of table grape cultivars during the dormant seasons 2015/2016 and 2016/ 2017

Cultivars	Primary Killed buds (%)		Secondary Killed buds (%)	
	2015/2016	2016/2017	2015/2016	2016/2017
	$\overline{X} \pm s_{\overline{X}}$	$\overline{X} \pm s_{\overline{X}}$	$\overline{X} \pm s_{\overline{X}}$	$\overline{X} \pm s_{\overline{X}}$
Cardinal	63.26±5.89	62.31± 6.08	35.38±3.34	36.57±3.67
Victoria	59.47±5.35	60.16±5.86	38.12±2.83	30.15±2.94
Muscat Hamburg	53.68±6.81	57.39±5.67	31.75±3.46	37.43±3.08
Alphonse Lavallée	61.28±6.37	49.52±5.18	37.19±2.14	37.45±2.75

$\overline{X}$ - mean; $s_{\overline{X}}$ - standard deviation.

Table 5

Phenological data of table grapes varieties (Șimnicu de Sus, average data 2015-2016)

Varieties	Budburst	GDD_{10}	Floraison	GDD_{10} Budburst-Floraison	Veraison	GDD_{10} Bloom-Veraison	Full ripening	GDD_{10}
Cardinal	2 April	20	28 May	251	10 July	548	10 Aug.	1363
Victoria	6 April	39	2 Jun.	297	15 July	562	23 Aug.	1508
Muscat Hamburg	9 April	59	5 Jun.	333	23 July	632	8 Sept.	1672
Alphonse Lavallée	10 April	64	7 Jun.	352	26 July	714	11 Sept.	1716

Depending on the variety, for the budburst (stage 05 Eichhorn & Lorenz) where necessary the cumulation of growing-season sum of daily mean temperatures above the base temperature comprised between 20 GDD_{10} (Cardinal) and 64 GDD_{10} (Alphonse Lavallée).

Floraison (stage 23 Eichhorn & Lorenz) was run from May 28 to June 7, and it is necessary in the interval budburst-floraison the accumulation of a growing season sum of daily mean temperatures above the base temperature between 251 and 352 GDD_{10}.

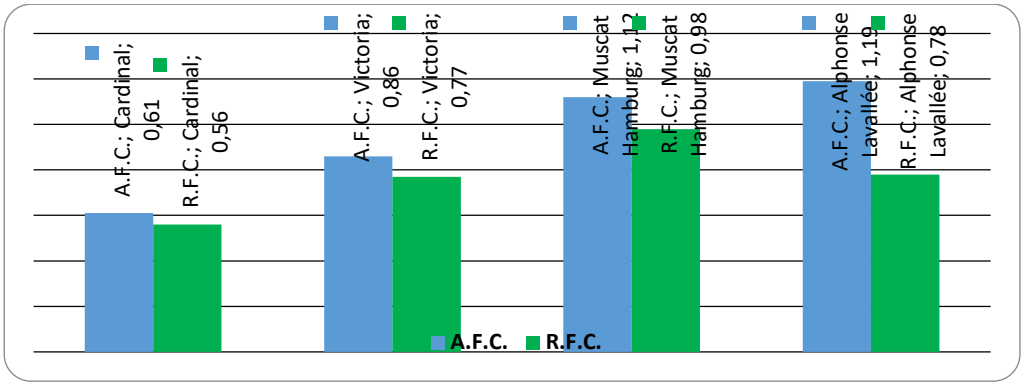
Veraison (stage 35 Eichhorn & Lorenz) was installed between July 10 and August 16. For this phenophase, it was necessary to accumulate in the interval of floraison-veraison of a growth-season sum of daily mean temperatures above the base temperature ranging between 548 and 714 GDD_{10} (Table 5).

Full ripening took place between August 10 and September 11, noting, in particular, the earlier ripeness of the Cardinal variety. To reach the full ripening table grape varieties they needed the accumulation of 1363 GDD_{10} (for Cardinal), and 1508 GDD_{10} for Victoria, and 1672 GDD_{10} for Muscat Hamburg and 1716 GDD_{10} for full ripening of the Alphonse Lavallee cultivar (Table 5).

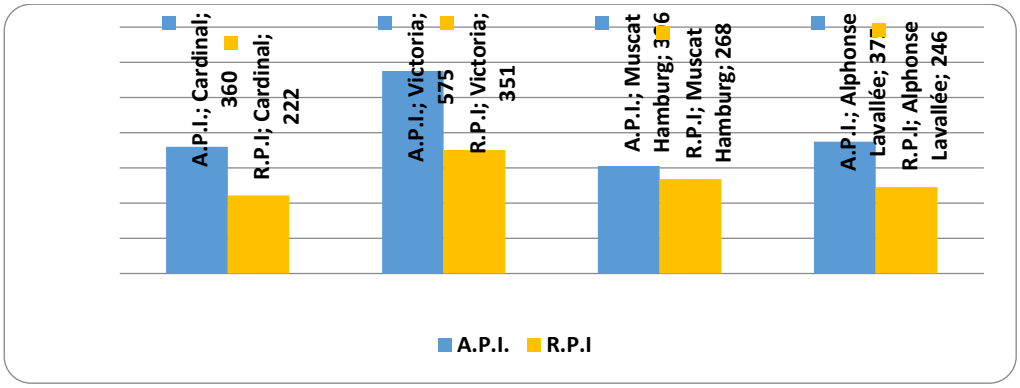
The potential for fructification and productivity of vine they are specific to each variety, being largely influenced by the climatic conditions of the wine year, photoperiodicity and applied technology.

Fertility of shoots has been expressed using the fertility coefficients (figure 1a). The absolute fertility coefficient (A.F.C.) is calculated as the ratio of the number of inflorescences/ vine and number of fertile shoots/ vine. The relative fertility coefficient (R.F.C.) is calculated as the ratio between the number of inflorescences and the total number of shoots on the vine (Cichi et al., 2011). Observations were made after flowering and were expressed as an average of 10 vines / variety.

Relative fertility coefficient had mean values (2015-2017) between 0.56 in the Cardinal variety and 0.98 in the Muscat Hamburg variety, while the absolute fertility coefficient (A.F.C.) had values between 0.61 for the Cardinal variety and 1.19 for the Alphonse Lavallee variety (Figure 1a.).



a.



b.

Figure 1. Fertility and productivity of shoots (average 2015-2017)
(a.- Fertility of shoots: A.F.C.- absolute fertility coefficient, R.F.C.- relative fertility coefficient; b.- Productivity of shoots: A.P.I.- absolute productivity Index, R.P.I.- relative fertility Index)

Productivity of shoots was expressed by productivity indices (figure 1b): the absolute productivity index (A.P.I.) and relative productivity index (R.P.I.). The absolute productivity index (A.P.I.) it was calculated as the product between the average weight of a bunch (expressed in grams) and the absolute fertility coefficient (A.F.C.); the relative productivity index (R.P.I.) as the product between the average weight of a bunch (expressed in grams) and the relative fertility coefficient (R.F.C.). Observations and measurements were made at full ripening.

Regarding the average values recorded for the shoots productivity index for the four grape varieties, they were between 222 in the Cardinal variety and 351 in the Victoria for relative fertility index (R.P.I.). The absolute productivity index (A.P.I.) ranged from 306 to Muscat Hamburg and 575 to the Alphonse Victoria variety (Figure 1b).

Synthetic analysis of the results during the period 2015-2017 regarding the fertility and productivity of the shoots (figure 1), highlights the cumulative effect of the negative impact of the critical temperature conditions during the two dormant seasons (large losses of primary and secondary buds) and hydric deficit in the growing season on the bio-productive potential of the four table grapes varieties. Thus, both the average values of fertility coefficients and productivity indices were below the potential of these

varieties mentioned in the literature or recorded in Dealurile Craiovei vineyard (Cichi D.D. et al. 2011).

CONCLUSIONS

The studied viticulture area has rich heliothermal resources during the vegetation period, which gives it great availability for growing a diversified range of table grape varieties.

The annual climatic variability may generate periods with the negative thermal risk during the dormant season, with implications for vine production. In conclusion, it can be appreciated that in the critical winter conditions in the Şimnicu de Sus area, specific of the two dormant seasons, with hourly thermal values that dropped to -24.7°C at the level of the vine stocks due to the low speed wind, all table grape varieties studied fall into the group with low resistance to frost (over 50 % of the destroyed buds).

The results presented in this study on the need for growing-season sum of daily average temperatures above base temperature (GDD10) of the four varieties of table grapes provide valuable information on the timing of each phenological stage of individual grapevine varieties, but also on the organization of annual wine-growing activities.

REFERENCES

Amerine M. A., Berg H. W., Kunkee R.E., Ough C.S., Singleton V.I., Webb A.D.,1980, The technology of wine making (4th ed.). AVI Publishing Company, Inc., Westport, Conecticut, 795 pp.

Băducă C., Felicia Stoica, Camelia Muntean, 2011, The influence of climatic changes on quality of wines obtained from the Romanian varieties grapes. Lucrări Ştiinţifice USAMV Bucureşti, Seria B, vol. 55: 480-483.

Băducă Campeanu C., Beleniuc G., Simionescu V., Panaitescu L., Grigorica, L., 2012, Climate change effects on ripening process and wine composition in Oltenia's vineyards from Romania. Acta Hortic. 931:47-54.

Bucur Georgeta Mihaela, Liviu Dejeu, 2017, Researches on situation and trends in climate change in South part of Romania and their effects on grapevine, Scientific Papers. Series B, Horticulture. Vol. LXI:243-247

Bunea C.I., Popescu Daniela, Bunea Andrea, Ardelean M., 2013, Variation of attack degree of downy mildew (*Plasmopara viticola*) in five wine grape varieties, under conventional and organic control treatments, Journal: Food, Agriculture and Environment (JFAE), 2013, Vol.11 (3& 4) : 1166 – 1170.

Cichi Daniela Doloris, Monica Vintilescu, Giugea N. Costea D.C., Camelia Popa, 2011, Agrobiological and technological potential of sometable grape varieties in the Banu Maracine vineyard, Annals of the University of Craiova- Biology, Horticulture, Food Produce Processing Technology, Environmental Engineering, vol. XVI (LII): 87-92.

Cichi Daniela Doloris, Costea D.C., Gheorghiu N., 2016, The cold hardiness of some varieties of grapevine cultivated in the viticultural area Plenita (Southwestern Romania). Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series, vol. 46 (no.1): 62-67.

Constantinescu G., 1967, Méthodes et principes de détermination des aptitudes viticoles d'une région et du choix des cépages appropriés. Bull. l'OIV, 441: 1179-1205.

Costea D.C., 2006, Regimul hidric al viței de vie (Cerințe, asigurare, studii) Edit. EUC, Craiova, 182p.

Costea D.C., Cichi Daniela Doloris, Genoiu Elena, Savescu P., Maracineanu L.C. Capruciu D.F., 2010, The influence of the climate variability on the main chemical

compounds defining the quality of the viticulture production, JOURNAL of Horticulture, Forestry and Biotechnology Volume 14 (2): 258-262.

Dinis L.T., Correia C.M., Ferreira H.F., Gonçalves B., Gonçalves I., Coutinho J.F., Ferreira M.I., Malheiro A.C., Moutinho- Pereira J., 2014, Physiological and biochemical responses of Semillon and Muscat Blanc à Petits Grains winegrapes grown under Mediterranean climate. Scientia Horticulturae v. 175 : 128-138

De Martonne E., 1926, Une nouvelle fonction climatologique: L'indice d'aridité. La Meteorologie, 449-458.

Eichhorn K.W., Lorenz H.K., 1977, Phaenologische Entwicklungsstadien der Rebe, Deutsche Weinbau, 1, Sonderdruck

Fraga H., Santos J., Moutinho-Pereira J., Carlos C., Silvestre J., Eiras-Dias J., Malheiro A., 2016, Statistical modelling of grapevine phenology in Portuguese wine regions: Observed trends and climate change projections. The Journal of Agricultural Science, 154(5), 795-811.

Greer D.H., 2012, Modelling leaf photosynthetic and transpiration temperature-dependent responses in *Vitis vinifera* cv. Semillon grapevines growing in hot, irrigated vineyard conditions. *AoB Plants*, *2012*, http://doi.org/10.1093/aobpla/pls009

Huglin P., 1978, Nouveau mode d'évaluation des possibilités héliothermiques d'un milieu viticole. C.R. Acad. Agr.France,64: 1117–1126.

Irimia L., Patriche C.V, Quénol H., 2013, Viticultural zoning: a comparative study regarding the accuracy of different approaches in vineyards climate suitability assessment. Cercetări Agronomice în Moldova, Vol. XLVI , No. 3 (155): 95-106.

Jones G.V., Davis R.E., 2000, Climate influences on grapevine phenology, grape composition, and wine production and quality for Bordeaux, France. Am J Enol Vitic 51, no 3: 249–261

Marais J., Hunter J. J., Haasbroeck P. D., 1999, Effect of canopy microclimate, season and region on Sauvignon blanc grape composition and wine quality. S. Afr. J. Enol. Vitic. 20 (1), 19-30.

Mărăcineanu L.C., 2011, Aplicaţii ale ecologiei în viticultură, Editura Universitaria, Craiova

Mosetti D., Herrera J.C., Sabbatini P., Green A., Alberti G., Peterlunger E., Lisjak K., Castellarin S. D., 2016, Impact of leaf removal after berry set on fruit composition and bunch rot in 'Sauvignon blanc'. Vitis 55: 57–64.

Oşlobeanu M*.,* Macici M*.,* Georgescu Magdalena, Stoian V., 1991, Zonarea soiurilor de viță de vie din România. Edit. Ceres, Bucureşti.

Szymanowski M., Kryza M., Smaza M., 2007, A GIS approach to spatialize selected climatological parameters for wine-growing in Lower Silesia, Poland. Proc. International Scientific Conference, Poľana nad Detvou, Slovakia, September 17 - 20, 2007.

Teslić N., Zinzani G., Parpinello G.P., Versari A., 2018, Climate change trends, grape production, and potential alcohol concentration in wine from the "Romagna Sangiovese" appellation area (Italy). Theor Appl Climatol 131:793–803.

Van Leeuwen C., Friant Ph., Choné X., Tregoat O.,Koundouras S., Dubourdieu D., 2004, Influence of climate, soil, and cultivar on terroir. Am J Enol Vitic., 55-3: 207-217

**** http://romanian.wunderground.com/history/airport/LRCV*

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

CORRELATES REGARDING THE TECHNOLOGICAL QUALITIES OF THE SOME HYBRID ELITES FOR TABLE GRAPES COMPARED WITH PARENTAL VARIETIES

Ciobotea Cristina-Magdalena[1], Popa Camelia[1]

[1*]N.R.D.I.B.H. Stefanesti – Arges, Street Bucharest-Pitesti, No.37, cioboteacristina76@yahoo.com

Keywords: *technological descriptors, hybrid elites, regression coefficients*

ABSTRACT

This paper aims to highlight the superior agrobiologic potential and technologically of 21 hybrid elites, obtained by the hybridization of the varieties Muscat Iantarnîi x Canner (codified HI), Victoria x Black Pearl (codified BP) and Victoria x Victoria (codified A) and compared with the genitors.

Since the hybrid elites selected from the experimental fields, have been highlighted by several descriptors, have been established correlations between all studied technological elements. The weight of the bunch and berry, content of the must in sugars and acidity. The graphical representation of relations between quantitative and qualitative characteristics of hybrid descendants appealing to function regression and the correlation coefficient has highlighted the connections and meaning of the variables.

INTRODUCTION

Because the selected hybrid elites in experimental fields, descendants of three types of hybridization, were highlighted by several descriptors, have been established the correlations between all studied agro biological and technological elements: viability of the buds, total and fertile shoots, the coefficients of fertility absolute and relative, the indices of productivity absolute and relative, the weight of the grapes and berry, content of the must in sugars and acidity (Onea Ciobotea Cristina-Magdalena, 2014).

These determinations require experimental data processing by appropriate statistical methods, which helps to expressing general conclusions only on the basis of individual data. The obtained data are a selection of the ones possible. Based on the data obtained are made, by appropriate statistical and mathematical processing, the general conclusions regarding the behavior of the genotypes of grape vines in interaction with biotic and abiotic factors. It is known that there is a natural variability in all processes and phenomena involved (Gribaudo I., Grando M.S., 2005).

MATERIAL AND METHODS

Pearson correlation was applied (r) that establishing the degree of association between two variables measured on the scale of range / report and show, after a linear model, the intensity and direction of the simultaneously variance of the values of a variable in relation to the other. In case the variable seeks the values of the other variable in direct sense, ascending and descending, then it is manifesting the effect of the correlation of their. Area of variation of Pearson correlation coefficient (r) is between r = -1 (perfect negative correlation) and r = +1 (perfect positive correlation). The absence of

any correlation between variables is presented as r = 0 (Shapiro S.S., Wilk M.B., Chen M.J., 1968). Existing connections from between the different characteristics of the varietiesand elites involved in hybridization, it can be demonstrated using regression coefficients (Pearson) by the method of the squares and correlation coefficients for the recorded data. The graphical representation of relations between quantitative and qualitative characteristics of hybrid descendants, appealing to the function of the regression and coefficient of correlation were revealed the connections and meaning of variables. In order to calculate the coefficient of linear correlation Pearson the priority condition is that the variables be measured on the scale interval / report and which implies the presence of a form of distribution that does not deviate too much from the normal curve (Shapiro S.S., Wilk M.B., Chen M.J., 1968).

RESULTS AND DISCUTIONS

A very significant correlation, intensely positive and linear was found in the case of the weight of 100 berry (g) and weight of a bunch (g). The weight gain of the grapes was positively influenced by the weight of the berries, wich has registered the coefficient of determination with the R^2 = 0.3806 *** value). On the range 270-470 g the weight of the grapes is increasing intense, and the weight of 100 berry is agglomerated in the range 350-650 g, values low and between which include the hybrid varieties. Can not pass unnoticed A16 and A19 elites with the weight of the berry between 14 and 11g (figure 1).

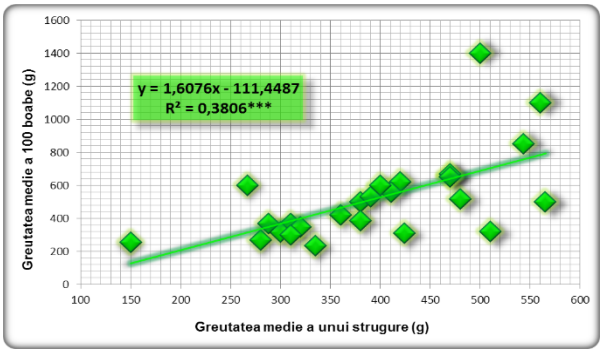


Fig. 1 - Correlation between the average weight of 100 beries and the average weight of a grape

The index of absolutely productivity (IAP) is positively and linear correlated with average weight of a grape (g). The coefficient of determination is highly significant R^2 = 0.7164 ***). In a proportion of 71.64 % of the values of productivity indeces is assigned of the average weight of grapes. More than half of the genotypes distributed, they had amplitude of the variance increased in the range 260-430 and 250-400 g the weight of the bunch and the value I.A.P. Values are grouped into three categories for the weight of bunches and two categories for the indices of the productivity. Muscat Iantarnîi (150 g and 150 I.A.P.) was considerably exceeded by the all presented elites for the two descriptors (figure 2).

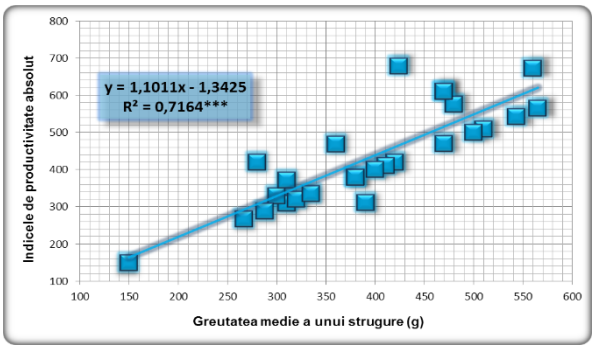


Fig. 2 – Correlation between the absolute productivity index and average weight of a grape

The increase of the glucoacidimetric index values between 30 and 78 a significant increase in the sugars content of the berries between 110 - 220 g / l. The correlation between these two elements (figure 3) is distinct significant positive linear (R^2=0,3177**).

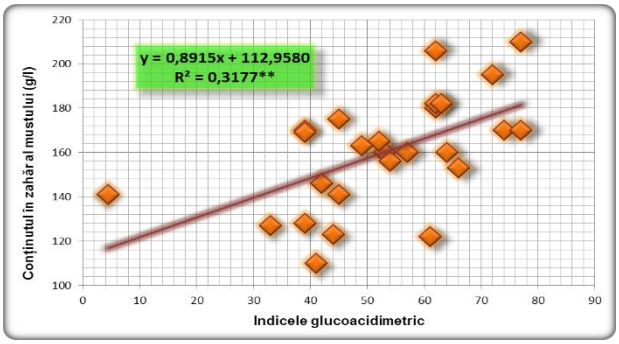


Fig. 3 - Correlation between sugar content of must and the glucoacidimetric index

If from point of view of the content in sugars were big differences between elites: 110 g/l (elite HI13) - 206 (BP8) and 210 (A31), glucoacidimetric indices has grouped them more in the second part of variation line (the range 40-80). A similar situation is encountered approximately in the case of glucoacidimetric correlation between the index and acidity of the must, with the difference that these are negatively correlated. The acidity is higher in the range 1,5-4,5 g / l H_2SO_4 the glucoacidimetric index is low in the range of 80-35 (figure 4).

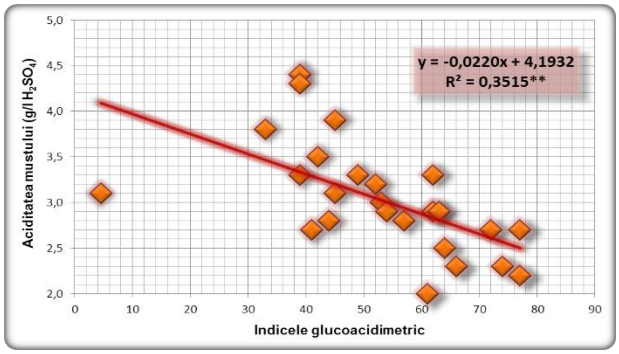


Fig. 4 - Correlation between the acidity of the must and the glucoacidimetric index

CONCLUSIONS

The index of absolutely productivity (I.A.P.) is positively and linear correlated with average weight of a grape (g). The coefficient of determination is highly significant R^2 = 0.7164 ***). More than half of the genotypes distributed, they had amplitude of the variance increased in the range 260-430 and 250-400 g the weight of the bunch and the value I.A.P.

A very significant correlation, intensely positive and linear was found in the case of the weight of 100 berry (g) and weight of a bunch (g). The weight gain of the grapes was positively influenced by the weight of the berries, wich has registered the coefficient of determination with the R^2 = 0.3806 *** value).

The increase of the glucoacidimetric index values between 30 and 78 a significant increase in the sugars content of the berries between 110 - 220 g / l. The correlation between these two elements is distinct significant positive linear (R^2=0,3177**).

REFERENCES

Gribaudo I., Grando M.S., 2005, Caratterizzatione varietale e miglioramento genetico della vite. In: Marenghi M., Manuale di viticoltura, Impianto, gestione, e difesa del vigneto, Edagricole Bologna, 1-15;

Onea (Ciobotea) Cristina-Magdalena, 2014, Study of ampelographic, agro-biological and technological characteristics of the some intra-specific hybrids for table grapes obtained at Stefanesti-Arges, PhD Thesis, University of Craiova, 120; 260-167;

Shapiro S.S., Wilk M.B., Chen M.J., 1968 - A comparative study of various tests for normality. Journal of the American Statistical Association, 63;

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE DETERMINATION OF RESISTANCE TO THERMAL AND OF WATER STRESS TO THE NATIVE VARIETIES OF WATERMELONS

Elena CIUCIUC, Alina Nicoleta PARASCHIV, Mihaela CROITORU

Research-Development Center for Field Crops on Sandys Soils Dabuleni 130, Victoria Street, 207220, Dabuleni, Dolj County, Romania, Phone: +40251334402, Fax: +40251334347, E-mail ccdcpndabuleni@yahoo.com; http://www.ccdcpndabuleni.ro/
Corresponding author: ciuciucelena@yahoo.com

Keywords: *watermelon, water stress.*

ABSTRACT

In the context of climate change, increasing temperatures and reducing precipitation are stress factors for watermelon plants. In order to determine the resistance of native varieties to stress factors, the Dulce Dabulni, Oltenia and De Dabuleni varieties were studied using two watering ceilings: watering according to the technology specific to sandy soils and watering reduced to ½.The main physiological processes number of fruits / plants, the average weight of a fruit, its production and its quality were determined. Under reduced watering conditions, at watermelons reduced their photosynthetic yield, and sweating losses were higher. The number of fruit / plant was maintained at both watering ceilings, instead the average weight of a fruit and the yields produced were higher in the optimally watered variants. At the minimum ceiling, a higher total dry matter and vitamin C was obtained, and at the optimum ceiling, higher levels of soluble dry matter and carbohydrates were obtained. The highest resistance to thermal the stress was due to the Oltenia variety, which achieved an average fruit weight of 6.1 kg / fruit and a production of 38.2 t / ha under conditions of low watering.

INTODUCTION

Variety is one of the basic factors that contribute through the productive potential of producing productions. The exploitation of the productive potential of a variety is achieved through the applied technology, but to a large extent by the degree of adaptability to the natural pedological and climatic conditions specific to the crop area.Cultivating genetically varieties with the risk of non-adaptability to the heat and water stress factors in the sandy soil area implies a great risk for the growers in the area. The introduction of varieties into culture must be done with discernment, depending on the particular ecological plasticity (Pintilie I., 1996, Voican V. şi colab., 1998). In recent years, we are increasingly confronted with the acceleration of drought periods, therefore the increase in crop drought resistance is of particular interest to areas where the drought is negatively affected.

On the whole, drought resistance is manifested by the delay of occurrence of by-flow, by maintaining over a long period of low irrigation and by a slight return to normal turgescence when the water regime improves (Creţu A. et al., 2002).

Climate change causes changes in the physiology and resistance of pathogens in the developmental stages (Prestidge R. A: et al., 1990), while plants are unable to adapt as quickly to changing environmental conditions (Sutherst RW et al., 1996).

The water supply of watermelon crops throughout the growing season is essential for high temperature production due to the lack of precipitation (Yesim E., et al., 2003).

MATERIAL AND METHOD

At the Research-Development Station for Field Crops on Sandy Soils Dabuleni was studie the three varieties of watermelon, creations of the unit (Dulce de Dabuleni, Dabuleni and Oltenia), under the application of two watering rules: reduced watering to 1/2 and applying the watering rules according to the technology .

Was determined: the main physiological processes, the fruit / plant number, the average fruit weight, the watermelon production achieved and the biochemical composition of the fruit

RESULTS AND DISCUSSIONS

In the maximal thriving phenophase, the photosynthetic rate, foliar sweat rate, active radiation in photosynthesis, leaf temperature using the LC Pro + instrument were determined.

Although watermelon is a pretentious species of temperature and is well tolerated by drought, the studied genotypes behave differently at the two watering ceilings.In the irrigated green watermelons according to the technology, at 9 o'clock the photosynthesis rate recorded values between 18.31 µmoli CO_2 /m^2/s at De Dabuleni and 21.91 µmol CO_2/m^2/s at Dulce de Dabuleni at an active radiation between 915 -1124 µmol/m^2/s (Table 1).

Table 1

The daily variation of photosynthesis to watermelons

Watering level	The genotype	RAPh µmol/ m^2/s	Ph µmol CO_2/ m^2/s	RAPh µmol/ m^2/s	Ph µmol CO_2/ m^2/s	RAPh µmol/ m^2/s	Ph µmol CO_2 /m^2/s	Daily average Ph µmol CO_2/m^2 /s
		9 o'clock		129 o'clock		15 o'clock		
Normal watering	Dulce de Dabuleni	915	21.91	1609	10.17	1678	22.25	18.11
	Oltenia	1124	20.88	1784	19.15	1552	18.10	19.37
	De Dabuleni	936	18.31	1648	13.14	1681	17.93	16.46
Reduced watering	Dulce de Dabuleni	1263	16.91	1766	16.18	1526	14.28	15.79
	Oltenia	1039	15.81	1534	5.14	1756	16.17	12.37
	De Dabuleni	1397	18.33	1591	14.91	1475	12.69	15.31

Compared to these, the irrigated watermelons ½ of the normal ceiling recorded lower values of photosynthesis, with values ranging from 15.81-18.33 µmol CO_2/m^2/s. At 12 o'clock, as the leaf temperature increased (reaching an average of 38^0C), the amount of active radiation in photosynthesis increased, recording values between 1534-1784 µmol/m^2/s. Under these conditions, the watermelons have reduced their photosynthetic yield due to the hydroactive closure of the stomata.

At 15 o'clock, although the leaf temperature reached 42^0C, the photosynthetic yield remained high, ranging from 17.93-22.25 µmol CO_2/m^2/s at the plants with the nomal watering and between 12.69-16.17 µmoli CO_2/m^2/s in plants with low watering.

The daily average of photosynthesis shows a more intense synthetic activity in tehnologic wetted plants than those with low watering. The highest rate of photosynthesis was recorded at the Oltenie variety under conditions of normal watering.

The elements that make up the structure of the leaf (mesophile, epidermis and cuticle thickness, number of stomata) play an important role in the photosynthesis process and are specific to each genotype. They generate differences between genotypes on photosynthetic activity under the same ecotope conditions.

Analyzing the diurnal variation of foliar sweat, it is noted that as the stressful action of environmental factors increases throughout the day, the intensity of this physiological process increases (Table 2).

Table 2

The diurnal variation of foliar sweating at green watermelons

Watering level	The genotype	T ^{0}C	Perspi-ration mmol H_2O/ m^2/s	T ^{0}C	Perspi-ration mmol H_2O /m^2/s	T ^{0}C	Perspi-ration mmol H_2O/ m^2/s	Daily average perspi-ration µmol CO_2/m^2 /s
		9 o'clock		129 o'clock		15 o'clock		
Normal watering	Dulce de Dabuleni	28.3	2.13	32.6	1.68	38.3	5,60	3.13
	Oltenia	28.9	2.94	32.9	3.11	38.7	5,41	3.82
	De Dabuleni	29.8	3.44	34.1	2.88	39.2	5,31	3.87
Reduced watering	Dulce de Dabuleni	33.9	4.20	39.5	6.15	41.0	6,80	5.71
	Oltenia	34.2	3.73	39.9	4.73	41.4	6,48	4.98
	De Dabuleni	34.4	2.39	40.5	5.28	41.4	4,80	4.15

The very high June temperatures (which at the leaf level are a few degrees higher than in the air), strong solar radiation, very low air humidity (less than 30 %) have acted as dehydrating forces on the foliar appliance, increasing water losses through foliar sweating.

The foliar sweat rate ranged between 2.13 - 3.44 mmol $H_2O/m^2/s$ at 9 o'clock to optimal watering plants and between 2.39 - 4.20 mmol $H_2O/m^2/s$ to low watering plants. At 12 o'clock, perspiration increased to plants with low watering, with the highest values being recorded at 15 o'clock due to the increase in temperatures. The daily average of sweat indicates the highest values for genotypes in the low-irrigation variant.

The total production of watermelon was determined by the average weight of a fruit according to the technological factors studied, namely the watering level (figure 3).

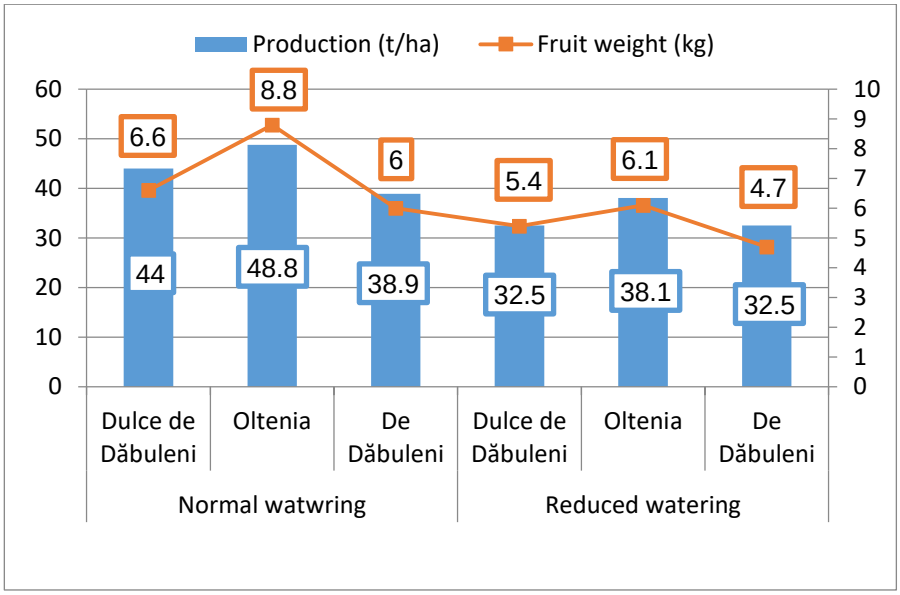


Figure 3: The influence of irrigation level and variety on the weight of a fruit and the production of watermelon

To all three varieties, the production in the technologically wetted version was well above those obtained in the low watering variant. The Dulce de Dăbuleni variety produced a production of 32.5 t/ha and an average fruit weight of 5.4 kg/fruit under reduced watering conditions and 44.3 t/ha and an average fruit weight of 6.6 kg / fruit under optimum watering conditions. The Oltenia variety achieved 38.1 t/ha and an average fruit weight of 6.1 kg/fruit at low watering and 48.8 t/ha and an average fruit weight of 8,8 kg/fruit at optimum watering, and in the Dăbuleni variety yields of 32.5 t/ha and an average fruit weight of 4.7 kg/fruit and 38.9 t/ha respectively were obtained and an average fruit weight of 6 kg/fruit.

It was detached by the weight of the fruit and by the production the Oltenia variety regardless of the level of watering.

In the experimental variants have determined the biochemical composition of watermelon fruits: water content, total dry substance, soluble dry matter, acidity, carbohydrate content and vitamin C (table 3).

The total dry substance showed higher values for the cultivars Dulce de Dăbuleni and Oltenia in the irrigated variant at the optimal ceiling (8.80 % and 8.85 %), but also at the minimum ceiling the fruits accounted for 8.46 % and 8.47 %.

At the De Dabuleni cultivar, a higher dry matter content in the irrigated version was determined in the fruit at the lowest ceiling (10.27 %).

In the fruit of the Dulce de Dăbuleni and Oltenia cultivars in the irrigated variant at the optimal ceiling was also determined a higher content of soluble dry substance and carbohydrates.

The acidity of the fruit of the watermelon was reduced and less influenced by the irrigation system. It ranged from 0.18 grams of malic acid per 100 grams of fresh matter to the Oltenia cultivar in the irrigated variant at the minimum ceiling and 0.42 grams of malic acid per 100 grams of fresh substance at the Dulce de Dabuleni cultivar at the minimum ceiling.

Table 3

The biochemical composition of green melons in function of variety and level of irrigation

Watering level	The genotype	Water (%)	Total dry sub-stance (%)	Soluble dry sub-stance (%)	Acidity (g malic acid at 100g fs)	Carbo-hidrates (%)	C Vitamin (mg/100g fs)
Normal watering	Dulce de Dabuleni	91.54	8.46	8.20	0.42	6.85	9.68
	Oltenia	91.53	8.47	8.20	0.18	6.80	9.68
	De Dabuleni	89.73	10.27	9.00	0.30	7.50	12.32
Normal watering	Dulce de Dabuleni	91.20	8.80	8.48	0.29	7.00	10.56
	Oltenia	91.15	8.85	8.60	0.22	7.18	8.80
	De Dabuleni	91.32	8.68	8.50	0.26	7.10	11.44

Vitamin C content is a character of variety and may be influenced by culture and climatic conditions. It ranged between 8.80 mg / 100g of the fresh substance at the Oltenia cultivar in the irrigated variant at the optimal ceiling and 12.32 mg / 100g of fresh substance at the De Dabuleni cultivar in the irrigated variant at the minimum ceiling.

CONCLUSIONS

The three cultivars, Dăbuleni Dulce de Dăbuleni and Oltenia were created at CCDCPN Dabuleni respond very well to the climatic conditions in the area, even under conditions of thermal-hydro stress.

Applying a small amount of water to the irrigated water has led to the development of a stronger and deeper radicular system with a high absorption capacity, resulting in increased drought resistance to these genotypes.

Ensuring optimal irrigation water determines the photosynthesis process with positive implications for fruit weight, watermelon production and its quality.

ACKNOWLEDGMENT

The paper is a part of the ADER Project 3.3.6. from Sectorial Programme "ADER 2020", funded by Ministry of Agriculture and Rural Development - Romania.

REFERENCES

Creţu A., Creţu L., Simioniuc D., 2002 – Ameliorarea plantelor, producerea şi multiplicarea seminţelor şi materialului săditor. Ed. Ion Ionescu de la Brad, ISBN 9738014069.

Pintilie I., 1996 - Linii noi de ardei gras la SCPL Iţalniţa. Anale ICLF Vidra, vol. XIV, Bucureşti, pg. 233-240.

Prestidge R. A. And Pottinger R. P., 1990 – The impact of Climate Cange on Pests, Diseases, Weeds and Beneficial Organism present in Mew Zealand. MAF Technology, Ruakura Agricultural Center, Hamilton, N.z.

Sutherst R. W., Yonow T., Chakraborty S., O· Donnell C. And White K., 1996 – A generic approach to dening impacts of climate change on pests, weeds and diseases in Australia. In Greenhause, Coping wth Climate Change. W. J. Buoma, G. I. Pearman and M.R. Manning, (Eds). CSIRO, Australia, pp 287-307.

Voican V., Lăcătuş V., 1998 – Cultura protejată a legumelor în sere şi solarii. Editura Ceres, Bucureşti.

Yesim Erdem, A. Nedim Yuksel, 2003 - Yield response of watermelon to irrigation shortageYield response of watermelon to irrigation shortage. Scientica Horticulturae 98(4):365-383. Mexic.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

IN VITRO MICROPROPAGATION OF *OSCULARIA DELTOIDES* SPECIES AND OPPORTUNITIES TO USE IT IN SETTING-UP *IN VITRO* GARDENS

Cosmulescu Sina[1,*], Mîndrilă Gheorghiţa[1], Eciu Mihaela[2]

[1]Horticulture Faculty, University of Craiova, A.I.Cuza Street, 13, 200585, Craiova, Romania
[2 1]Horticulture Faculty, University of Craiova, Master Management and Consultancy in Horticulture and Rural Development Resources, A.I.Cuza Street, 13, 200585, Craiova, Romania
*Corresponding author's email: sinacosmulescu@hotmail.com

Keywords*: Oscularia deltoids, micropropagation, in vitro gardens*

ABSTRACT

To meet the needs of lovers of nature and beauty, and trying to reproduce the image of a garden corner and bring it into enclosed spaces, the paper aimed to study the in vitro behavior and adaptation of some cactus and succulent plants species in different combinations. In setting-up the mini-gardens, the following species have been used: Oscularia deltoides, Opuntia microdasys, Mammillaria duwei and Hatiora salicornioides. Three weeks after inoculation, Oscularia deltoides developed and adapted best in association with Hatiora salicornioides, and the results prove that the studied species can be used successfully in setting up in vitro mini-gardens, both standing alone, and in association with other species. The following studies will focus on finding environmental variants that will keep plantlets alive for as long as possible, with moderate growth, given the limited culture area, as well as on setting-up other combinations with a high decorative effect.

INTRODUCTION

Many species can be micro-propagated *in vitro*, which enables the use of this technique in different areas/directions. One of the practical applications of *in vitro* cultures is to setting-up mini-gardens in closed glass vessels, in a completely sterile environment. Such mini-gardens have been set-up within by Jibou Biological Research Center, using insectivorous plants of *Drosera* and *Pinguicula* species. *Drosera* and *Pinguicula* species respond well to *in vitro* multiplication (Clapa et al., 2009, 2010). A proper micro-propagation protocol is required in order to set-up the gardens. A series of investigations have followed-up the behavior of succulent decorative species under *in vitro* culture. Estrada-Luna et al. (2008) have studied the response of *Opuntia lanigera* species to *in vitro* culture and have established a reliable and efficient micro-propagation protocol for this species. Juárez et al. (2002) have shown that *Opuntia ellisiana* can be successfully micro-propagated and easily acclimatized. *Cereus peruvianus* species was used as a source of explants in order to set-up effective conditions for inducing and keeping callus in a rapid growth state to obtain new plants (Oliveira et al., 1995). Although conventional micro-propagation methods are quite satisfactory for *Hylocereous undatus* species, a micro-propagation protocol has been developed in order to enable rapid creation of clones or improved genotypes (Drew et al., 2000). In *Pelecyphora aselliformis*, a Mexican cactus that is rare and highly appreciated on the commercial market, *in vitro* culture has been set-up using seeds as culture explants (Santos-Diaz et

al., 2003). To meet the needs of lovers of nature and beauty, in trying to reproduce the image of a garden corner and bring it into enclosed spaces (offices, dwellings), the paper aimed at studying the *in vitro* behavior of *Oscularia deltoides* species and analyzing the opportunities to use it in setting-up *in vitro* gardens.

MATERIAL AND METHODS

Material. The species *Hatiora salicornioides*, *Opuntia microdasys*, *Mammillaria duwei*, *Oscularia deltoides* have been used. Biological material used was derived from *in vitro* stabilized culture. In order to obtain the necessary material to setting-up the mini-gardens, the standard stages of *in vitro* culture were followed-up (Cosmulescu, 2002). The research activities have been conducted within the Laboratory of Innovative Techniques and Processes in Biotechnologies (INCESA).

Methods. In conducting the experiments, Murashige and Skoog M-5519 (SIGMA) culture medium was used and supplemented with different concentrations of growth hormones within auxins group (alpha naphthylacetic acid, ANA) and cytokinins (benzylaminopurine, BAP) in different concentrations, depending on the species requirements. Murashige & Skoog medium was also used by Corneanu et al. (1996) for the *in vitro* culture of cactus explants with various supplements. For micro-propagating *Oscularia deltoides* species, 5 variants of medium have been tested, with different hormone concentrations (V1: 0 mg/l ANA, 0 mg/l BAP; V2: 0.5 mg/l ANA, 1 mg/l BAP; V3: 1 mg/l ANA, 2 mg/l BAP; V4: 2 mg/l ANA, 3mg/l BAP; V5: 3 mg/l ANA, 4 mg/l BAP). After inoculation, explants were introduced into the growth chamber (24°C temperature and 16/8 hours photoperiod, 70 % humidity) in order to ensure proper development and evolution of explants.

RESULTS AND DISCUSSIONS

The results of micro-propagation behaviour of *Oscularia deltoides* species are presented in Table 1. Measurements were made 30 days after inoculation and targeted the number of shoots, their length, and callus diameter. The explant diameter has recorded the highest value in the control (2.20 cm), where there was only one shoot on the explant, with no ramifications. Lack of hormones prevented proliferation, the variant 1 having also the largest length of shoots (1.38 cm). Callus formations have been recorded in variants 3, 4 and 5, the highest value for callus diameter being recorded in variant 5, with 1.25 cm diameter. Variant 4 showed a positive influence on the number of shoots (4.4), and negative influence on their length (0.48 cm), therefore the concentration of 2 mg/l of ANA and 3 mg/l of BAP favours the production of non-prolonged shoots that are suitable to setting-up *in vitro* mini-gardens. In order to set-up in vitro mini-gardens, *Oscularia deltoides* was associated with the species *Hatiora salicornioides* with *Opuntia microdasys*, *Mammillaria duwei*. The data obtained are presented in Table 2. Observations in dynamics have been conducted at every one week intervals. It can be noticed that the three cacti species, *Hatiora salicornioides*, *Opuntia microdasys* and *Mamillaria duwei*, had a positive influence on development of *Oscularia deltoides*, during which they recorded vegetative growth in all culture variants. *Osculia* showed proper diameter development and good in vitro compatibility, forming mini-gardens with a special nice appearance (Figure 1, 2).

Table 1

Mean biometric values recorded after 30 days

Var.	Mini-cuttings from shoot tips						
	Ø explant (cm)	Diference	No. of shoots	Diference	Length (cm)	Diference	Ø callus (cm).
1	2.20±0.29	-	1±0	-	1.38±0.16	-	-
2	1.60±0.39	-0,60	3.2±1.92	+2.2	0.72±0.26	-0.66^{ooo}	-
3	1.60±1.38	-0.60	3.2±0.84	+2.2	0.62±0.16	-0.76^{ooo}	1.1
4	1.62±0.54	-0.62	4.4±1.14	+3.4*	0.48±0.13	-0.90^{ooo}	0.5
5	1.00±0.29	-1.20	2.6±0.89	+1.6	0.54±0.13	-0.84^{ooo}	1.25
	DL 5 % =0.96 DL 1 %=1.31 DL 0.1 %=1.82		DL 5 % =2.44 DL 1 %=6.34 DL 0.1 %=8.59		DL 5 % =0.22 DL 1 %=0.30 DL 0.1 %=0.41		

Good behaviour in in vitro culture in the studied species was supported also by other authors (Corneanu and Corneanu, 1994; Corneanu et al., 1996). Micro-propagation in *Mammillaria prolifera* was studied by Vyskot and Jara (1984) by cultivating shoots fragments, including axillary buds, on medium with addition of low concentrations (0.5-5 mg/l) auxins and cytokines, thus producing a direct production of new shoots of axillary meristems.

Table 2

Biometric data recorded in *Oscularia deltoides* in association with *Hatiora salicornioides, Opuntia microdasys* and *Mamillaria duwei*

	Species	Dimensions of initiation explant		Observations in dynamics					
				I		II		III	
		Ø (mm)	h (mm)	Ø (mm)	h (mm)	h (mm)	H (mm)	Ø (mm)	H (mm)
1	*Oscularia deltoides*	10	10	15.3	12.8	18.5	15.6	19.4	20.7
	Hatiora salicornioides	10	10	12.4	12.6	12.6	13.7	13.2	13.9
2	*Oscularia deltoides*	10	10	13.6	12.1	13.2	14.3	15.7	16.8
	Opuntia microdasys	10	10	12.2	16.9	15.5	20.5	17.1	23.4
3	*Oscularia deltoides*	10	10	11.7	14.4	13.1	19.1	14.5	20.2
	Mamillaria duwei	10	10	11.3	11.3	11.5	11.7	11.9	12.1

Three weeks after inoculation, *Oscularia deltoides* developed and best adapted in association with *Hatiora salicornioides*, and the explant increased so that the diameter reached 19.4 mm, with the height of 20.7 mm, i.e. a double increase relative to the explant size at inoculation. A rather rapid increase was also observed in *Opuntia microdasys*, the diameter reaches within 3 weeks the value of 17.1 mm, while the height reaches the value of 23.4 mm. Species of *Opuntia* genus develop well in *in vitro* culture. Juárez et al. (2002) showed that *Opuntia ellisiana* can be successfully micro-propagated, and the shoots obtained had an average length of 10.2 mm after 49 days of culture. The way of development, the colour of explants, the duration of decoration, all indicate that the studied species can be successfully used in *in vitro* mini-gardens (Figure 3.4) both alone and in combination with other species.

CONCLUSIONS

In the mini-gardens, the three cacti species, *Hatiora salicornioides*, *Opuntia microdasys* and *Mamillaria duwei*, had a positive influence on the development of *Oscularia deltoides*. Studies in this area are just starting out, which is why we need to find some environmental variants that keep the plantlets alive for as long as possible, with moderate growth, given the limited culture space. Research has shown that the *in vitro* culture technique can ensure the setting-up of "*in vitro"* mini-gardens, bringing in new trends in plant biotechnology.

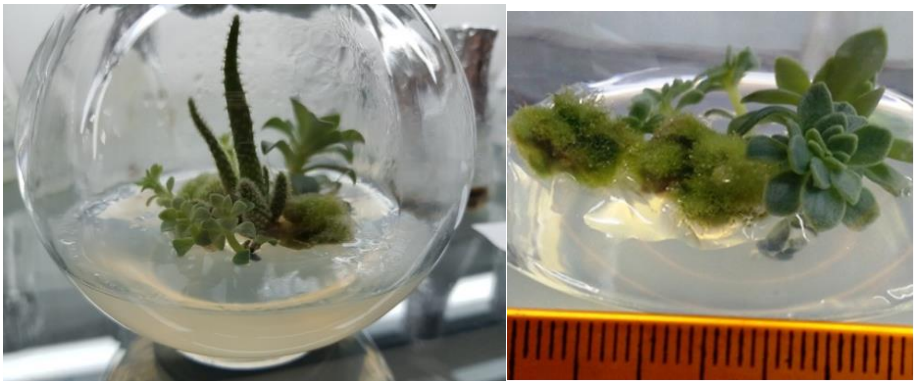


Figure 1-2. *in vitro* mini-garden

Figure 3-4. Variants of *in vitro* mini-gardens

REFERENCES

Clapa D., Fira A., Pacurar I. (2010). In vitro multiplication, conservation and ex vitro acclimation of *Drosera rotundifolia*. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca Horticulture 66(1):34-39.

Clapa D., Fira A., Pacurar I. (2010). In vitro propagation of *Pinguicula vulgaris*. Bulletin UASVM Horticulture 67(1):330-335.

Corneanu M., Corneanu G., Morariu V, Cosmulescu S, Badica C, Bica D., Vekaş L. (1996). The effect of biocompatible magnetic fluids on in vitro culture in *Mammillaria duwei* (*Cactaceae*) in the conditions of a near-null geomagnetic field. Revue Roumaine de Biologie, Série de biologie végétale 4:53-58.

Corneanu M.,Corneanu G.C. (1994). *In vitro* culture of *Cactaceae* through different explants types. In: Proceedings of the 8th National Symposium of Industrial Microbiology and Biotechnology, Bucharest:443-445.

Cosmulescu S. (2002). Aplicaţii ale biotehnologiilor în pomicultură. Editura Reprograph.

Drew R.A., Azimi M. (2000). Micropropagation of red pitaya (*Hylocereous undatus*). In International Symposium on Tropical and Subtropical Fruits 575:93-98.

Estrada-Luna A.A., Jesús Martínez-Hernández J., Torres-Torres M.E., Chable-Moreno F. (2008). In vitro micropropagation of the ornamental prickly pear cactus *Opuntia lanigera* Salm–Dyck and effects of sprayed GA 3 after transplantation to ex vitro conditions. Scientia Horticulturae 117(4):378-385.

Juárez M.C., Passera C.B. (2002). In vitro propagation of *Opuntia ellisiana* Griff. and acclimatization to field conditions. Biocell 26(3):319-324.

Oliveira S.A., Silva M.D., Prioli A.J., Mangolin C.A. (1995). In vitro propagation of *Cereus peruvianus* Mill. (*Cactaceae*). In Vitro Cellular & Developmental Biology-Plant 31(1):47-50.

Santos-Díaz M., Méndez-Ontiveros R., Arredondo-Gómez A., Santos-Díaz M. 2003. In vitro organogenesis of *Pelecyphora aselliformis* Erhenberg (*Cactaceae*). In Vitro Cellular and Developmental Biology-Plant 39(5):480-484.

Vyskot B., Jara Z. (1984). Clonal propagation of cacti through axillary buds in vitro. Journal of Horticultural Science 59(3):449-452.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

STUDIES ON THE EFFECT OF ECOCLIMATIC RESOURCES OF VITICULTURAL AREAS ON YOUNG GRAPEVINE GROWING

Costea Dorin Constantin[1*], Iordan Roxana[1],

*University of Craiova, Faculty of Horticulture,
University of Craiova, Faculty of Horticulture, Master M.C.H.D.R
** Correspondence author. E-mail: dinuc3@gmail.com*

Keywords: *ecoclimatic resources, quality, grapevine growing*

ABSTRACT

The areas favourable to grapevine cultivation have most various pedoclimatic conditions which, correlated with the ecological requirements of varieties and parent stocks, are key elements in obtaining high level production of grapes and wine in terms of both quantity and quality. The quality of viticultural and wine-making products depends to a great extent on the environmental conditions that leave their mark on production areas (regions, vineyards, viticultural centres, etc.).The paper presents the results obtained by applying the studies on young grapevine growing in the Banu Mărăcine viticultural centre

INTRODUCTION

It is widely recognized that *Vitis vinifera (L).* is a specie very sensitive to climate change, so that it has been elected as a valuable bio-indicator. Climate is a key terroir determinant that affects yearly productions, grape quality traits and, indirectly, resource management and vineyard agroecosystem (Biasi R, et al 2016)

The ecoclimatic conditions influence the development of the physiological and biochemical processes inside the plant, determine the length of the vegetation period, influence the hydro-mineral feeding system, the quality of crops, and offer singularity to the grapes and wines obtained on a certain area, expressed by the specificity of the viticultural area Grapevine cultivation with superior productive results requires, besides the biological characteristics of the cultivated soil, the continuous appreciation of the ecological favourablness of the space used for this purpose, in order to identify and then apply the most appropriate counter measures according to the variation of the ecoclimatic conditions Bora. et al(2014), Cichi D et al (2006,2016), Costea D.C. et al, (2008,2015,) Lung M et al (2012) .

In order to perform durable and sustainable viticulture, studies were made trying to identify the reaction of grapevine under conditions of the ecoclimatic resources.Vintners try to encourage the vine resistance and self-adaptation by restoring the complex ecological net of relations between the vine and its whole environment in order to enhance its compensation capacity Geneviève Teil,(2016), Giugea et al, (2015) Ollat N et all (2016), Schaller, K (2001), Seguin G. (1986), Stan, S et al (2011).

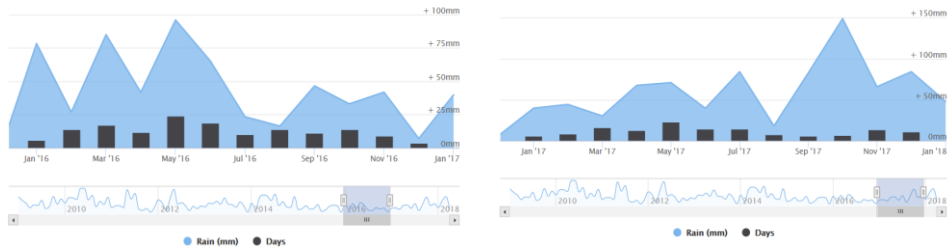
MATERIAL AND METHODS

In accordance with the research topic proposed, the observations and determinations focused on: monitoring climatic factors (mostly hydric supply) for the evaluation of the favourableness of the study years and the classification of the years according to this criterion; studying the influence of the varied ecoclimatic resources characteristic to the study years on the bioproductive parameters.The observations and determinations were conducted at Banu Mărăcine viticultural centre in the vineyard set up in 2016 (during the second and third year after its creation) for high quality wines, such as Tămâioasă românească and Chardonnay varieties, that were grafted onto rootstock Berlandieri x Riparia selection Oppenheim 4 (SO4). The experimental variants consisted in keeping a different number of main shoots (2-4) on the plant after the weeding operation was performed.The recording of the climatic data was made in the existent meteorological network.The effect of the varied ecoclimatic resources on the studied varieties (Chardonnay, Tămâioasă românească) was evaluated through the analysis of the following indicators: *biological*- shoot growth; physiological (the intensity of photosynthesis), bioproductive parameters – bud fertility.

RESULTS AND DISCUSSIONS

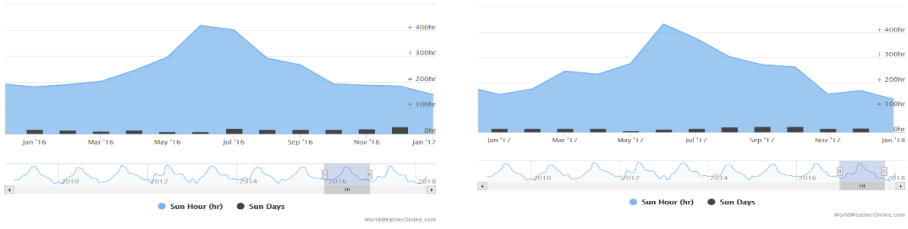
The monitoring of the ecological offer has great importance, given the fact that by permanently knowing the condition of the viticultural ecosystems we could move on to their rational and ecological use. The monitoring has the role of effectively finding any change that occurs in the arrea, offering the posibility to clarify the cause of the change, in order to adopt certain protective measures that allow the maintenance of a durable balance of the ecosystems in the area.

Climate data for the Banu Mărăcine viticultural centre, for years of study are shown in the graphs below(graphs 1-3) (by www.worldweatheronline.com)



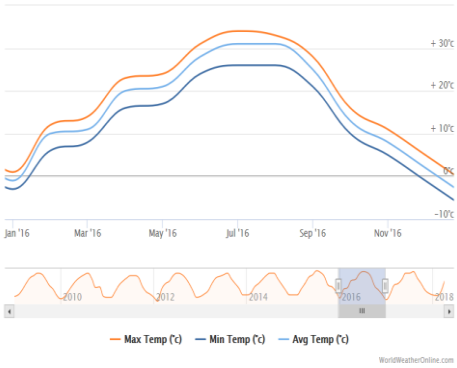
2016 2017

Graph. 1 –Monthly precipitation and rainfall days

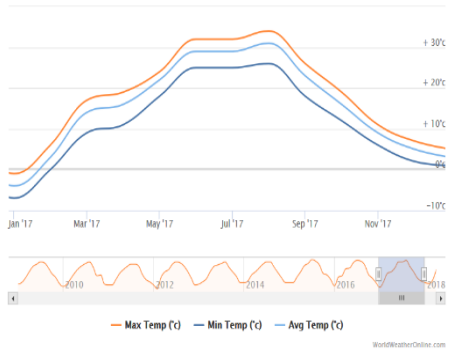


2016 2017

Graph. 2 – Monthly sun hours and sun days



2016



2017

Graph. 3 Monthly high, low and average temperatures

An analysis of the data indicated in the graphs above shows that Banu Mărăcine viticultural centre has met the climate conditions required for high quality grape yields.

The differences found in the length of matured and unmatured canes amongst the varieties under study are shown in Figure 1. The analysis of the results obtained indicates that the Tămâioasă românească variety had bigger growths in comparison with the Muscat Chardonnay variety. Such results may be explained by the fact that the growth vigour of Tămâioasă românească is bigger than that of Chardonnay, as well as by the fact that the vegetation process of Chardonnay had a later start compared with Tămâioasă românească.

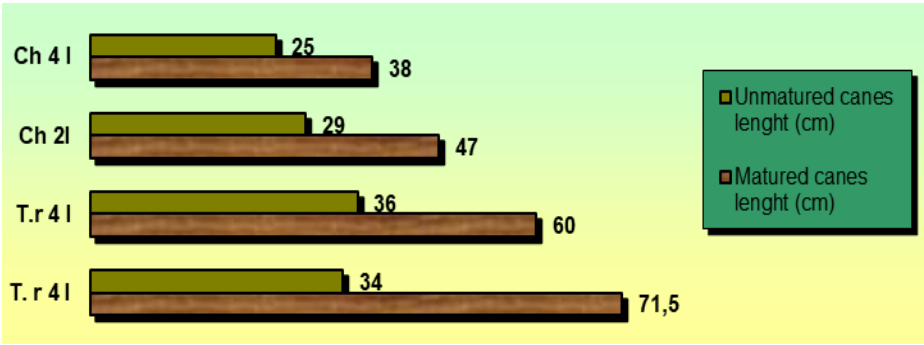


Figure 1. The length increase of canes (matured and unmatured)

The water known in its two forms as imbibition and hygroscopic water had a significant role in the study of the physiological process of adjustment to low temperatures during vegetative rest. The results obtained with regard to the dynamic of the water content during the vegetative rest are shown in Table 1.

Bigger content of imbibition water was found in canes in case of Tămâioasă românească (47 – 42 %), as well as a higher sensitivity to low temperatures compared with Chardonnay where the content of imbibition water was 40.3 and 38.9 % respectively.

Table 1

Content of imbibition and hygroscopic water in shoots during the vegetative rest

Variants	Imbibition water	Hygroscopic water	Imbibition water / Hygroscopic water
Tămâioasă românească 2l	47	6.3	0.13
Tămâioasă românească 4l	42	6.1	0.14
Chardonnay 2l	40.3	5.7	0.14
Chardonnay 4l	38.9	5.6	0.15

The analysis of the bud fertility of varieties under study was made in the spring of 2018, during the third year after planting in the early vegetation period.

The values of the relative bud fertility coefficient vary depending on the genetic characteristics of the variety in question, the vegetative growths, as well as on the quantity and quality of last year metabolites, being determined by the ecoclimatic and pedological resources. Chardonnay had higher values of relative bud fertility coefficient (approx.1.1) as compared to Tămâioasă românească (0.6-0.7)

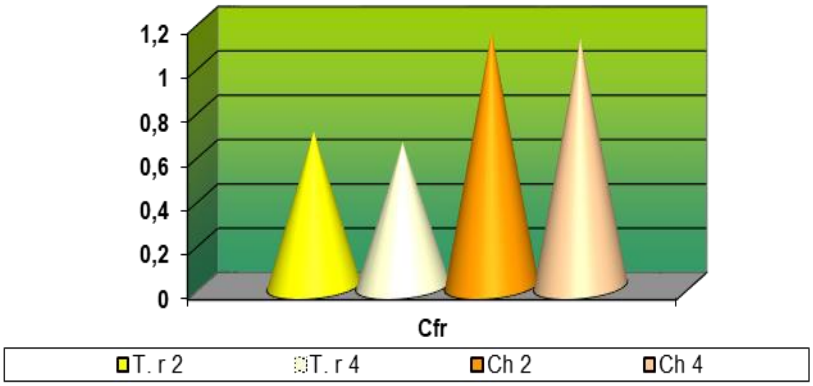
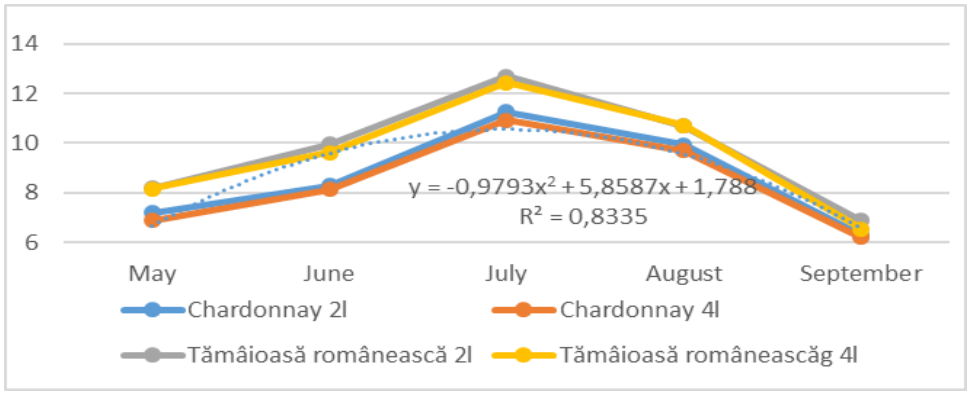


Figure 2. The analysis of the bud fertility of varieties

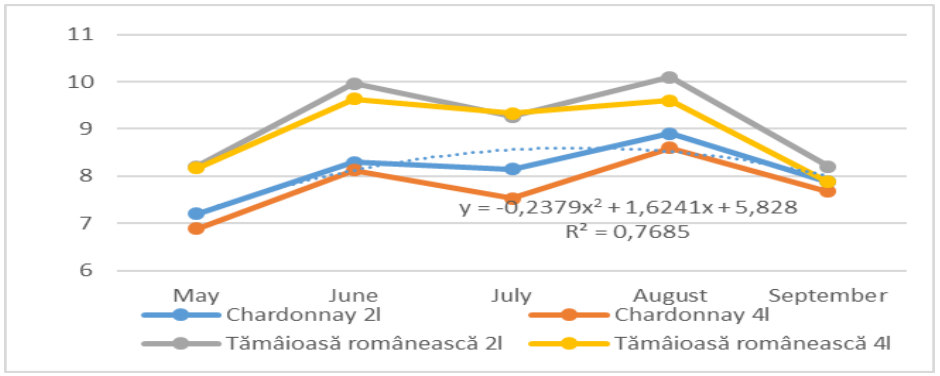
The intensity of the photosynthesis process.

The results obtained with the MINI PAM equipment during May – September indicated an increase of the photosynthesis intensity in 2016 until the month of July, after which the values started to decrease. In 2017, as result of the low hydric supply as compared with 2016, the photosynthesis process developed at lower intensity rates compared to year 2017 – Figure 3.

The differences between 2 and 4-shoot variants are very small, yet a higher intensity of the photosynthesis process has been noticed in case of Tămâioasă românească as compared with Chardonnay – Figure 3.



2016



2017

Figure 3. The intensity of the photosynthesis process- yearly dynamics

CONCLUSIONS

Climate has a predominant role on the growth and development of grapevines. One of the most direct effects of climate change on grapevines is the change in onset phenology and the length of the growth season, which has further influences on the grapevine metabolism, grape quality and productivity. The knowledge and modeling of those changes may be a key tool to plan viticultural management practices in the near future under variate climate scenarios.

The study made during 2016-2018 allows us to draw the following conclusions:

- Both the length of matured and unmatured shoots are bigger in the variety with stronger growth vigour, as well as in case of the 2-shoot post weeding variant.
- The overall analysis of the variants in terms of starch and imbibition water contents leads to the conclusion that the variety, where the starch hydrolysis is stronger and the content of imbibition water in shoots during the vegetative rest period is higher, is more sensitive at lower temperatures in comparison with other varieties.
- One can notice a more intense photosynthesis in case of the variety where the quantity of metabolites is bigger and the growths are higher and with yet very low differences between the 2 and 4-shoot variants.

REFERENCES

Biasi,R, Brunori E., L. Salvati, 2016. Climate change in a Mediterranean grape-wine growing area: understanding variation in varietal phenology, berry maturation and health, Climwine international symposium, Bordeaux

Bora,F.D, Pop Tiberia Ioana, Bunea C.I, Delia-Elena Urcan, Anca Babeş, Cozmuta, I., Anca Mihaly-Cozmuta, Nastasia Pop,2014, Influence of ecoclimatic and ecopedological conditions on quality of white wine grape varieties from North-West of Romania, Bulletin UASVM Horticulture 71(2)

Cichi Daniela Doloris,2006, Modificările termice din ecosistemul viticol (cauze, efecte asupra viţei de vie), Editura Universitaria Craiova, 280 p

Cichi Daniela Doloris, Olteanu I, Costea D.C., 2006, Monitoring of the thermic stress parameters in Dealurile Craiovei vineyards and their impact on grape vines, Lucrări Ştiinţifice, Seria Horticultură, Anul XLIX vol. 1 (49): 693-699

Cichi Daniela Doloris, Costea D.C., Gheorghiu N., 2016, The cold hardiness of some varieties of grapevine cultivated in the viticultural area Plenita (Southwestern Romania). Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series, vol. 46 (no.1): 62-67

Costea,D.C, Daniela Cichi, 2008. Cultura vitei de vie în conditiile modificărilor climatice, edit ARVES, Craiova, ISBN 978-606-518-068-0

Costea D., Daniela Doloris Cichi, Ramona Capruciu, Elena Genoiu, 2008- The influence of the hydro-termal regime over bioproductive parameters of Feteasca neagra variety cultivated at Banu Maracine viticultural centre, Bulletin UASMV Horticulture, vol. 65(1):530,I ISSN 1843-5254

Costea D.C, Căpruciu Ramona, Cichi Daniela Doloris, 2015. The influence of the variation of climate conditions over the growth and fruit bearing of Cabernet sauvignon variety, Analele Universitatii din Craiova, Seria Biologie, Horticultura, Tehnologia Prelucrarii Produselor Agricole, Ingineria mediului, pp 107-112, Vol. XX ,ISSN 1453-127

Giugea N., Mărăcineanu, L.C, Camelia Popa, 2015, The possibilities of multiple characterization of the ecological potential of a viticulture region by graphic and numerical methods., Journal of Horticulture, Forestry and Biotechnology, pp 74-78

Lung M, Pop N, Ciobanu F, Babeș A, Bunea CI, Lazar S, 2012. Environmental factors influence on quality of wine grape varieties in four different areas of culture. Bulletin UASMV Horticulture, 69(1):219-22

Ollat,N, Garcia de Cortazar Atauri, I, Touzard, J,M. 2016 Sustainable grape and wine production in the context of climate change, Climwine int. symp., Bordeaux

Schaller K ,2011. Quality of grapevines – Endogenous and exogenous factors and their differing influences. Bulletin UASVM Horticulture, 68(1): 177-184

Seguin G.1986. ”Terroirs” and pedology of vinegrowing. Experientia, 42:861-873

Stan S., Giugea N., Mărăcineanu L.,Costea D., Popa C, 2011 Dynamics of some biotope factors that characterize the Viticultural center Banu Maracine**,** Analele Universitatii din Craiova, Seria Biologie, Horticultura, Tehnologia Prelucrarii Produselor Agricole, Ingineria mediului, Vol. XV (LXII) , pp 404-409, ISSN 1453-1275

Teil, Geneviève , 2016 Climate change and adaptation: Alsace and Loire Valley vintners’ challenging point of view, Climwine international symposium, Bordeaux

***https://www.worldweatheronline.com/craiova-weather-averages/dolj/ro.aspx

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

INFLUENCE OF PHYTOSANITARY TREATMENTS ON THE TUBERS PRODUCTION AND OF QUALITY AT SWEET POTATO (IPOMOEA BATATAS [L] LAM.) CULTIVATED ON SANDY SOIL

Gh. Coteţ [1*], Aurelia Diaconu[1], Reta Drăghici[1], Mihaela Croitoru[1], Rodi Mitrea[2]

[1]Research and Development Station for Plant Culture on Sands Dabuleni
[2]University of Craiova, Faculty of Horticulture
*Corresponding author email : georgecotet@yahoo.ro

Keywords*: sweet potato, phytosanitary treatment, quality, slips*

ABSTRACT

Sweet potato (Ipomoea batatas) is a dicotyledonous plant belonging to the Convolvulaceae family, being the only one of over 1,000 species of this family of major economic importance. Under the pedo-climatic conditions of 2017, RDSPCS DĂBULENI set up this experience, which shows the importance of planting the shoots obtained by planting the tubers in the previously disinfected solarium with Basamid 5G (Dazomet 97 %), applied at a dose of 5 kilograms/100 m ^{2}.

Following the harvesting of the production on variants, the qualitative indices of the sweet potato tubers were established. The production obtained from applying the chemical treatments on the culture set up with shoots obtained on Basamid 5G-treated soil (20 days before the planting of the tubers in the solar) was distinctly significant compared to that obtained in the crop with shoots on untreated soil.

INTRODUCTION

Sweet Potato (Ipomoea batatas [L.] Lam) is a drought-resistant plant with vigorous growth and high productivity, adaptable to sandy soils (Iamandei Maria et al., 2014). It is one of the most important foods due to its high yields, high nutritional value and the ability to tolerate difficult environmental conditions (Date and Eronico, 1987; Waribo and Ogidi, 2014). Of the total of 105.2 million tones of sweet potato produced globally in 2016, 67 % was produced in China (70.6 million tones) (FAOSAT, 2018). From the point of view of the risk of disease and pests, the literature indicates that the most important symptoms appear on the tuberous roots. In North Carolina, the most important economic losses are those produced by viruses, nematodes, root fusariosis and root rot (Clark, C.A., and Moyer, J.W. 1988). Sweet potato is attacked by around 300 species of arthropods (Talekar, 1991) that of can cause severe to complete crop loss, as well as at Least 30 Diseases (Clark et al., 2013; Johnson & Gurr, 2016).

The significance of the quality of the biological material of sweet potato used in planting (shoots) is also reflected in the local researches carried out at INCDCSZ Braşov, (Cioloca Mihaela et al., 2013). Sweet potato is vulnerable to diseases caused by viruses, such as the Sweet Potato Feathery Mottle Virus (SPFMV), which causes the greatest loss of production (Karyeija et al., 1998, Usugi et al., 1994). Sweet potato production may be affected by viral diseases, harmful insects and weeds (Harrison and Jackson, 2011; Iamandei Maria et al., 2014). During the growing season, 51 species of anthropods

(Iamandei Maria et al., 2014) were identified in the sweet potato cultivated on the sandy soil of RDSPCS Dăbuleni in 2013. At the same fields, Fusarium stem rot was noticed in 2016 (Boiu-Sicuia Oana Alina et al., 2017).

MATERIAL AND METHODS

Pests and diseases of sweetpotato are generally well controlled using approaches such as clean planting material and monitoring with pheromone traps and pesticides (Clark et al., 2013). For the establishment of the experiment in the field, sweet potato shoots were obtained in solar conditions. In this regard, two variants of shoots were studied: planting of sweet potato tubers in untreated field and planting in field treated with Basamid 5G, a nematicide, insecticide, fungicide and herbicide soil sterilization. Basamid 5G has a fungical effect on Phytopthora parasitica, Fusarium spp. and Verticilium dahliae, and insecticide effect on Meloidogyne icognita. For this purpose, the product was applied at the beginning of March when the temperature exceeded 6° C in a dose of 5 kilograms/100 m^2 by spreading on the wet soil surface, then being incorporated into the soil with the cultivator. To stimulate the herbicidal action and to retain the sterilizing gas for as long as possible in the soil, the treated soil surface was covered with PE foil until March 25th. At the planting, the Korean KSP1 sweet potato variety was used. After the planting of the tubers, the aim was to create an optimal microclimate in the solar, with temperatures of about 25-28° C during the day, through ventilation and irrigation works, and at 12° C minimum temperatures overnight by double protection in the tunnel, covered with PE foil. Sweet potato shoots were harvested about 40-45 days after the tuber planting, when they were 30-35 cm long and 6-7 knots. For ease of field planting, the shoots were bundled 100 pieces, kept for 24 hours at a temperature of 20° C, upright and planted in the field on the 2nd day after 17-18 o"clock. The experience has been placed on bilonated ground, under drip irrigation conditions, according to the two-factor subdivision parcel method. (Table 1). The planting was performed on a sandy soil with reduced natural fertility, being fertilized with $N_{150}P_{80}K_{80}$ prior to making the billoons. In order to ensure a high rooting percentage of the shoots, an optimal soil moisture was obtained before and after planting with about 200 m^3 of water per hectare. The quantity and quality of tuber production was determined at 120 days from planting and the results obtained were interpreted by variance analysis and mathematical functions.

RESULTS AND DISCUSSIONS

Under the pedo-climatic conditions of 2017, RDSPCS DĂBULENI we have set up this experience, which shows the importance of planting the shoots obtained by planting the tubers in the previously disinfected solarium with Basamid 5G (Dazomet 97 %), applied at a dose of 5 kilograms/100 m^2. Following the harvesting of the production on variants, the qualitative indices of the sweet potato tubers were established. The production obtained from applying the chemical treatments on the culture set up with shoots obtained on Basamid 5G-treated soil (20 days before the planting of the tubers in the solar) was distinctly significant compared to that obtained in the crop with shoots on untreated soilThe dynamics of the vine green moth flight (Lobesia botrana Den et Schiff.) comprised 3 peaks corresponding to the three generations and for each there has been applied a treatment.

Table 1

Variants of chemical treatment of sweet potatoes

SOIL TREATMENT	VARIANT	TREATMENT IN VEGETATION	DOSES (kg/ha)
Basamid 5G (Dazomet 97 %) 5 kilograms/100 m ^{2}	V1	Untreated	-
	V2	Topsin 70 PU (70 % Tiofanat Metil)	1
	V3	Actara 25WDG (Thiametoxam 25 %)	0,2
	V4	Topsin +Actara	1 +0,2
	V5	Topsin+Actara+Signum (Boscalid 26.7 %+Piraclostrobin 6,7 %)	1+0,2+1,5
Untreated Soil	V1	Untreated	-
	V2	Topsin 70 PU (70 % Tiofanat Metil)	1
	V3	Actara 25 WDG (Thiametoxam 25 %)	0,2
	V4	Topsin 70 PU +actara 25 WDG	1 +0,2
	V5	Topsin+Actara+Signum (Boscalid 26.7 %+Piraclostrobin 6,7 %)	1+0,2+1,5

The production results obtained at the harvesting of sweet potato tubers highlight the variant in which sweetpotato shoots were planted on Basamid 5G treated soil at 5 kg / 100 m ^{2} with a production difference of 7.937 t / ha, distinct significantly, compared to the shoots obtained on untreated soil (Table 2).

The percentage of large tubers ranged between 42.85 % and 85.29 %, weighing between 0.51 - 1.08 kg / plant and the diameter between 3.6 - 5.8 cm, the maximum values being obtained only in the variants set up with shoots obtained on Basamid 5G treated soil, indicating that soil treatment with Basamid 5G resulted in vigorous shoots that were protected against disease and during the vegetation period (Table 3).

Table 2

Average yield on the two ways of obtaining shoots

Soil Treatment	Production Average	Difference	Significance
Basamid 5G (DAZOMET 97 %)	32,996	7,937	**
Untreated soil	25,058	Mt	
LSD 5 %=1,281 t/ha; LSD 1 %=2,959 t/ha; LSD 0,1 %=9,416 t/ha			

Table 3

Gravimetric determinations on sweet potato tubers

Soil Treatment	Treatment In Vegetation	Medium Weight Tubers (Kg)		Diameter Trading Tubers (Cm)	Procent Large Tubers (%)
		Large	Small		
Basamid 5G (Dazomet 97 %)	Untreated	0,52	0,14	5,46	51,02
	Topsin 70 PU	0,82	0,04	5,46	85,29
	Actara 25WDG	0,76	0,19	5,8	48,71

	Topsin 70 PU+Actara 25WDG	0,81	0,13	5,63	50
	Topsin 70 PU+Actara 25WDG+Signum	1,08	0,05	5,43	78,78
Untreated soil	Untreated	0,50	0,10	3,56	50
	Topsin 70 PU	0,54	0,27	5,86	42,85
	Actara 25WDG	0,62	0,08	5,7	74,07
	Topsin 70 PU+actara 25WDG	0,51	0,12	4,76	52,94
	Topsin 70 PU+Actara 25WDG+Signum	0,58	0,12	5,9	57,89

Analyzing the effect of soil treatment in the same chemical treatment in vegetation, the positive effect on the production of tubers in sweet potato of Basamid 5G 5 kg / 100 m^2 is clearly distinguished. Thus, compared to the untreated witness, production differences of 3.071-12.026 t / ha, statistically assured as distinct and very significant (Table 4), were recorded through the planting of shoots obtained on the Basamid 5G treated soil. Soil treatment with Basamid 5G - as a technological element in the production of sweet potato shoots influenced not only the growth and development of the plants in the field but also the accumulation of assimilated in tubers. The results obtained are presented in Table 5. In the variants where the plants were treated with different pest and disease control products and the soil on which the plants were obtained was treated with Basamid, higher values of the main biochemical components studied were obtained . When the soil was untreated with Basamid, in all variants where disease and pest control treatments were performed, better tubercular quality results were obtained compared to the untreated control variant. The best results were obtained in the version treated with Topsin 1kg / ha + Actara 0.2kg / ha.

Table 4

Differences between treatment options depending on how the shoots are used for planting

Treatment in vegetation	**Soil treatment**	**Average t/ha**	**Difference t/ha**	**Significance**
Untreated	Basamid 5G	29,281	7,712	***
	Untreated soil	21,568	Mt	
Production Average		25,424		
Topsin 70 PU	Basamid 5G	33,738	5,633	***
	Untreated soil	28,104	Mt	
Production Average		30,921		
Actara 25WDG	Basamid 5G	31,241	3,071	**
	Untreated soil	28,169	Mt	
Production Average		29,705		

Topsin 70 PU+Actara 25WDG	Basamid 5G	33,071	12,026	***
	Untreated soil	21,045	Mt	
Production Average		27,058		
Topsin 70 PU+ACTARA 25WDG+Signum	Basamid 5G	37,647	11,241	***
	Untreated soil	26,405	Mt	
Production Average		32,026		
LSD5 %=1,446 t/ha; LSD1 %=2,295 t/ha; LSD 0,1 %=4,296 t/ha				

Between the accumulation of total dry substance in tubers, in the variants treated with pest and disease products, polynomial correlations with significant correlation factors (Figure 1) were established on the two soil types. The total dry matter quantity increases in all treated variants as compared to the control leaflet, and the correlation factor is higher for plants from the Basamid treated soil (0.99 ** vs. 0.93 *). Between the accumulation of starch in tubers, in the variants treated with diseases against pests and diseases, polynomial correlations with significant correlation factors (Figure 2) were established on the two soil types. The amount of starch increases in all treated variants compared to the control leaflet, and the correlation factor is very significant for plants from Basamid treated soil (0.97 **) compared to untreated soil, where the correlation factor is insignificant (r = 0.83).

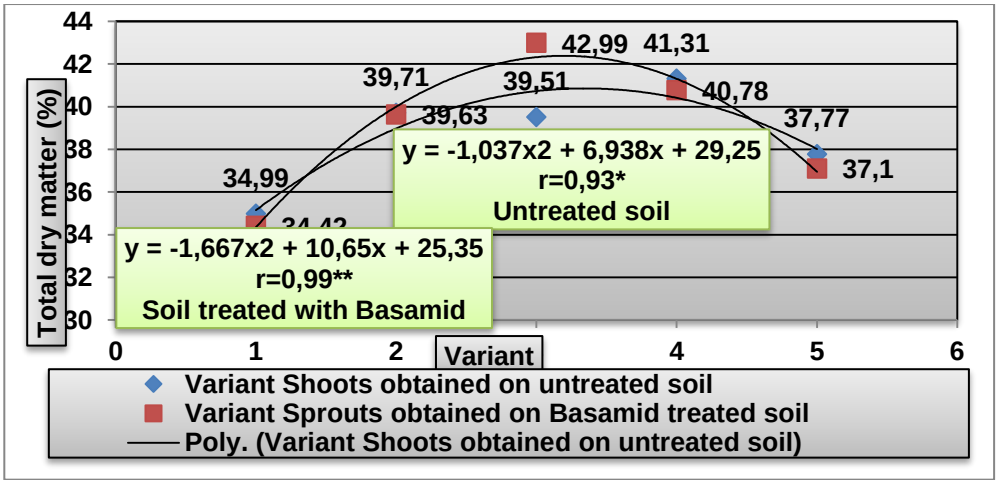


Fig. 1 - Correlation between the total dry substance accumulation in sweet potato tubers on the two soil types

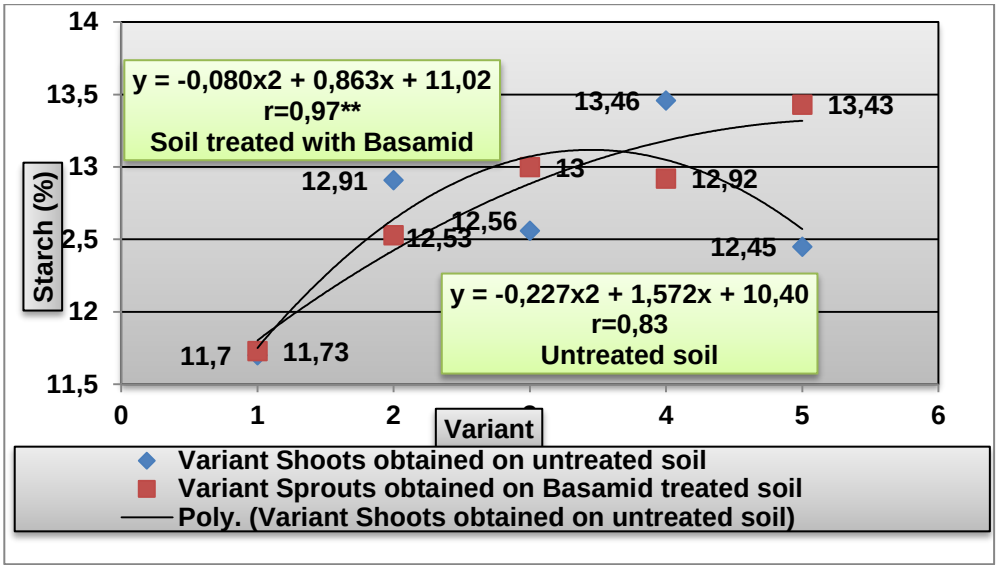


Fig. 2 - Correlation between the accumulation of starch in sweet potato tubers on the two soil types

If we analyze the influence of Basamid treatment on the soil that the shoots were obtained, the results on the quality of the tubers are better in the Basamid-treated variant (Table 6). The differences are not very high, but almost all of the biochemical components have increased Basamid by more than 0.2 %. A healthy soil, amidst the treatment of crop disease and pests, leads to higher production of better quality.

Table 6

The influence of Basamid treatments on the quality of sweet potatoes 2017

Culture method	Total dry matter %	Water %	Soluble dry matter %	Soluble simple glues %	Starch %	Vitamin C mg/100g s.p
Shoots obtained on Basamid 5G-treated soil	38,98	61,12	11,76	9,74	12,72	9,72
Shoots obtained on untreated soil	38,66	61,34	11,56	9,64	12,62	9,63

Analyzing the influence of treatments against diseases and pests, the best results were obtained in the Topsin + Actara treated (41.05 % total dry substance, 58.95 % water, 12.2 % soluble dry matter, 10.15 % carbohydrate soluble, 12.74 % starch and 10.15 mg vitamin C. In all treatment variants, better results were obtained compared to the control variant. Actara is a long-acting systemic insecticide that combats a wide range of pests in a large number of crops. In the variants where this product was applied the starch content was the highest (13.23 % in the variant only with Actara, 12.74 % with

Topsin + Actara and 12.94 % with Topsin + Actara + Signum (Table 7) Topsin also has fungicidal, contact and systemic action, being absorbed by plants through leaves and roots, having a very good preventive and curative effect.

Table 7

Influence of treatments with products for the control of diseases and pests on the quality of sweet potato tubers

Culture method	Total dry matter %	Water %	Soluble dry matter %	Soluble simple glues %	Starch %	Vitamin C mg/100g s.p
Mt.(untreated)	34,71	62,29	11,3	9,37	11,72	9,63
Topsin 1kg/ha	39,67	60,33	11,6	9,65	12,72	9,56
Actara 0,2kg/ha	39,75	60,50	11,6	9,64	13,23	9,46
Topsin + Actara	41,05	58,95	12,2	10,15	12,74	10,15
Topsin+Actara + Signum	37,44	62,56	11,6	9,64	12,94	9,58

Signum is a granular, systemic translaminar and protective fungicide based on boscalid and pyraclostrobin. Successfully combat Monilinia spp. and gray rot (Botrytis cinerea), but also other important diseases such as Rhizopus sp.

CONCLUSIONS

The production results obtained at the harvesting of sweet potato tubers highlight the variant in which sunflower shoots were planted on Basamid 5G treated soil at a rate of 5 kg / 100 m2 with a production difference of 7.937 t / ha , distinctly significant, compared to the shoots obtained on untreated soil.

By planting the shoots obtained on the Basamid 5G soil, we recorded productions of 29,281 - 37,647 t / ha, depending on the chemical treatment applied to the vegetation, with the best results in the version treated with Topsin, 1 kg / ha + Actara, 0.2 % + Signum 1.5 kg / ha.

From the point of view of the quality of the crop, the chemical treatment in vegetation with Topsin 1 kg / ha + Actara 0,2 % (41,05 % total dry substance, 58,95 % water, 12,2 % soluble dry matter, 10, 15 % soluble carbohydrates, 12.74 % starch and 10.15 mg vitamin C).

Treatment with Basamid 5G did not significantly differentiate the quality of tubers.

REFERENCES

Boiu-Sicuia Oana-Alina, Constantinescu Florica, Diaconu Aurelia, Drăghici Reta, 2017, Research approaches regarding biological control of Fusarium sp. Stem rot of sweet potato produced on sandy soils, Studii și comunicări.Stiinţele naturii, Muzeul Olteniei Craiova, Tom.33, no. 2/2017, ISSN 1454-6914

Clark, C.A., and J.W. Moyer. 1988. Compendium of sweet potato diseases. The American Phytopathological Society. 74 p.

Clark CA, Ferrin DM, Smith TP, Holmes GJ (eds.) 2013. Compendium of sweetpotato diseases, pests and disorders, Second edition, Minnesota : APS Press.

Cioloca Mihaela, Andreea Nistor, Nicoleta Chiru, Monica Popa,, 2013, Cartoful dulce – o alternativă în condiţiile schimbărilor climatice. Rezultate privind înmulţirea in vitro. Cartoful in Romania, Publicaţie de informare tehnică pentru cultivatorii de cartof, vol 22. nr 1, p:50-53

Date E.S. and Eronico P.S., 1987, Storage performance of some newly developed sweet potato hybrids, Radix 9(1) :p 3-5

Harrison HF Jr., Jackson DM, 2011, „Response of two sweet potato cultivars to weed interference", Crop Protec. 30: 1291-1296

Iamandei Maria, Draghici Reta, Diaconu Aurelia, Drăghici I., Dima Milica, Cho Eun-Gi, 2014. Preliminary data on the arthropod biodiversity associated with sweet potato (Ipomoea batatas)crops under sandy soils conditions from southern Romania. Romanian Journal for Plant Protection, Vol. VII, 2014. ISSN 2248 – 129X; ISSN-L 2248 – 129X

Johnson AC, Gurr GM. 2016. Invertebrate pests and diseases of sweetpotato (Ipomoea batatas): a review and identification of research priorities for smallholder production. Annals of Applied Biology 168(3): 291-320.

Karyeija R.F., Gibson R.W. and Valkonen J.P.T. (1998), Resistance to sweet potato disease (SPVD) in wild East African Ipomoea.Ann. appl. Biol. 133: 39-44

Talekar NS. 1991. Integrated Control of Cylas formicarius. In: Jansson RK, Raman KV,eds. In Sweet potato pest management: a global perspective, San Francisco : Westview Press 139-156.

Usugi T., Nakano M., Maoka T. And Hayashi T. (1994) A new strain of sweetpotato feathery mottle virus that causes russet crack on fleshy roots of some Japanese cultivars of sweetpotato. Ann. Phitopatol. Soc. Jpn. 60: 545-554

Waribo C. And Ogidi I.A.,2014, "Evolution of the performance of improved sweet potato (Ipomoea batatas L. LAM) varieties in Bayelsa State, Nigeria", African Journal of Environmental Science and Technology, Vol. 8(1), pp 48-53

Food and Agriculture Organization of the United Nations, Statistic Division (FAOSAT), 2017, "Sweet potato production in 2016;World Regions/Production Quantity from pick lists", Retrived 25 April 2018, http://www.fao.org/faosat/en/#data/QC

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

RESEARCH ON THE INFLUENCE OF THE PLANTING EPOCH AND THE METHOD OF CULTURE ON THE NUTRITIONAL QUALITY OF POTATO CROP ON SANDY SOILS IN SOUTHERN OLTENIA

Croitoru Mihaela[1*], Diaconu Aurelia[1], Dima Milica[1],Drăghici I.[1], Drăghici Reta[1]

[1]Research & Development Station for Plant Culture on Sandy Soils-Dabuleni,Romania
**Corresponding author e-mail: mhlcroitoru@yahoo.com*

Keywords*: potato, sandy soils, quality*

ABSTRACT

The researches carried out at SCDCPN Dăbuleni at potato showed that the planting period and the method of cultivation influenced both the production of tubers and their nutritional quality.The best results were obtained in the Belarosa variety planted in the 2nd age (09.03) both in the agril-protected version (21.74 % total dry matter, 4.30 % soluble dry matter, 15.84 % starch and 24.20mg C vitamin) and the unprotected (23.27 % total dry matter, 4.27 % soluble dry matter, 17.98 % starch and 19.95 mg C vitamin).

As far as he is concerned the influence of the planting age, the results show higher values of the biochemical indices studied at the second epoch (19.23 % total dry matter, 4.15 % soluble dry substance, 16.64 % starch and 19.60 mg C vitamin).

INTRODUCTION

The planting period is an important factor for any crop. If the planting is in the optimal period, the plant meets the favorable conditions for development and produces superior crops both in terms of quantity and quality.

This time depends on the temperature and humidity of the soil, but it is also correlated with the climatic conditions in the area, as stated by Ianoşi I.S., et al., 2002. The researches have shown that in the potato culture every day of delay after the optimal planting period leads to irreversible losses of production (Ianosi I.S., et al., 1989, Berindei, M., 2009). In an early planting, even if the period, planting-emergence lasts longer, tuberization begins earlier when the conditions of temperature, humidity and the length of the day are favorable to this process (Ianosi I.S., et al., 2002, Arab H. R., et al., 2012, Iliev P., 2016).

The planting season significantly influenced potato starch content in the Covasna area, meaning that a higher average content was recorded at the second planting season (end of April), 21.4 % versus 19.4 % as was achieved on average through early planting (early April) (Göncz E., 2011).

According to Rytel E., 2004 and Lisińska G., 2006, extension of the vegetation period depending on the planting season, has increased the starch content and the dry matter content of the potatoes, but the rate of their accumulation depends on the cultivar and the growing conditions.

Many authors (Blenkisop R.W., et al., 2002; Rymuza K.,et al.,, 2004; Hamouz K. J., et al., 2005; Wang Z. H., et al., 2008; Lombardo S., et al., 2013) consider that the quality of the tubers fluctuates significantly due to several factors (variety, climatic conditions, planting season, culture method, etc.).

MATERIAL AND METHOD

Research has been conducted in Research and Development Station for Plant Culture on Sandy Soils Dăbuleni during the three experimental years (2015, 2016, 2017).

Factor A - the planting epoch:
a_1- Epoch I (28 February)
a_2 - Epoch II (9 March)

Factor B - method of culture:
b_1 - Protected with agril
b_2 – Unprotected

Factor C – variety:
c_1 –Riviera
c_2 –Carerra
c_3 -Evolution
c_4 -Belarosa

Location of the experience was based on the three-repeat subdivision parcel method. Samples were harvested at harvest maturity, and the following determinations were made in the laboratory:

- the water and the total dry matter (%) - gravimetric method;
- soluble dry matter (%) - refractometric method;
- C vitamin (mg / 100g fresh substance) - iodometric method;
- starch (%) - colorimetric method;
- production (t / ha);
- recording climatic elements at the SCDCPN Dăbuleni weather station.

RESULTS AND DISCUSSIONS

The epoch planting, as well as culture method have influenced both the production of tubers and their nutritional quality. The results obtained are presented in Table 1.

The best results were obtained in the Belarosa variety, planted in the epoch II (9 March), both in the agril-protected version (21.74 % total dry substance, 4.30 % soluble dry substance, 15.84 % starch and 24.20mg C vitamin) and the unprotected (23.27 % total dry substance, 4.27 % soluble dry substance, 17.98 % starch and 19.95 mg C vitamin) .

A high starch content was also obtained in the varieties Evolution (18.22 %) cultivated in the epoch II (9 March), in a protected crop with agril and Riviera (18.11 %), also cultivated in the epoch II (9 March), in unprotected culture. The results obtained show a higher content of starch in most varieties studied, planted in the epoch II (9 March) irrespective of the protection system. Similar results have also been obtained by Göncz E., 2011, in the Covasna area (the planting season has significantly influenced potato starch content, meaning that a higher average content was recorded at the second planting period (end of April) (21.4 %) compared to 19.4 % on average on early planting (early April)). Analyzing the influence of the variety, the best in terms of quality behaved the Belarosa variety (21.95 % total dry matter, 4.29 % soluble dry matter, 15.36 % starch and 19.98mg / 100g fresh substance C vitamin) (Table 2).

Table 1

Biochemical composition of potato tubers according to their epoch planting, method of culture and variety (2015-2017)

Planting epoch	Method of cultivation	Variety	Total dry matter (%)	Soluble dry matter (%)	Starch (%)	C vitamin (mg/100g f.s *)
Epoch I (28 February)	Protected with agril	Riviera	17.46	4.37	13.15	16.13
		Carerra	19.15	4.03	13.33	17.01
		Evolution	17.70	3.13	14.94	12.91
		Belarosa	20.76	4.27	12.95	17.89

	Unprotected	Riviera	17.19	4.20	15.08	20.24
		Carerra	18.63	3.97	15.00	19.65
		Evolution	20.10	3.53	14.10	18.48
		Belarosa	22.03	4.33	14.65	17.89
Epoch II (9 March)	Protected with agril	Riviera	14.95	4.13	17.24	19.95
		Carerra	18.71	4.30	14.03	19.05
		Evolution	19.30	4.07	18.22	21.12
		Belarosa	21.74	4.30	15.84	24.20
	Unprotected	Riviera	18.54	4.10	18.11	18.48
		Carerra	19.01	4.00	17.23	17.01
		Evolution	18.29	4.00	14.47	17.03
		Belarosa	23.27	4.27	17.98	19.95

f.s*- fresh substance

Table 2

Biochemical composition of potato tubers according to variety

Variety	Total dry matter (%)	Soluble dry matter (%)	Starch (%)	C vitamin (mg/100g f.s *)
Riviera	17.04	4.20	15.90	18.70
Carerra	18.88	4.08	14.90	18.18
Evolution	18.85	3.68	15.43	17.39
Belarosa	21.95	4.29	15.36	19.98

f.s*- fresh substance

The crop protection did not affect the quality of potato tubers, the best results were obtained in the unprotected variant (Table 3). As for the influence of the planting epochn, the results presented in Table 4 show higher values of the biochemical indices studied at the epoch II (9 March) (19.23 % total dry matter, 4.15 % soluble dry matter, 16.64 % starch and 19.60mg C vitamin).

Table 3

Influence of the protection method on the biochemical composition of potato tubers

Method of cultivation	Total dry matter (%)	Soluble dry matter (%)	Starch (%)	C vitamin (mg/100g f.s *)
Protected with agril	18.73	4.08	14.96	18.54
Unprotected	19.64	4.05	15.83	18.59

f.s*- fresh substance

Table 4

Influence of the planting epoch on the biochemical composition of potato tubers

Planting epoch	Total dry matter (%)	Soluble dry matter (%)	Starch (%)	C vitamin (mg/100g f.s *)
Epoch I (28 February)	19.13	3.98	14.15	17.53
Epoch II (9 March)	19.23	4.15	16.64	19.60

f.s*- fresh substance

Between tuber production and the accumulation of total dry substance from the tubers, according to the planting sepoch and the method of cultivation, correlations have been established showing that the total dry substance content of the tubers increases to lower yields (Figure 1).

In tubers obtained by planting in the epoch II, in the protected system the best correlation (r = 0.98 *) was established, which shows that in this planting variant potato tubers with a production of 53 -54 tonnes / ha and with a high dry matter content of 22 %. At these values, production is financially profitable, and the quality of tubers is very good, since at dry matter levels over 20 % of potatoes can be used for both fresh and industrialized consumption.

The results obtained are influenced in addition to the planting season and the crop method, the variety and climatic conditions of the crop year, and the best results were obtained in the climatic conditions of 2016, which was poorer in precipitation and less warmth during the maximum accumulation period (table 5).

Similar results were obtained by Wanda Wadas, Tomasz Dziugieł, 2015, who showed that the largest amount of total dry matter and starch had accumulated in the years with the lowest rainfall during the growing season, and by Dorota Wichrowska, et al., 2014, which showed a vitamin C content in potato tubers ranging from 10 to 30 mg / 100 g of fresh substance and which depended considerably on the climatic conditions during the vegetation period.

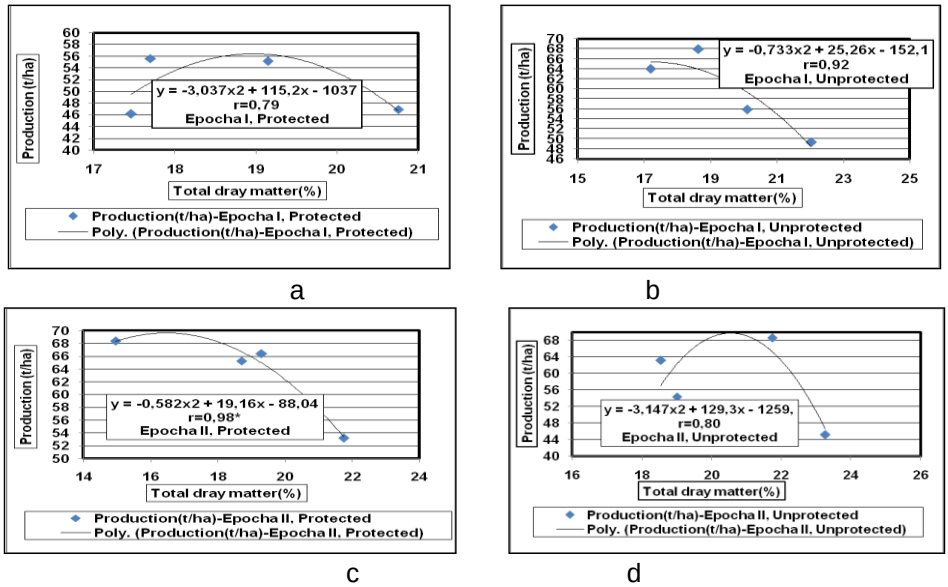


Fig. 1(a,b,c,d) – The correlation between tuber production and accumulation of total dry substance in tubules in the variants studied

Table 5

Influence of years of study on the biochemical composition of potato tubers

Year	Total dry matter (%)	Starch (%)	C vitamin (mg/100g f.s *)	Rainfall (mm)	The sum of the degrees of temperature (^{0}C)
2015	18.48	12.73	18.93	134.2	615
2016	19.58	16.75	25.18	53.2	708
2017	19.69	16.71	11.45	17.4	720

CONCLUSIONS

- The epoch planting and culture method have influenced both tuber production and nutritional quality.

- The best results were obtained in the Belarosa variety, planted in epoch II (9 March), both in the agril-protected version (21.74 % total dry matter, 4.30 % soluble dry matter, 15.84 % starch and 24.20mg Cvitamin) and the unprotected (23.27 % total dry matter, 4.27 % soluble dry matter, 17.98 % starch and 19.95 mg C vitamin) .

- As for the influence of the planting epoch, the results obtained show higher values of the biochemical indices studied in the tubers obtained during the epoch II (19.23 % total dry matter, 4.15 % soluble dry matter, 16.64 % starch and 19.60 mg C vitamin).

- In tubers obtained by planting in the epoch II, in the protected variant, a significant correlation (r = 0.98 *) was established, which shows that in this planting variant potato tubers with a production can be obtained of 53-54 t / ha and with a high dry matter content of 22 %.

REFERENCES

Arab H. R., et all., 2012, The effect of planting date, depth and density on yield and yield components of potato in Shahrood (Iran), Journal of Research in Agricultural Science, nr. 7, p. 141-149.

Berindei M., 2009, Importanţa calităţii cartofului pentru sămânţă în obţinerea de producţii mari şi economice la cartoful pentru consum. Cartoful în România,vol. 18, nr.1,2, p. 14-19.

Blenkisop R. W., L. J. Copp, R. Y. Yada, A. G. Marangoni, 2002, Changes in composition parameters of tubers of potato during low-temperature storage and their relationship processing quality. J. Agric. Food Chem., 50: 4545-4553

Dorota Wichrowska, Elżbieta Wszelaczyńska, Jarosław Pobereżny, 2014, Effect of nutrient supply from different sources on some quality parameters of potato tubers, J. Elem. s. 217–230, DOI: 10.5601/jelem.2014.19.1.603

Göncz E., 2011, Perfecţionarea tehnologiei de cultivare a cartofului destinat procesării în condiţiile judeţului Covasna, Teză de Doctorat, Universitatea De Ştiinţe Agricole Şi Medicină Veterinară Cluj Napoca, Şcoala Doctorală Facultatea De Agricultură

Hamouz, K., J. Čepl and P. Dvořák, 2005. Influence of environmental conditions on the quality of potato tubers. Hort. Sci., Prague, 32 (3): 89-95

Ianoşi I.S., Ana Crăciun, I. Mezabrovsky, 1989, Modificarea elementelor de producţie funcţie de perioada de plantare a cartofului in zona de stepă în condiţii de irigare. Anale ICPC Braşov, vol. XVI, p. 69-91.

Ianosi I.S., Ianoşi Maria Elena, Plămădeală B., Popescu A., 2002, Cultura cartofului pentru consum. Braşov: Phoenix, 2002. 302 p.

Iliev P., 2016, Bazele ştiinţifico-practice de producere a cartofului in Republica Moldova Chişinău: “Reclama”, 2016. 420 p.

Lisińska G., 2006. Technological and nutritive value of the Polish potato cultivars (in Polish). Zesz. Probl. Post. Nauk Roln., 511: 81-94.

Lombardo S., A. Lo Monaco, G. Pandinio, B. Parisi, G. Maruomicale, 2013. The phenology yield and tuber composition of early crop potatoes: a comparison between organic and conventional cultivation system. Renew. Agr. Food Syst., 28: 50-58.

Rymuza, K., A. Bombik, 2004, The effect of forecrop and mineral fertilisation on qualitative traits of selected potato cultivars. Fragm. Agron., 1 (81): 69-84 (Pl).

Rytel E., 2004, The effect of edible potato maturity on its after-cooking consistency (in Polish). Zesz . Probl . Post . Nauk Rol., 500: 465-473.

Wanda Wadas, Tomasz Dziugieł, 2015, Effect of complex fertilizers used in early crop potato culture on loamy sand soil Efekty stosowania nawozów kompleksowych w uprawie ziemniaka na wczesny zbiór na glebie piaszczysto-gliniastej, Journal of Central European Agriculture, 16(1), p. 23-40

Wang Z. H., S. Li, S. Malhi, 2008, Effects of fertilization and other agronomic measures on nutritional quality of crops. J. Sci. Food Agric., 88: 7-23.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

TRENDS OF TABLE GRAPES PRODUCTION AND CONSUMPTION IN BULGARIA

Dimitrova Daniela[1*], Dimitrov Vladimir[1], Simeonov Iliyan[1], Belberova Yordanka[1]

[1]Institute of Viticulture and Enology, Kala Tepe Street, № 1, Pleven 5800, Bulgaria
* *Correspondence author. E-mail*: vachevska_d@abv.bg

Keywords: *table grapes, production, consumption*

ABSTRACT

Grapes (including wine and table grapes) took a leading place in the total value of fruit production globally in 2014, according to information from the Food and Agriculture Organization (FAO). A strong positive trend has been observed in table grapes production, while determining at the same time its increased consumption. With a view of the high nutritional value of the table grapes, the achievement of positive consumption dynamics contributes to the realization of the EU strategic objectives on the prevention of increased morbidity of the population. On the basis of official statistics analysis, the dynamics of the production and the consumption of table grapes in Bulgaria was established. The tendency of lagging behind the level of table grapes consumption compared to the average for the country among the children and the working age population has been particularly worrying. Besides the reasons of economic nature, an impact has also the lack of eating habits for grapes consumption among the young people and the discrepancy between the consumers' tastes and the qualitative indicators of the supplied grapes. The development of the domestic market for table grapes is directly related to updating of the variety structure and the production technological modernization in response to the growing consumers' requirements.

INTRODUCTION

The relatively low level of consumption of fruit and vegetables among the population (especially children and adolescents globally is one of the main problems identified by the World Health Organization (WHO), in view of efforts to improve healthy and balanced nutrition and the prevention of a number of chronic diseases in the long term - hypertension, cardiovascular disease, stroke, diabetes, and some cancers (OECD/EU, 2016). According to the European Fresh Produce Association (Freshfel, 2017), average daily consumption of fruit and vegetables per capita in Bulgaria in 2014 amounted to 267.96 g (at the recommended 400 g per day according to the WHO guidelines). Pursuant to the average amount of fruit consumed per capita per day - 134.58 grams, our country ranks 24th in the EU. This level is almost two times less than the highest values recorded in the European community - in Italy (288.68 g) and in Romania (263.39 g). Eurostat data (2016) showed that more than half of the inhabitants of our country aged 15 years old and over do not consumed daily fruits and vegetables. A study conducted in the 2013/2014 school year by the World Health Organization (2016), showed that in children at the age of 11 years the situation was almost similar - 47.0 % of girls and 42.0 % of boys consumed fruits every day. Unfortunately, with the age increases, these percentages decreased, respectively, to 37.0 % of the girls at 13

years old and at 36.0 % of the boys respectively. Building healthy eating habits from early childhood is an important factor, and at the same time a prerequisite for improving the health status of the nation (OECD/EU, 2016).

Table grapes is the fruit with extremely valuable for health ingredients (Crupi et al., 2011; Percival, 2009; Stalev and Angelov, 2011; Zhou and Raffoul, 2012). Besides possessing diverse composition of vitamins and minerals, table grapes are also one of the richest sources of polyphenols among fruits (FAO-OIV, 2016). World production of table grapes over the last two decades had noted a steady growth trend - by 71 % in 2014 compared to 2000 (FAO-OIV, 2016). Increased production stimulates consumption growth - from 15 million tons to 26.2 million tons during this period (+ 73 %).

The aim of this study was to describe the long-term trends in the development of table grapes production and consumption in Bulgaria as an element of the healthy diet of the population.

MATERIAL AND METHODS

The analyses were based on official statistical data with sources from the Ministry of Agriculture Food and Forestry (MAFF), Agricultural Statistics Department, Eurostat and the National Statistical Institute (NSI). The methods of comparative and dynamic analysis, index method and graphical method were applied (Petrov et al., 2004). The dynamics of the production of table grapes in the long run period was based on the indicators of harvested area of vines with table grapes varieties (ha), average yield (kg/ha), production (tons), gross output of table grapes at basic prices (EUR million). The rate of change of the relative share of the gross output of table grapes in the total value of the gross output of fruits was monitored.

The trend in the consumption of table grapes was derived from the consumed quantity per year on average per person from household (kg). According to the methodology used by the NSI it should be noted that this level was calculated on the basis of consumption at home and does not included the consumption in the mass caterers. In order to more detailed analysis that disclosing a part of the socio-demographic characteristics of the users of the fetus, the average consumption per household was considered according to two main criteria:

- availability of children under 18 years old in households;
- presence of pensioners in households.

RESULTS AND DISCUSSIONS

The value of the gross output of table grapes in 2016 amounted to EUR 3,79 million, which was almost 3,2 times less than the reported value of the indicator in 2002 (fig. 1). The decrease was mainly due to the fall in the physical volume of production, with the lowest levels recorded in 2010, 2012 and 2014 (between 7989 and 8659 tonnes). During the period 2002-2016, the producer prices ranged between 11.87 and 50.54 euros per 100 kg, with a more significant increase in the price level observed after admission to EU membership of our country in 2007 with gainig access to the Single European Market. The increase in producer prices was happening at a slower rate than overall growth of production costs, along with the lack of manpower were of the main reasons for maintaining a low level of production of table grapes in the country.

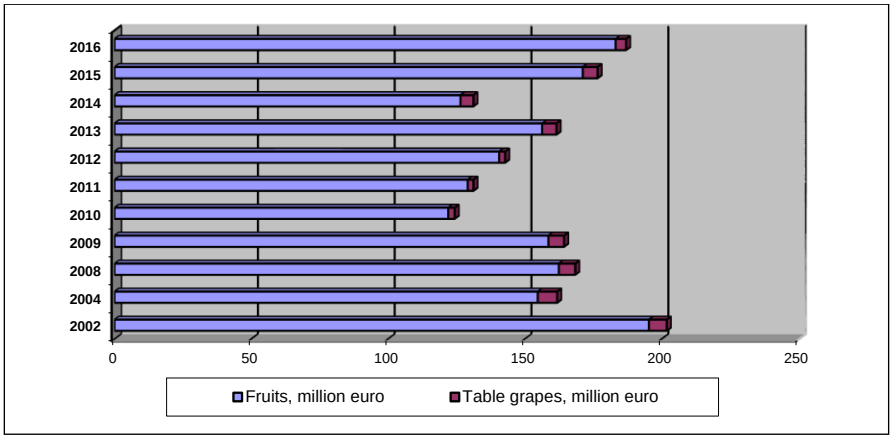


Fig. 1: Dynamics of gross output of table grapes in the gross output of fruits in the 2002-2016 period, EUR million

Source: Eurostat, http://appsso.eurostat.ec.europa.eu/, extracted on 27.08.2018

The trend of decline in gross output of fresh fruits - by 6.2 % in 2016 compared to 2002 was unfavorable in general both in the stability of agricultural production and in satisfying the interests of consumers. At the same time, the share of table grapes in the gross output of fruits declined from 3.3 % to 2.1 % over the same period.

Considered in the long term, the decline in the production volume resulted both from the serious reduction in the harvested areas so because of to the lower level of the average yields. The data presented in Table 1 showed that on average for the period 1981-85 - years in which the table grapes had occupied not a small share in the export list of our country, the average level of the areas with fruit-bearing vineyards amounted to 16,100 ha. The harvested areas with table grapes vines in 2017 represented only 13.2 % of the indicated level. However, it should be noted that in recent years there has been some stabilization in terms of this the indicator under consideration, which to a certain extent can be explained by the subsidies granted under the coupled support scheme for fruits (plums and table grapes) from the beginning of 2015. The amount of financial support set for 2017 was EUR 582.42 per hectare for the first 30 ha eligible for aid and EUR 388.29 per hectare for the areas over 30 hectares.

In the three years from 2015 to 2017, there was an increase in average productivity per unit area, as reported average yield in 2015 - 7240 kg/ha was closest to the average for the period 1981-85, the - 7662 kg/ha. Although development of the indicator in dynamic emerging positive trend, significant annual fluctuations were the main problems facing the expansion of production in the country.

The quantity of table grapes produced in 2017 amounted to 14297 tonnes, which represented only 11,6 % of the production level during the baseline period. The production was insufficient to meet the needs of the internal market, which is expanding every year, under the impact of the positive development of tourism (Dimitrova, 2018). According to NSI data in the past year 9532 tons of table grapes were imported into the country, which exceeded 6 times the quantity of imports in 2007 - 1627 tons.

Table 1

Change in the production of table grapes and average yields of vines with table grapes varieties, %

Period, years	Cultivated area, ha	Change, %	Production, tons	Change, %	Average yield, kg/ha	Change, %
1981-85	16100	100,0	123400	100,0	7662	100,0
1986-90	12700	*78,9*	76000	*61,5*	5986	*78,1*
1991-95	13813	*85,8*	68259	*55,3*	4898	*63,9*
1996-00	13646	*84,8*	55086	*44,6*	3893	*50,8*
2001	8999	*55,9*	30483	*24,7*	3350	*43,7*
2002	5207	*32,3*	17480	*14,2*	3560	*46,5*
2003	5876	*36,5*	22961	*18,6*	3907	*51,0*
2004	5591	*34,7*	16448	*13,3*	2942	*38,4*
2005	4062	*25,2*	10723	*8,7*	2640	*34,5*
2006	3096	*19,2*	13563	*11,0*	4383	*57,2*
2007	2498	*15,5*	13641	*11,1*	5460	*71,3*
2008	2448	*15,2*	17889	*14,5*	7305	*95,3*
2009	3263	*20,3*	17344	*14,1*	5315	*69,4*
2010	2629	*16,3*	7989	*6,5*	3039	*39,7*
2011	2373	*14,7*	12080	*9,8*	5091	*66,4*
2012	2248	*13,9*	8659	*7,0*	3853	*50,3*
2013	2842	*17,7*	16770	*13,6*	5901	*77,0*
2014	1610	*10,0*	7079	*5,7*	4397	*57,4*
2015	2254	*14,0*	16320	*13,2*	7240	*94,5*
2016	2009	*12,5*	10066	*8,2*	5010	*65,4*
2017	2126	*13,2*	14297	*11,6*	6725	*87,8*

Source: National Statistical Institute, MAFF, Agrostatistics Department

The data on the average level of consumption of table grapes per capita showed a drastic decline compared to the level achieved since the mid-1980s - 10.9 kg. (fig. 2). Under the influence of steadily declining production, the consumption of the fruit was reduced to 2.1-2.3 kg per person from household during the period 2015-2017. The movement of the consumption curve showed fluctuations by years, depending on the variation in the quantity of the production, which testified the preferences of the Bulgarian consumer mainly on the taste qualities of the domestic table grapes. Traditionally, purchases of fruit were most intense during the months of September to November, when retail prices have been lowest.

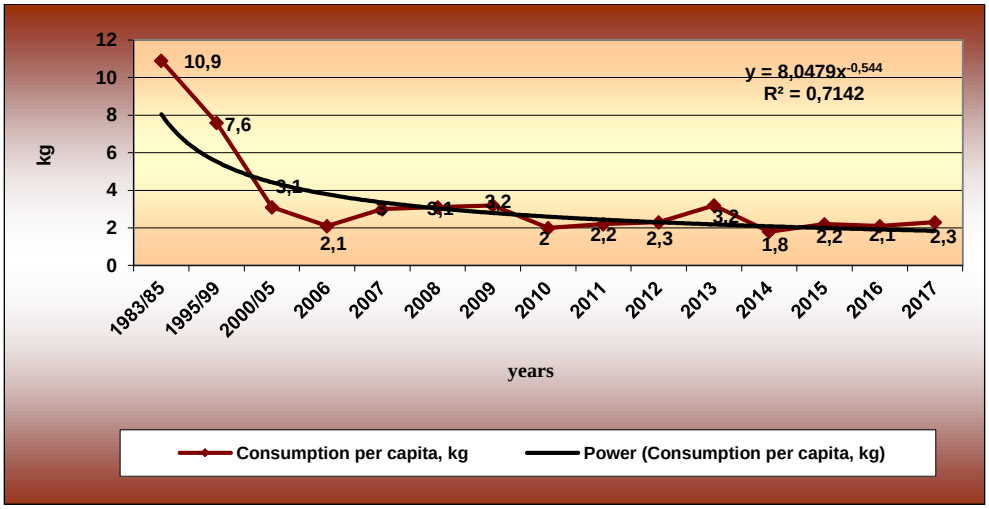


Figure 2: Consumption of table grapes on average per person from household, kg

Source: Cholakov (1989), NSI, http://www.nsi.bg

The structure of consumption according to the age status of users was interesting. Listed in Table 2 data showed that consumption of table grapes per capita was higher in households without children where the level of the indicator in 2017 exceeded by 21.7 % the national average. In households with children, the quantity of table grapes consumed is extremely small compared to healthy eating standards - from 0.8 kg to 1.4 kg and represented respectively 34.8 % and 60.9 % of the average for the country.

As evidence of worsening healthy diet of young population may indicate the structure of consumption of table grapes, according to the presence of retired in households. Disturbing is the fact that the greatest amount of table grapes per household was consumed in households of pensioners - 3.3 kg. The indicator level for 2017 exceeded the average for the country by 43.5 %. Despite the high realization price of the grapes, the traditions in the consumption of the fruit had a significant impact on the consumer demand in the group. At the same time, the consumption of table grapes in households without pensioners lagged significantly, both in the other groups and compared to the average for the country.

Besides the slow pace of increase income, respectively the purchasing power of households, the absence of nutritional habits that provide the necessary intake of vitamins and minerals for teenagers must be stated as the main reason for the relatively low amount of consumption among children and young people in the country. It is also important to emphasize the inadequacy between the tastes of consumers and the quality of the grapes marketed. The pursuit of comfort while eating directs the tastes of young consumers mainly to seedless varieties of table grapes, whose supply is limited. The influence on the consumer choice also has the appearance - large and uniformly colored berries and harmonious taste, parameters whose compliance is most cases not covered by the products exposed in the market.

Table 2

Household consumption of table grapes by number of the children under 18 and by presence of pensioners in the households, average per capita in kg

Years	National average, kg	Household consumption of table grapes by number of the children under 18 in households, kg				Household consumption of table grapes by presence of pensioners in the households, kg		
		1	2	3 or more	Without children under 18	Households		
						of pensioners	with pensioners	without pensioners
2004	2,9	1,9	1,9	0,5	3,8	4,8	3,1	1,9
2005	1,6	1,0	0,9	0,5	2,0	2,5	1,5	1,1
2006	2,2	1,6	1,1	0,5	2,8	3,8	2,0	1,6
2007	3,0	2,0	2,0	0,5	3,8	5,0	2,7	2,2
2008	3,1	2,0	1,7	0,7	3,9	5,0	2,9	2,1
2009	3,2	2,2	1,8	1,4	3,9	5,4	3,1	2,1
2010	2,0	1,5	1,1	0,1	2,4	3,2	1,7	1,6
2011	2,2	1,4	1,2	0,6	2,7	3,7	1,8	1,6
2012	2,3	1,7	1,8	0,5	2,7	3,5	2,0	2,0
2013	3,2	2,1	2,1	0,8	3,9	4,8	3,0	2,5
2014	1,8	1,3	1,0	1,0	2,2	3,1	1,5	1,4
2015	2,2	1,6	1,2	0,4	2,8	3,4	2,1	1,8
2016	2,1	1,4	0,9	0,6	2,7	3,4	1,5	1,8
2017	2,3	1,4	1,4	0,8	2,8	3,3	1,9	1,9
2017/ 2004, %	*79,3*	*73,7*	*73,7*	*160,0*	*73,7*	*68,8*	*61,3*	*100,0*

Source: NSI, Household Budgets in the Republic of Bulgaria (2009-2017), www.nsi.bg, https://infostat.nsi.bg

CONCLUSIONS

Negative trends in the production of table grapes - a decrease in harvested area, relatively low and fluctuating yearly average yields, a decline in the quantity of production had a negative impact on the consumption of fruit. Annual fluctuations in the amount of table grapes consumed per capita correspond to variations in production volume, which indicated a potential for increase in consumer demand with increasing of production. The reduced consumption of table grapes in households with children under the age of 18 years have a negative impact on the health status of both adolescents and the working age population. This highlights the need to stimulate consumer demand and to increase awareness of the benefits of fetal consumption. Renovation of varietal structure is also an important measure in this regard, which should provide such quality parameters of marketed fruit demanded by consumers. Overcoming the negative trends require both macro and micro-measures to be taken to expand and modernize the production of table grapes in order to ensure a high quality and inexpensive production for Bulgarian consumers, contributing to the improvement of the healthy diet of the population.

REFERENCES

Petrov, V., P. Angelova, K. Slaveva. 2004. Methods of analysis and management in agribusiness, Abagar, pp. 302.

Cholakov, T., 1989. Problems in development of viticulture in the People's Republic of Bulgaria. Research work for academic rank, Pleven. pp. 330.

Crupi, P., R. A. Milella, R. Perniola, R. Genghi, M. A. G. A. Coletta, A. R. Caputo, D. Antonacci, 2011, The intake of unpeeled table grapes is important in dietary habits as a source of antioxidant and anticarcinogenic polyphenols. Bulletin de l´OIV, vol. 84, nº 959-960-961, 37-52, www.oiv.int

Dimitrova, D., 2018, Opportunities to improve the market position of table grapes growers, In Conference proceedings "Challenges of agribusiness and rural areas", Publishing complex – UNWE, 75-81.

Eurostat Newsrelease 197/2016 – 14 October 2016. Consumption of fruit and vegetables in the EU, pp. 4

FAO-OIV Focus 2016. Table and dried grapes, pp. 62, http://www.fao.org/3/a-i7042e.pdf

Freshfel Consumption Monitor. 2017. Fresh Friut and Vegetables Production, Trade, Supply and Consumption Monitor in the EU-28. Based on statistical data from 2014, pp. 20, http://freshfel.org/wp-content/uploads/2017/05/Freshfel-Consumption-Monitor-EU-overview.pdf

OECD/EU, 2016, Health at a Glance: Europe 2016: State of Health in the EU Cycle, OECD Publishing, Paris, pp. 199, http://dx.doi.org/10.1787/9789264265592-en.

Percival, S., 2009, Grape consumption supports immunity in animals and humans, The Journal of Nutrition, American Society for Nutrition, http://jn.nutrition.org/content/early/2009/07/29/jn.109.108324. full.pdf

Stalev, B., L. Angelov, 2011, Dietetic and Therapeutic properties of table grapes and wines, V MIĘDZYNARODWA KONFERNCIJA WINIARSKA, materialy konferncyjne, Instytut Zarządzania i Inżinerii Rolnej PWSZ w Sulechowie, pp. 83-88

World Health Organisation, 2016, Health policy for children and adolescents, №7: Growing up unequal: gender and socioeconomic differences in young people's health and well-being. Health behaviour in school-aged children (HBSC) study: International report from the 2013/2014 survey, pp. 113-116.

Zhou, K., J.J. Raffoul, 2012, Potential anticancer properties of grape antioxidants. *Review Article,* Journal of oncology, pp. 8, www.hindawi.com/journals/jo/2012/803294/

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

STUDIES ON THE PEDOLOGICAL OFFER OF SOME AREAS IN NORTHERN OLTENIA FOR VINE CULTIVATION

Giugea Nicolae[1]., Cîrstea David[1*], Mărăcineanu Liviu[1]

[1]University of Craiova, Faculty of Horticulture
**Correspondence author e-mail:* david_cirstea@yahoo.com

ABSTRACT

Within the depressions of the Sub-Carpathians of Oltenia, located along the axis: Drobeta Turnu Severin, Corcova, Polovragi, Tg. Jiu, Horezu, Râmnicu Vâlcea, Jiblea-Călimăneşti, vineyard culture has been a major attraction for man's preoccupations, which is why the vine is believed to have been adopted by man since his stage of picker when in the first gardens he set up he chose to store vineyards and fruit trees.

Our studies have highlighted the fact that in these depressions, the vine is still cultivated on large areas (2723 ha). Eleven types of soil were identified, in each of the seven areas their predominance is dependent on the conditions in which they were formed. We meet the calcic preluvosoil, eroded preluvosoil, typical luvisol, pelic faeziom, lithosols, regosols, podzols, etc.

Although most soil types have texture and structure that can be considered good, they need to be enriched by appropriate agro-technical measures for each situation.

The soil types in this area have a very good drainage, a very important aspect, especially since we find ourselves in an area where precipitation is significant over a year.

Vineyards are located on slopes with small angle of inclination, therefore, do not require land management terraces. In fact, these slopes are the sunniest, which is why the vine grows and fructifies in the best conditions.

INTRODUCTION

The soil and the subsoil with their chemical properties, but especially the physical ones, are those that regulate the water, air and temperature regime but also the permeability and the water retention capacity.

In cool vineyards, gravel soils provide a good drain of excess water and heat slightly, allowing for heat retention and better ripening of the grapes.

Also, the torrential rains that occur after the first fruit are less unfavorable if the soil is permeable and allows rapid infiltration in the depth of the water. Well-drained soils are a first major quality factor, especially in cool wine regions. The soil therefore has an important role in defining the composition and quality of grapes, a role that reaches the level of an obvious vocation to achieve certain high quality features. It is noteworthy that in the same favorable climatic area the quality of the grapes ceases to be excellent and becomes common, even if the soil is the same.

The scientific researches carried out over time in Romania (Bucur N., 1956, Chiriţă Constantin, 1966, Condei Gh., Popa P., 1977, Condei Gh., Et al., 2017, Dejeu L. 1984, Puiu et al, 1977, Teaci D., 1980, Teodorescu C.I., Băjescu N., 1956, Chiriţă C., et al., 1938, Urucu Justin, 2011), regarding the soil's influence on the processes of growing and fruit-bearing of the vine they have highlighted the fact that high quality grapes are obtained on the limestone, skeletal and ferruginous soils. Our research aimed to highlight the predominant soil types and their properties in the northern Oltenia vineyards

along the axis: Drobeta Tr. Severin, Corcova, Polovragi, Târgu Jiu, Horezu, Râmnicu Vâlcea, Jiblea-Călimăneşti.

MATERIALS AND METHODS

The identification of the soil types and the shaping of their properties was done with the support of O.S.P.A laboratories in Mehedinţi, Gorj and Vâlcea counties, using the methods and procedures recommended by the International Society of Soil Science. Wine-growing areas in northern Oltenia have been grouped according to their distance to the foothills of the mountains and taking into account the specific climatic conditions. Surface areas and prevailing soil types were established for each area, for which the morphological, chemical and microbiological properties were analyzed on the basis of the profiles.

RESULTS AND DISCUSSIONS

Depending on the geographical location closest to or farther away from the mountain, the following wine-growing areas have been outlined:

1. In Mehedinţi County 3 areas: Area I, closest to the mountain (immediately below the mountain) comprising five localities; Area II with immediate location under the first area, consisting of four localities; Area III, which includes localities around Drobeta Turnu Severin.

Table 1

Areas in the Subcarpathian depression, belonging to Mehedinţi county, where vineyards are grown:

Area I		Area II		Area III	
Localities	Vineyard (ha)	Localities	Vineyard (ha)	Localities	Vineyard (ha)
Obârşia-Cloşani	6,19	Corcova	250	Drobeta-Turnu-Severin	375
Baia de Aramă	34,63	Căzăneşti	28,55	Brezniţa-Ocol	97
Isverna	19,27	Floreşti	27,5	Izvoru Bârzei	46,1
Ponoarele	23,1	Broşteni	36,77	Malovăţ	133,6
Ilovăţ	22,46	-	-	-	-
TOTAL I	105, 64	TOTAL II	342,82	TOTAL III	651,7
TOTAL A I + A II + A III = 1100, 15 ha.					

2. The areas on the Sub-Carpathian hills belonging to Gorj County are spread over large areas and have been classified according to their geographic location in two categories: Area I comprising 16 localities in the immediate vicinity of the mountain and the Area II comprising 15 localities in the vicinity of Târgu Jiu Municipality.

Table 2

Areas in the Subcarpathian depressions, belonging to Gorj county, where vineyards are grown:

Area I		Area II	
Localities	Vineyard(ha)	Localities	Vineyard(ha)
Tismana	130,6	Bălăneşti	73
Peştişani	27,3	Săcelu	24
Runcu	147	Bengeşti-Ciocadia	41
Stăneşti	57,9	Bumbeşti-Piţic	27
Bumbeşti-Jiu	119,4	Prigoria	68

Muşeteşti	66,9	Alimpeşti	14,2
Crasna	91,7	Tg. Jiu-Bârseşti	36,6
Novaci	43,2	Roşia de Amaradia	18,3
Baia de Fier	12,2	Albeni	11,6
Polovragi	21	Bustuchin	22,5
Godineşti	32,3	Târgu Cărbuneşti	32
Teleşti	17,2	Scoarţa	44,1
Băleşti	26,2	Dăneşti	53
Arcani	46,1	Drăgoţeşti	44,2
Turcineşti	44,5	Câlnic	17
Leleşti	15,3	-	-
TOTAL	898,8	TOTAL	526,5
TOTAL A I + A II = 1425,3 ha.			

3. Areas on the Subcarpathian hills belonging to Vâlcea county have also been grouped according to the geographical position in two categories: Area I refers to 13 localities located near Râmnicu Vâlcea and the Area II comprising 7 localities around the city Horezu.

It is found that in the depressions of the Sub-Carpathians of Oltenia the vines occupy 2723.7 hectares (1100 ha in Mehedinţi, 1425.3 ha in Gorj and 198.4 ha in Vâlcea), a surface that cannot be neglected and which says much about the vocation of these areas for the cultivation of the vine and the covenant between man and this plant.

In the wine-growing areas under study we identified, as the main 11 types of soil, which are presented, in order of predominance, in the table 4.

The soil type of calcic preluvosol (pseudo-rendzine brown clay) predominates in Drobeta Turnu Severin and Corcova, and in Târgu Jiu and Horezu it is the descending predominance, on the third place.

Table 3

Areas in the Subcarpathian depressions, belonging to Vâlcea county, where vineyards are grown:

Area I		Area II	
Localities	Vineyard(ha)	Localities	Vineyard(ha)
Călimăneşti-Jiblea	36	Mateeşti	8
Băile Olăneşti-Vlădeşti	7	Stroieşti	3
Runcu	4	Oteşani-Costeşti-Bistriţa	6
Stoeneşti	37	Alunu	5,5
Dăeşti	5	Berbeşti	5
Ocnele Mari	5	Copăceni	6,2
Rm. Vâlcea	13	Popeşti	9,4
Goleşti	10	Horezu-Măldăreşti	6
Frâncesti	10	-	-
Mihăeşti	3	-	-
Budeşti	6,3	-	-
Milcoiu	3,6	-	-
Păuşeşti	9,4	-	-
TOTAL	149,3	TOTAL	49,1
TOTAL A I +A II = 198,4 ha.			

It is defined by the presence of a Bv horizon, with a V ≤ 55 % and at least at the upper part of the spots (in proportions above 50 %), colors in SYR yellow, with values and chroma ≥ 3,5 in the wet state. It has a good state of saturation in absorbed basic cations. The profile of this soil has the formula Ao Bv-Cpr. The Ao horizon is 10-35 cm thick and brown, the Bv horizon, 20-120 cm thick, and the yellow-brown Cpr horizon is in the first 120 cm in the form of biogenic neoformations at the top and weak oxides and hydroxides in the Bv horizon.

The type of soil calcic preluvosol (pseudo-rendzine leached brown) is on the third place in Drobeta Tr. Severin and on the fourth place in Jiblea-Călimăneşti. Its profile is Ao-Bv-Cpr.

The type of ground luvosol soil on gravels (Brown eroded podzolic on gravel). It is located in the areas of Drobeta Tr. Severin, Târgu Jiu and Horezu, but on the fourth place as decreasing predominance. Its profile is Ao-Bv-Rrz. The Ao and Bv horizons have the thickness and colour as the previous soil type. The Rrz horizon is found at 150 cm. The texture of the soils in the preluvosol group is usually medium (loose or lumpy), undifferentiated in the profile, and the weak-moderately developed structure, grain in Ao and angular or prismatic polyhedric in Bv. The rest of the physical, physiochemical, hydrophysical and aeration properties are generally favourable. Humus content is 2-4 %, saturation in high bases (60-80 %), weak acid reaction to neutral (6.2-7), relatively good nutrition.

Table 4

The soil types, in order of prevalence present in some areas in northern Oltenia:

Type of soil	AREA							Soil profile
	Dr Tr. Severin	Corcova	Polovragi	Tg Jiu	Horezu	Rm Vâlcea	Jiblea-Călimăneşti	
Pseudo-rendzine brown clay (calcic preluvosol)	1	1	-	3	3	-	-	A_0BvCpr.
Preluvosol skeletally eroded (Eroded brown clay)	2	2	-	-	-	-	-	A_0-Bv-Cpr
Calcic preluvosol (Brown eroded pseudo-rendzine)	3	-	-	-	-	-	4	A_0-Bv-Cpr
Luvosol typical on gravels (Brown eroded podzolic on gravel)	4	-	-	4	4	-	-	A_0-Bv-Rzr
Eutricambosol scheletic (Brun pe roci calcaroase)	-	3	2	-	-	-	-	A_0-Bv-R
Pelic Faeoziom (Leached pseudo-rendzine)	-	4	-	2	-	2	1	Am-Bv-Cpr
Litosols on skeletal limestone	-	-	1	-	-	-	-	A_0-Bv-R

Typical faeoziom (Pseudo-rendzine)	-	-	-	1	-	1	2	Am-A/C-Cpr
The limestone regosol (rendzine regosol)	-	-	-	-	-	3	-	A_0-C-Rzr
Skeletal podzol (skeletal podzol)	-	-	-	-	1	4	3	Am-Es-Bhs-R
Podzol on the gravel (Podzol on the gravel)	-	-	-	-	2	5	-	A_0u-Es-Bhs-R

The type of soil Typical Faeoziom (Pseudo-rendzine) is predominant in Târgu Jiu and Rm. Valcea and secondly, as a predominantly descending one at Jiblea-Călimăneşti. The soil is defined by: Cpr horizon in the first 150 cm; Am horizon formed out of the material resulting from alteration of the Cpr substrate; the A/Cpr horizon or B horizon has at least the upper part, colors and values, and chromes <3.5 for the wet material on both sides and within the structural elements. Due to the parent materials (clay and calcium carbonate), a C-pseudo-rendzine horizon, specific for these soils, is separated from the base of the profile. The Cpr horizon is made up of marshes, clayey marshes or muddy clays usually containing more than 33 % clay and over 12 % carbonates. Humification is active, high amounts of humus are formed. The profile has the formula Am -A/C- Cpr. Horizon Am 25 to 40 cm thick and it is black. The A/C horizon has, at least in the upper part, colours with values and chromes <3.5 for the wet material. The Cpr horizon has the upper limit in the first 150 cm. The soil has a fine texture, clayey or lime-like, undifferentiated on the profile. The structure is well developed, glomerular or polyhedral. Due to the high clayness, although well structured, they have other physical properties, as well as physical-mechanical, hydro-physical and aeration, not very favourable. The degree of saturation in bases is 80-100 % weak alkaline-neutral-weakly acid reaction (ph = 6-8), nutrient supply and microbiological activity are good.

The type of soil pelic Faeoziom (high pseudo-rendzine) is predominant in Jiblea-Călimăneşti, second in Râmnicu Vâlcea and Târgu Jiu and in fourth place in Corcova. It is similar to the typical Faeoziom, but with the Bv horizon having, at least in the upper part, colours with values and chromes ≤ 3.5 for the wet material.

The limestone regosol (rendzine regosol) is present in the Area Rm. Vâlcea. It has an underdeveloped profile, Ao-C. The Ao horizon, generally slightly contoured, has a thickness of 10-40 cm. Horizon C is the parental material made up of unconsolidated rocks. The texture is very varied (sandy-clayey) and undifferentiated on the profile. It is unstructured, or poorly developed, or poorly developed polyhedral structure. The content of humus and nutrients, usually low, has low fertility.

The type of skeletal podzol soil is predominant in Horezu, and Rm. Vâlcea and Jiblea Călimăneşti, it occupies positions four or three respectively. The profile has the following composition: Au or Aou-Es-Bhs-R or C. The Au/Aou horizon is dark with acidic humus; Es (podzolic or spodular eluate) strongly depleted in organic matter, enriched in silicone particles, 5-20 cm thick, very light (whitish), unstructured. Bhs horizon (accumulation of sexioxides and humus), 30-70 cm thick, rusty brown; then the R or C horizon follows. The podzols have a varied texture, often mid-coarse, undifferentiated on the profile. They have a grainy structure in the upper horizon and unstructured in the rest of the profile. The drainage is good, does not show excess water when it is on flat

surfaces or depressions. The humus content is relatively high but the humus is crude and acidic, it decreases a lot in Es and increases in Bhs it has a degree of saturation in bases and the ph is the smallest encountered in soils; microbiological activity and the supply of very low nutrients.

Similar properties and properties have the Podzols on the gravel, plus it has a good drainage and it warms slightly, we meet it at Horezu and Rm. Vâlcea.

CONCLUSIONS

1. In the areas belonging to the Sub-Carpathian depressions of Oltenia, the vine culture has been practiced since ancient times. Only in the areas along the axis: Drobeta Turnu Severin, Corcova, Polovragi, Târgu Jiu, Horezu, Râmnicu Vâlcea, Jiblea-Călimăneşti, the vine is cultivated on the surface of 2723.7 ha today.

2. The main types of soil present in these areas are 11 (eleven). In each area predominantly one or the other of the soils: calcic Preluvosol, limestone Preluvosol, eroded skeletal Preluvosol, Typical Luvosol on gravels, Eutricambosol skeletal, pelic Faeoziom, Litosol on skeletal limestone, Typical faeoziom, Limestone regosol, skeletal Podzol, Podzol on gravel.

3. The characteristics and attributes of the 11 types of soil are part of the ones preferred by the vineyard.

4. Although the vast majority of these soils have texture and structure that can be appreciated as good, they must however be ennobled by different and appropriate agro-technical measures for each individual situation.

5. All soil types have a very good drainage and the vineyards are located on slopes with a small angle of inclination, so the land does not need to be arranged on the terraces.

REFERENCES

Bucur N., 1956, Clasificarea solurilor folosite în cultura viţei, Rev. Grădina, Via şi Livada, nr. 7.

Chiriţă Constantin, 1966, Solul Pământ rodnic, Ed. Ştiinţifică, Bucureşti.

Chiriţă Constantin, Bălănică T.P., 1938, Cercetări asupra nisipurilor din sudul Olteniei. Analele I.C.E.F., seria I, vol. IV, Bucureşti.

Condei Gh., Popa P., 1977, Testarea fertilităţii solului din podgoriile Drăgăşani şi Miniş, prin analiza agrochimică şi diagnoza vegetală, Analele I.C.V.V., Valea Călugărească, vol. VIII, Bucureşti.

Condei Gh., Şerdinescu A., Liliana Pârcălabu, Mihai Ciolacu, Mihai Toti, 2017, Terroir-ul viticol- de la concept la implementare, Ed. Ceres, Bucureşti.

Dejeu L., 1984, Caracterizarea solurilor în legătură cu cultura viţei de vie în centrul Valea Călugărească, Teză de doctorat, IANB, Bucureşti.

Puiu Şt., Oprea D., Condei Gh., Udrescu S., Butănescu Gh., Ralicovschi Angela, 1977, Cercetări asupra solurilor de la Sâmbureşti plantate cu soiul Cabernet Sauvignon. Lucrări ştiinţifice IANB, seria B, XIV.Teaci D., 1980, Bonitarea terenurilor agricole, Ed. Ceres, Bucureşti.Teodorescu C.I., Băjescu N., 1956, Elemente agroclimatice şi caracteristicile solului din principalele regiuni climatice ale R.P.R. Ed. Academiei R.P.R., ICAR Tratat Monografic nr. 5, Bucureşti.

Urucu Justin, 2011, Research Concerning the influence of the soil type on the quantity of the production of black grapes, into the Sâmbureşti viticultural area, Analele Universităţii din Craiova, vol. XVI (LII).

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

RESEARCH ON THE CLIMATIC SUPPLY OF SOME NORTHERN OLTENIA AREAS FOR THE VINEYARD CULTURE

Giugea Nicolae[1], Cîrstea David[1*], Mărăcineanu Liviu[1]

[1]University of Craiova, Faculty of Horticulture
**Correspondence author e-mail:* david_cirstea@yahoo.com

Keywords: *viticulture, Oltenia, climate*

SUMMARY

In the Oltenia depressions under the mountains (Drobeta Tr. Severin, Corcova, Polovragi, Târgu Jiu, Horezu, Rm. Vâlcea, Jiblea-Călimăneşti) the vine has sufficient climatic resources for growth and fructification.

In the Polovragi area, belonging to the Ao oenoclimatic area, the vine can offer: grapes for fresh consumption, grape stum or grape juice, white wines with geographical indication, sparkling and distilled raw materials, sometimes white wines with a designation of origin white Fetească varieties, Crâmpoşie, Italian Riesling.

In the Tg. Jiu, Horezu, Rm. Valcea, Jiblea-Călimăneşti, belonging to the A2 oenoclimatic area can be obtained: table grapes, stum and grape juice; wines with a geographical indication, mistelles, wine alcohol, concentrated stum and white wines of dry white quality or dry descent with a designation of origin, quality rose wines or red wines with a designation of origin (priority varieties Fetească neagră, Pinot noir, Merlot), semi-dry, semi-sweet and sweet or liqueur wines (especially if there is noble rot), distilled wines (obsolete) with a designation of origin, sweet-flavoured wines with a designation of origin (mainly from Muscat Ottonel).

INTRODUCTION

Researches and studies conducted over time (Teodorescu C.I., 1939, 1968, Teodorescu Ştefan, 1977, Teodorescu Ştefan et al., 1987, Popa A., 2012, 2014, Popa A. et al., 2015, Popa A. , Genoiu C., 2007, Condei Gh., Et al., 2017) pointed out that in the depressions of the Sub-Carpathians of Oltenia, the vine cultivation was practiced from the harvesting stage of the man, when in the "runes" of forests he protects plants vines and fruit trees, being of great use to him. Besides, the names of "Runcu" localities in Gorj and Vâlcea betray this.

As viticulture met the practice of technologies that involved mainly the mechanization of the works, the vineyards were planted mainly in the southern areas on the Getic Plateau where the new technologies could be used.

However, in the depressions of the Sub-Carpathians of Oltenia, the vine is still cultivated on the area of 2723 ha.

Through our researches we wanted to prove the climate offer that allowed the cultivation of vineyards to the foot of the Sub-Carpathians of Oltenia.

MATERIAL AND METHODS

In order to capture the climate offer for vine cultivation in some areas in the sub-Carpathian depressions of Oltenia, we analyzed data on some elements of the climate

recorded for a long time (1950-2016) by some meteorological stations belonging to the National Meteorological Authority, located in the area under study.

To date, among all the criteria that capture a favourable area for vine cultivation, the most used and recognized as relevant is the "Oenoclimatic Skill Index" (Teodorescu Ştefan 1977), which implies the quantification of the sums of temperature degrees and the hours of brilliance of the sun, recorded during the active vegetation period (1 April 30 October) less the sum of precipitation, less than 250 (mm), which means the excess rain, always unfavorable to the quality.

A = T + I- (P-250) wherein:

A = Oenoclimatic ability;

T = Sum of temperature degrees;

I = Sunshine duration (hours);

P = Sum of precipitation (mm) from which 250 is decreased (excess rain).

This index reflects the temperature offer and the duration of sunstroke in an area, decisive factors for the growth and fructification of the vine. The more climate-friendly the two elements of the climate, the more the area has a greater vocation to cultivate the vine and get quality output.

RESULTS AND DISCUSSIONS

The climate characteristics of an area are also determined by its geographic location. Around the 45th parallel, the best climate offers are provided, where the vine provides quality produce. It is remarkable that the Romanian wine regions and centers are favored by their own geographical location. Between northern hemispheres parallels 44 and 48, all European countries enjoy the most favorable conditions for wine growing, and in this latitude range, there are many and varied categories and types of wines of the highest quality.

In Table 1 are presented the geographical and climatic elements found in some of the wine-growing areas, in the sub-Carpathian depressions of Oltenia.

The vineyards of Oltenia below the mountains are located between the coordinates 44º 35¹ (Corcova) and 45º 59¹ (Horezu) north latitude. Compared to the sea level, the areas are 116 m (Drobeta Turnu Severin) and 650 m (Jiblea-Călimăneşti). Between these altitudes we find the other arches studied: Corcova (150 m), Tg. Jiu (210 m), Râmnicu Vâlcea (242 m), Horezu (468 m), Polovragi (530 m).

The average annual temperature varies between 9.3° C at Polovragi and 11.6° C at Drobeta Tr. Severin. At Jiblea Călimăneşti we record 9,7° C, Râmnicu Vâlcea 10,2° C, Horezu 10,3° C, Tg. Jiu 10,4° C and Corcova 10,7° C. The most consistent annual rainfall is found at Polovragi (893 mm), closely adjacent to the Tg. Jiu (816 mm) and Jiblea-Călimăneşti (805 mm). In the other areas we record annual precipitation in the sum of: 762 mm (Drobeta Tr. Severin), 714 mm (Corcova), 710 mm (Râmnicu Vâlcea) and 710 mm (Horezu), the narrowest precipitation compared to the other areas of Oltenia below the mountain.

Table1

Geographical and climatic elements of some vineyards in northern Oltenia. (climate data (media) 1950-2016)

No.	Area	Northern latitude	Altitude (m)	Average annual temperature (ºC)	The annual amount of rainfall (mm)	Suma 1 April – 30 October			Oenoclimatic ability A= T+ I- (P-250)
						T	I	P	
						Temperature degrees (ºC)	Hours of sunshine (ore)	Rainfall (mm)	
1	Drobeta-Turnu Severin	44º38´	116	11, 6	762	3487	1542	354	4929
2	Corcova	44º35´	150	10,7	741	3313	1546	374	4682
3	Polovragi	45º11´	530	9,3	893	2938	1302	513	3978
4	Târgu Jiu	45º02´	210	10,4	816	3233	1450	433	4500
5	Horezu	45º59´	468	10,3	700	3270	1461	400	4581
6	Râmnicu Vâlcea	45º06´	242	10,2	710	3173	1425	411	4437
7	Jiblea-Călimăneşti	45º21´	650	9,7	805	3145	1460	470	4425

Of primary importance are the amounts of climatic elements that occur during the active vegetation period of the vine, when the delicate and complex physiological-biochemical processes that define the growth and fructification of the vine are actually taking place.

The sum of the temperature ranges during the vegetation period (1 April - 30 October) oscillates between 31-45° C, recorded at Jiblea Călimăneşti and 34-47° C at Drobeta Tr. Severin.

We find that in all the areas under study the sum of the temperature degrees of the vegetation period is sufficient for the plant to perform in optimal conditions the growth and maturation processes. In a similarly similar way, we find that even with sunshine the offer is a good one, oscillating between 1302 hours (Polovragi) and 1546 hours at Corcova. In Drobeta Turnu Severin we record 1542 hours at Tg. Jiu the sun during the vegetation period shines 1450 hours, at Horezu 1461 hours, at Rm. Vâlcea 1425 hours, and at Jiblea-Călimăneşti 1460 hours.

If the annual amount of rainfall in the areas studied is somewhere within the maximum accessibility limit for the vine, the sum of rainfall in the growing season is already at the level of the optimum plant requirements. Most rainfall during the vegetation period is recorded at Polovragi (513 mm), and the fewest at Drobeta Tr. Severin (354 mm). La Corcova fall 374 mm, at Tg. Jiu 433 mm, at Horezu 400 mm, Rm. Vâlcea 411, and at Jiblea-Călimăneşti 470 mm.

Now, the data on the sum of temperature ranges, the sunshine duration and the sum of rainfall, all during the active vegetation period, was available, which is the value of the Oenoclimatic Skill Index of each of the areas under study.

On the basis of this indicator, in each of the seven areas studied, it was possible to estimate with sufficient objectivity the climatic and quality offer of the vine. The value of the Oenoclimatic Skill Index oscillates between 3978 (Polovragi) and 4929 (Drobeta Tr Severin). With the value of the 3978 Oenoclimatic Skill Index, Polovragi Area is among the chilly Ao regions and wine centers with vineyards producing only quality white wines

The level of the Oenoclimatic Skill Index (Jiu 4500, Horezu 4581, Râmnicu Vâlcea 4437, Jiblea-Călimăneşti 4425) places these areas in the category of wine producing regions and centers mainly of white wines and, secondarily, of red wines quality A_3.

Corcova Area, with the value of the 4682 Oenoclimatic Skill Index, is part of the wine-growing centers and regions, belonging to the oenoclimatic zone A_3, the sub-group of hills, producing mainly red and aromatic wines, and secondly by quality white wines.

The area of Drobeta-Tr. Severin has a high value (4929) of the Oenoclimatic Skill Index, which makes it part of the wine-growing regions and centers of the A_3-hill-meridional oenoclimatic area, mainly producing red wines and, secondarily, quality white wines.

Growing and fructification processes, and especially grape-ripening, have proven to be the way of distribution (rainfall, sunshine duration and temperatures). Table 2 shows the monthly distribution during the vegetation period and precipitation.

Table 2

Monthly average precipitation (mm) during the vegetation period recorded in vineyards in northern Oltenia (1950-2016).

No.	Area	MONTH						
		April	May	June	July	August	September	October
1	Drobeta- Tr. Severin	70	62	70	79	36	35	40
2	Corcova	65	67	74	82	44	39	32
3	Polovragi	68	99	106	105	78	56	43
4	Târgu Jiu	65	67	94	86	59	51	33
5	Horezu	64	66	89	76	49	42	35
6	Râmnicu Vâlcea	69	73	81	94	66	42	35
7	Jiblea-Călimăneşti	70	69	90	96	60	45	36

The overall proportion of precipitation over the entire period is rather abundant and their excess may cause difficulties; however, it is observed that during August and especially in September and October, the rainfall is the lowest, the rainfall reduction in these three months, where the grapes are matured, creates conditions for better soil heating, but more chosen to remove the risk of gray rot.

The monthly (average) hours of sunlight recorded in the areas under study are shown in Table 3.

Table 3

Hours of sunlight during the vegetation period, recorded in the vineyards in northern Oltenia (average 1950-2016).

No.	Area	MONTH						
		April	May	June	July	August	September	October
1	Drobeta- Tr. Severin	173	186	275	316	302	217	173
2	Corcova	183	248	263	300	286	222	173
3	Polovragi	165	202	219	255	248	213	170
4	Târgu Jiu	182	236	253	290	276	221	172
5	Horezu	185	240	256	292	286	230	189
6	Râmnicu Vâlcea	183	222	247	283	272	217	181
7	Jiblea-Călimăneşti	191	247	249	249	240	219	187

It is noted that in all areas throughout the vegetation period, the vine has sufficient light, a decisive factor in the processes of chlorophyll assimilation, determining the processes of growth, fructification and maturation of the grapes.

Average monthly temperatures, the highest, are recorded in July. In August, near or after grape maturity, the temperature drops a little, but still retains a good level. In September, when finishing and defining the most delicate traits of composition and quality, when the grain skin is thinner and perishable for over-maturing and the installation of noble rot, the temperature drops by 3-4ºC, preventing important losses of valuable volatile compounds and significant combustion of organic acids. The same happens in October, the month with the least rainfall.

Table 4

Monthly average temperature recorded in vineyards in northern Oltenia during the growing season (average 1950-2016).

No.	Area	MONTH						
		April	May	June	July	August	September	October
1	Drobeta-Tr. Severin	12,4	17,3	20,8	22,7	22,5	18,5	12,8
2	Corcova	11,6	16,5	19,8	27,8	27,4	17,4	11,8
3	Polovragi	10,9	14,5	17,7	19,4	19,0	15,6	10,5
4	Târgu Jiu	11,5	16,3	19,7	27,4	20,9	16,7	11,0
5	Horezu	11,4	16,9	19,6	27,8	20,9	16,9	12,0
6	Râmnicu Vâlcea	11,2	15,8	19,2	20,9	20,3	16,4	11,0
7	Jiblea-Călimăneşti	11,7	16,5	19,5	20,0	19,9	16,6	11,2

Monthly average temperatures (Table 4), the highest, are recorded in July. In August, near or after grape maturity, the temperature drops a little, but still retains a good level. In September, when finishing and defining the most delicate traits of composition and quality, when grain skins are thinner and more presumptive for over-maturing and noble rotation, the temperature drops by 3-4ºC, preventing important losses of valuable volatile compounds and significant combustion of organic acids. The same happens in October, the month with the least rainfall.

Also, the average of the maximum temperatures during August and September (Table 5) indicates a high enough level to satisfy the complex synthesis processes that occur in grapes at this stage. At the same time, the average of the absolute maximum temperatures in these two months marks small levels, far from being necessary to pay attention. The moderate average absolute temperature in August and September, as well as the difference between the absolute maximum and the absolute minimum temperature in August, remove the fear of essential shortcomings that might occur.

Table 5

Maximum and minimum air temperature averages and maximum and minimum absolute, in August and September, in wine-growing areas in northern Oltenia (average 1950-2016).

No.	Area	Average temperatures									August (Difference Tx-Tn)
		Maximum			Minimum		Maxime absolute		Minime absolute		
							Tx		Tn		
		July	Augst	September	August	September	August	September	August	September	
1	Dr. Tr. Severin	29,1	29	25,1	16,2	12	37,4	34,8	9,6	1,2	27,8
2	Corcova	28,3	28,2	24,4	15,2	11,9	37,4	34,7	7,4	0,0	30,4
3	Polovragi	25,1	25,1	21,8	14	11	34	31,5	5,6	-1,8	28,4
4	Târgu Jiu	28,1	28,2	24,4	14	10,4	36,6	35,2	5,1	-2,2	31,5
5	Horezu	27,9	28	24,5	14,4	10,8	36,7	36	6,5	0,5	39,2
6	Râmnicu Vâlcea	27,5	27,3	23,9	14,2	10,7	36	33,5	7	-1,4	29
7	Jiblea-Călimăneşti	26,7	27	24,5	14,3	10,4	31,4	30,9	8,9	1	22,5

The favorability of the relative air humidity in all the months in which its existence is important is shown by the values presented in Table 6.

It is noted that, even in the warmest July and August, the relative humidity of the air is kept at a convenient level to carry out the physiological-biochemical processes in the plant.

Table 6

The relative air humidity (U %) recorded during the vegetation period, in the areas in northern Oltenia (average 1950-2016).

No.	Area	August 13 hours		MONTH					Annual
		Relative humidity of the air (U %)	Vapour-water saturation deficiency in the air (mb/cm)	May	June	July	August	September	
1	Dr. Tr. Severin	47	20,3	70	71	68	69	71	77
2	Corcova	48	18,8	69	70	68	70	71	76
3	Polovragi	55	13,3	70	72	68	69	71	75
4	Târgu Jiu	49	20,3	-	68	65	66	70	74
5	Horezu	50	19,9	-	68	66	68	69	76
6	Râmnicu Vâlcea	48	18	-	69	66	69	73	74
7	Jiblea-Călimăneşti	58	17	-	70	70,1	70	74	77

CONCLUSIONS

1. The vineyard culture in the depressions of the Subcarpathians of Oltenia is one of the oldest preoccupations of man, still in his gathering phase;

2. The wine-growing areas in the depression of Sub-Carpathians in Oltenia are the closest to the Romanian Carpathians;

3. The main climatic factors that determine the favorability of an area for vine culture, the duration of sunshine and the precipitations present in the Sub-Carpathian depressions in Oltenia are manifested in the most suitable proportions for the vineyard culture;

4. The areas under study (Drobeta Tr. Severin, Corcova, Polovragi, Tg Jiu, Horezu, Rm. Vâlcea, Jiblea-Călimăneşti) through the Oenoclimatic Skill Index, between 3978 (Polovragi) and 4929 (Drobeta Tr., belong to the vineyard regions and centers: Ao (Polovragi), A2 (Tg Jiu, Horezu, Rm. Vâlcea, Jiblea-Călimăneşti), A3 (Corcova) and hill-meridional A3 (Drobeta Tr.

5. As a result of the values of the Oenoclimatic Skills Index, in the wine-growing areas of the Sub-Carpathian depressions in Oltenia can be obtained: quality white wines (Polovragi); white wines, dry, semi-sweet and aromatic (Tg. Jiu, Jiblea-Călimăneşti) such as Sauvignon, Muscat Ottonel, Italian Riesling, white Fetească, but also red wines of Pinot noir, Merlot and even Cabernet Sauvignon; red and aromatic wines of selected quality (Drobeta Tr. Severin, Corcova);

6. The vineyards of Oltenia below the mountains must be protected, rebuilt and developed.

REFERENCES

Condei Gh., Şerdinescu A., Pârcălău L., Ciolacu M., Toti M., 2017, Terroir-ul viticol- de la concept la implementare, Ed. Ceres, Bucureşti'

Popa A., Genoiu C., 2007, Oltenia Mica Românie Viticolă, Rev. Winex Spirit, nr. 15; 16; 17;18, Bucureşti;

Popa A., 2012, Viticultura din Oltenia între reconstrucţie şi dezvoltare, Ed. Alma, Craiova;

Popa A., 2014, Repere oenologice româneşti, Ed. Alma, Craiova;

Popa A., Giugea N., Genoiu C., 2015, Oltenia Mica Românie Viticolă, Ed. Aius, Craiova;

Teodorescu C.I., 1939, Viile Daciei şi ale Principatelor Române, pg. 157 (manuscris);

Teodorescu C.I., 1968, Activites viticoles sur le territoire Dace, Redacţia revistelor agricole, Bucureşti;

Teodorescu Ştefan, 1977, Les vinglobs et les vins de Roumanie. Trav. Simpoz. Intern. Oenologie, Bordeaux;

Teodorescu Ştefan, Popa Aurel, Sandu Gheorghe, 1987, Oenoclimatul României, Ed. Stiinţifică şi Pedagogică, Bucureşti.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

EFFECT OF REPETED FRYING PROCESS ON CHEMICAL COMPOSITION OF EDIBLE VEGETABLE OILS

Giurgiulescu Liviu[1*], Șugar Ioan Radu[2], Bănică Mihai[2], Timiș Elena[1]

[*]Department of Chemistry Biology, Faculty of Science, Technical University of Cluj Napoca, Victoriei Street No.76, 430122, Baia Mare, Romania
[2]Department of Engineering and Technologic Management, Faculty of Engineering, North University Center of Baia Mare, Technical University of Cluj Napoca,, Victor Babes 62A, 430083, Romania
** Correspondence author. E-mail*: giurgiulescu@gmail.com

Keywords*: edible oils, peroxide index, iodine index, organic acidity, mineral acidity*

ABSTRACT

The main objective of the present study was to examine the effects of the multiple frying process over the chemical composition of sun flower oil; olive oil and palm oil. In order for investigation vegetable oils have been passed by five frying cycles. Before and after each frying step it was determinate peroxide index, saponification index, iodine index. Peroxide index increase in all media treatments. Olive oil record low stability during the frying process. Palm oil present a constant stability in frying process. Sun flower oil record a medium stability.

INTRODUCTION

Vegetable oils are substances extracted from plants which are obtained from oil containing seeds, fruits, or nuts by different pressing methods, solvent extraction or a combination of these (Benion, 1995) There are numerous vegetable oils derived from various plants such as soybean, cottonseed, peanuts, sunflower, palm, palm kernel, coconut seed, castor seed and rapeseed oil. These oils can be further classified as edible and non- edible; edible oils are mostly used in cooking. Over the years, vegetable oils have been used in various methods of cooking (Chebet et al. 2016). Deep frying involves submerging the food in hot, liquid fat at a high temperature of 150^0C-190^0C. (Yamsaengsung et al., 2002). As deep fat frying is normally carried out at high temperatures (between 150^0C and 190^0C) and in the presence of air and moisture, these frying oils and fats will undergo physical and chemical deterioration which will affect their frying performance and the storage stability of the fried products (Fauziah et al., 2000).

After deep frying, many people are tempted to keep the oil to be reused for long periods of time. This causes adverse effects on flavor, stability, colour and texture of fried product and may be harmful to human health (Sharoba and Mohamed, 2012). Deterioration in the vegetable oils is reflected by the decrease in iodine value. Iodine value is used to measure unsaturation or the average number of double bonds in fats and oils (Chebet et al. 2016). Different physical and chemical parameters of edible oil were used to monitor the compositional quality of oils (Ceriani et al., 2008, Mousavi et al., 2012). These physicochemical parameters include iodine value (IV), saponification value (SV), viscosity, density and peroxide value (PV). Edible oils are one of the main constituents of the diet used for cooking purposes. Several researchers studied the impact of temperature on the stability, viscosity, peroxide value, and iodine value to assess the quality and functionality of the oil (Farhoosh et al., 2008, Jinfeng et al., 2011).

Deep frying is one of the most common methods used for the preparation of food. Repeated frying causes several oxidative and thermal reactions which results in change in the physicochemical, nutritional and sensory properties of the oil (Che Man and Jasvir, 2000). During frying, due to hydrolysis, oxidation and polymerization processes the composition of oil changes which in turn changes the flavor and stability of its compounds (Gloria and Aguilera, 1998).

During deep frying different reactions depend on some factors such as replenishment of fresh oil, frying condition, original quality of frying oil and decrease in their oxidative stability (Choe and Min, 2007). Atmospheric oxygen reacts instantly with lipid and other organic compounds of the oil to cause structural degradation in the oil which leads to loss of quality of food and is harmful to human health (Bhattacharya et al., 2008). Therefore, it is essential to monitor the quality of oil to avoid the use of abused oil due to the health consequences of consuming foods fried in degraded oil, to maintain the quality of fried foods and to minimize the production costs associated with early disposal of the frying medium (Vijayan et al., 1996).

The aim of the present study is the effect of temperature on the chemical composition of vegetable oils after heating and frying with potato pieces and used the same oil for five times in five frying passages.

MATERIAL AND METHODS

Material and chemicals

Sodium hydroxide (NaOH), potassium hydroxide (KOH), sodium thiosulphate ($Na_2S_2O_3$), hydrochloric acid (HCl), acetic acid (CH_3COOH), iodobromine (IBr), potassium iodide (KI), potassium iodate (KIO_3) indicators (phenolphthalein).

Saponification (SV) value measurement

The saponification value is determined by taking 1.0 g of oil sample in a conical flask to which is added 15 mL 1 N KOH and 10 mL of distilled water and heated under a reserved condenser for 30-40 min to ensure that the sample was fully dissolved. After this sample was cooled, phenolphthalein was added and titrated with 0.5 M of HCl until a pink endpoint was reached. A blank was determined with the same time conditions. (AOAC, 1984).

Iodine value (IV) measurement

A known weight of the oil sample is treated with an excess of iodobromine (IBr) in glacial acetic acid. Unreacted iodobromine is reacted with potassium iodide which converts it to iodine. The iodine concentration is then determined by titration with standard sodium thiosulphate.

$$\mathrm{IV} = (b - v) \times N \times 126.9 \times 100/w \times 1000 \quad (1)$$

where b is the quantity of sodium thiosulphate used for blank, v is the quantity of thiosulphate for sample, N is the normality of thiosulphate solution, w is the wt of the oil sample and 126.9 is the molecular weight of iodine. (AOAC, 1984)

Peroxide value (PV) measurement

Peroxide value is a measure of peroxides contained in the oil. PV is determined by measuring iodine released from potassium iodide.

A known measured weight of oil samples is dissolved in acetic acid then chloroform and saturated KI mixture are added to the sample and the amount of iodine liberated from KI by the oxidative action of peroxides present in the oil is determined by titration with standard sodium thiosulphate using starch solution as an indicator. Titration was also performed for blanks.

$$\mathrm{PV(meq/kg\ oil)} = (S - B) \times W \times N \quad (2)$$

where B is the volume of sodium thiosulphate used for blank,W is the weight of sample, S is the volume of sodium thiosulphate consumed by the sample oil and N is the normality of standard sodium thiosulphate (AOCS, 1993).

Frying process

Potatoes were peeled and cut into pieces (appx 15 cm^3) and were fried in the frying oil at constant temperature 160^0C five frying times. Each frying passage used a quantity approximative 250 g potatoes. Frying experiments were conducted in duplicate in each frying medium. It used 3 types of vegetable oils (sun flower, olive and palm oil). For each sample was determinate organic acidity, mineral acidity, peroxide value (PV), saponification index (SV), iodine value (IV) before and after frying process.

RESULTS AND DISCUSSIONS

Saponification value measurement

Saponification value (SV) is an index to measure average molecular mass of the fatty acids in oil composition. In generally saponification index decrease during frying treatment. A low value of saponification value (SV) suggests an oil with high content in ester bounds and low content in fatty acids with high number of carbon bounds.

Saponification index for sun flower oil and olive oil decrease from unfrying samples to first frying treatment. After first frying treatment saponification value increase for olive oil and continue to decrease for sun flower oil, but in low limits. Palm oil record a constant decrease of saponification value, in low variation for all of frying process.

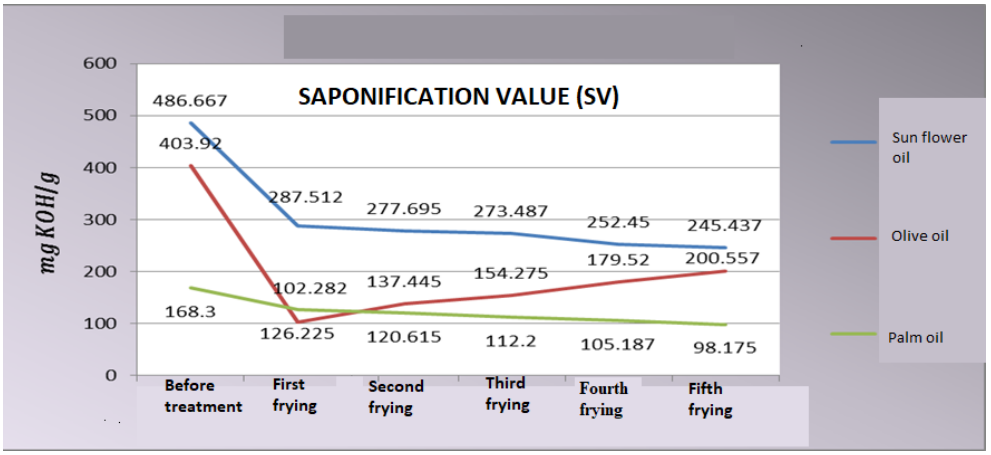


Figure 1. Variation of saponification value (SV) due frying process at edible vegetable oils

This might imply that sun flower oil records a medium stability in the frying process; palm oil presents a high stability during frying process and olive oil records a low stability during frying process.

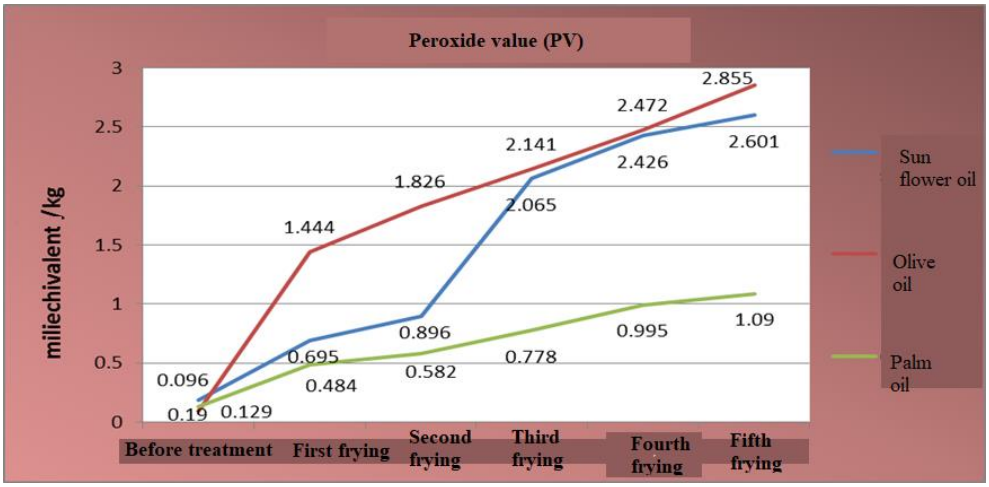


Figure 2. Variation of peroxide value (PV) due frying process at edible vegetable oils

Peroxide value (PV) is an indicator of the quality and stability of fats and oils during preservation period. In the same way the peroxide index can offer information regarding vegetable edible oils during technological process or frying treatment in household. A lot of people used many times vegetable oils in food coking even then the oil decrease in quality and generate high quantity of unhealthy substances. Peroxide value offer information regarding the vegetable edible oils during frying treatment. A first remark all the vegetable oils take in view record an increase of peroxide value (PV) during frying process. Olive oil achieve high content in oxidative compounds. Sun flower oil present low value of peroxide index after first and second frying treatment, but at the end the peroxide value are similar with olive oils. Sun flower oil can be used with good results for one or two frying treatment, begin with the third, fourth or fifth frying treatment sun flower oil can be unsafe for healthy use. Palm oil can be used with good results in any frying process. Peroxide value for palm oil increase with low values from the first frying treatment to the fifth frying treatment. The only problem that can occur is related to the concentration of the saturated fatty acids in palm oil composition, with high impact over human health. There is a successive increase in PV when the same oil was used for frying with a piece of potato. The peroxide value determines the extent to which the oil has undergone rancidity. (Zahir et al., 2017)

Iodine value (IV) measures the degree of unsaturation in a fat or vegetable oil. It determines the stability of oils to oxidation and allows the overall unsaturation of the fat to be determined qualitatively (AOCS, 1993; Asuquo et al., 2012). It was observed that measured iodine values for Sun flower and Olive oil are 1.44 g and 0.695 g respectively after first frying process. These low iodine values may have contributed to its greater oxidative storage stability. The oxidative and chemical changes in oils during storage are characterized by an increase in free fatty acid contents and a decrease in the total unsaturation of oils (Perkin, 1992).

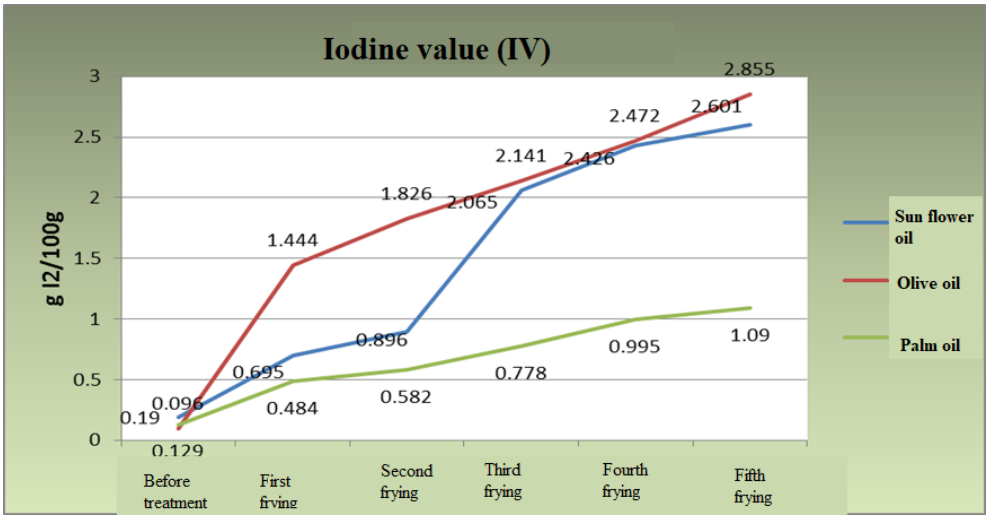


Figure 3. Variation of iodine value (IV) due frying process at edible vegetable oils

Iodine value follow the same way as peroxide and saponification value for edible vegetable oils have in view in this study. Olive oil record high iodine value at the end of frying process. Sun flower olive after first frying process present a value for iodine value near the palm oil. Second frying process determine an increase of iodine index for sun flower oil with 22 %. Third frying process determine a high value for iodine value at sun flower oil. Start with this step, sun flower oil is closed by olive oil than palm oil. As the previous results of peroxide value and saponification value, iodine index confirms a low resistance of sun flower oil after third, fourth and fifth frying treatment. Over the all is possible to affirm that sun flower oil can be used for one or two frying treatment, begin with third frying treatment sun flower olive It loses its qualities and becomes dangerous to consumers' health. Palm olive oil maintain its qualities throughout the frying process, iodine value increase from a step to other with low and constant values.

CONCLUSIONS

Deep frying and the use of same oil for frying many times is a general practice mostly in commercial and sometimes in domestic cooking processes. This practice generates lipid peroxidation products that may be harmful to human health. Most of these compounds remain inside the edible vegetable oils from a frying step to other. Compounds remain inside frying medium, affect physical and chemical properties of edible oils. In all the cases the main important index wich define quality of edible oils record increases. Values for peroxide, saponification and iodine index depends from a type of oil to other. Olive oils present high values of all the index and is not recommended for a deep frying with many passages. Sun flower oil can be used for one or two frying treatments, begin with third treatment the oil begins to be toxic for human health. Palm oil can be used for many frying processes without important changes in chemical composition, but the saturated fatty acids fraction is not recommended for daily consume.

REFERENCES

AOAC, 1984, Official Methods of Analysis. Association of OfficialAnalytical Chemists, Washington, DC.

AOCS, 1993, In: Official Methods and Recommended Practice of the American oil Chemist Society, fifth ed. AOAC Press, Champaign, IL.

Asuquo, J.E., Anusiem, A.C.I., Etim, E.E., 2012. Extraction and characterization of rubber seed oil. *Int. J. Mod. Chem.* 1 (3),109–115.

Benion M., 1995, Introductory Foods.10th Edition. Prentice-Hall Inc., Upper Saddle River, New Jersey, USA. Pp. 165-166

Bhattacharya A.B., Sajilata M.G., Tiwari S.R., Singhal R., 2008, Regeneration of thermally polymerized frying oils with adsorbents Food Chem., 110, pp. 562-570

Ceriani R., Paiva F.R., Alves C.B.G., Batista E.A.C., Meirelles A.J.A. , 2008, Densities and viscosities of vegetable oils of nutritional value Journal of Chemical and Engineering Data, 53 (8), pp. 1846-1853

Che Man Y.B., Jasvir I., 2000, Effect of rosemary and sage extracts on frying performance of refined, bleached and deodorized (RBD) palm olein during deep fat frying, *Food Chem.,* 69, pp. 301-307

Chebet J., Kinyanjui T., Peter K. C., 2016,Impact of frying on iodine value of vegetable oils before and after deep frying in different types of food in Kenya, Journal of Scientific and Innovative Research, 5(5), 193-196

Choe E., Min D.B. ,2007, Chemistry of deep-fat frying oils J. Food Sci., 72 pp. 77-86

Farhoosh R., Moosai S.M.R., Sharif A.,2008, Investigation on frying oils quality in terms of color index, refractive index and viscosity during frying process, J. Food Sci. Tech., 5 (1), pp. 13-19

Fauziah A, Razali I, Nor-Aini S., 2000, Frying performance of palm olein and high oleic sunflower oil during batch frying of potato crisps. *Palm Oil Developments*. 3: 1-7.

Gloria H., Aguilera J.M. 1998, Assessment of the quality of heated oils by differential scanning calorimetryJ. Agric. Food Chem., 46, pp. 1363-1368

Jinfeng P., Huixing S., Juan Y., Yong K.L., 2011, Changes in physiochemical properties of Myofibrillar protein from Silver Carp (Hypophthalmichthys mollitrix) during heat treatment, *J. Food Biochem*., 35 , pp. 939-952

Mousavi K., Shoeibi S., Ameri M., 2012, Effects of storage conditions and PET packaging on quality of edible oils in Iran, Adv. Environ. Biol., 6 (2), pp. 694-701

Perkin, E.G., 1992, Effect of lipid oxidation on oil and food quality in deep frying. In: Angels, A.J.S. (Ed.), Lipid Oxidation in Food, Chapter 18, ACS Symposium Series no. 500 ACS, *American Chemical Society*, Washington DC, pp. 310–321.

Sharoba A, Mohamed F.R., 2012, Impact of frying on fatty acid profile and rheological behavior of some vegetable oils. Journal of Food Process Technology. 3, pp. 7-8.

Vijayan J., Slaughter D.C., Paul S.R.,1996, Optical properties of corn oil during fryingInt. *J. Food Sci. Technol.*, 31, pp. 353-358

Yamsaengsung R, Moreira R.G., 2002, Modeling the transport phenomena and structural changes during deep fat frying, Part II: model solution & validation. *Journal of Food Engineering*.;53, pp. 11-25

Zahir Erum, Saeed Rehana, Hameed Mehwish Abdul, Yousuf Anjum, 2017, Study of physicochemical properties of edible oil and evaluation of frying oil quality by Fourier Transform-Infrared (FT-IR) Spectroscopy, *Arabian Journal of Chemistry* 10, S3870–S3876

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

EFFECT OF RIPENING STAGE ON THE TOTAL PHENOLICS CONTENT, LYCOPENE AND ANTIOXIDANT ACTIVITY OF TOMATO FRUITS GROWN TO A GEOTHERMAL GREENHOUSE

Gougoulias Nikolaos[1]*, Papachatzis Alexandros[1], Lazou Evangelia[1], Tsiountsioura Vassiliki[2], Ntalla Maria-Nektaria[3]

[1]Department of Agronomy Technology, Technological Educational Institute of Thessaly, Larissa, Greece.
[2]Faculty of Medicine, University of Thessaly, Larissa, Greece.
[3]Department of Computer Science and Engineering, Data Analysis, Technological Educational Institute of Thessaly, Larissa, Greece.
*Correspondence author's email: ngougoulias@teilar.gr

Keywords: *Tomato; hydroponic culture; lycopene; total phenols; DPPH activity*

ABSTRACT

Total phenols, flavonoids, non-flavonoids and lycopene content have been evaluated in hydroponically cultured tomato fruits cv. Sandin F1 of geothermal greenhouse for four stages ripening based on colour, as (mature green, mature pink, mature red and over ripening stage). Antiradical activity DPPH and the antioxidant activity FRAP were also assessed. The total phenols content ranged from 130.2 to 235 mg (GAE) kg^{-1} FW, flavonoids content ranged from 97.7 to 162.2 mg (GAE) kg^{-1} FW, non-flavonoids content ranged from 32.5 to 91.4 mg (GAE) kg^{-1} FW and lycopene content ranged from 12 to 143 mg kg^{-1} FW. The antioxidant activity FRAP ranged from 114 to 4970 µmol FRAP kg^{-1} FW, and the antiradical activity DPPH ranged from 62 to 989 µmol DPPH kg^{-1} FW. There were high correlation between lycopene and DPPH values (r^2= 0.6937) and lycopene and FRAP values (r^2= 0.8699).

INDRODUCTION

Free radicals are highly reactive compounds that play an essential role in many biological processes, both beneficial and deleterious. The excessive presence of free radicals induce cellular ageing and susceptibility to diseases (Sies 2015). This oxidative destruction of the biomolecules can be reduced by using natural antioxidants such as vitamin C, carotenoids and phenolic which are contained in fruits and vegetables (Valko et al. 2006).

Tomato consists a natural reservoir vitamin C, folic acid, carotenoids and phenolics compounds (Preedy and Watson 2009, Gougoulias et al. 2012). The carotenoids and phenolics compounds support and protect plant tissues, functioning as defence molecules in immunity, attractants for insect polinators, allelopathic agents and ultra violet protectants (Jaganath and Crozier, 2010). Lycopene is a long-chain unsaturated carotenoid which reflects the basis of the red colour of ripened tomato fruits, while it is the most powerful antioxidant member of the carotenoid family (Heuvelink, 2005). Furthermore, phenolic compounds affect the color and taste in many fruit, while exercising potent antioxidant properties (Alesiani et al. 2010). Generally, diets rich in carotenoids and in phenolic compounds are associated with low risk probability in some diseases, such as cardiovascular diseases and various types cancer (Zhang et al. 2016).

The ripeness degree markedly of fruits influence the quantity of the phenolic compounds. The degradation of some phenolic compounds it may be faster or slower than biosynthesis other phenolic compounds. According to some authors, phenolic acids content decrease during ripening, whereas flavonoid phenols content increase during ripening (Manach et al. 2004). Generally, agricultural, technological, and environmental factors influence in lycopene and phenolic compounds content of tomato fruits as well also and their antioxidant activity (Benton 2008, Tommonaro et al. 2008).

Greenhouses are one of the largest low-enthalpy energy consumers in agriculture. The development of today's hydroponic systems, is based on modern distribution systems of nutrient solution (Domingues et al. 2012, Gougoulias et al. 2015). Geothermal energy is derived by absorption of solar radiation, is stored from the earth's surface up to depth 200 m with a temperature of 10-18 °C. Geothermal energy provides economic benefits, and contributes to a reduction of greenhouse gases (Bloomfield et al. 2003).

The objective of our study was to determine at a geothermal greenhouse the total phenols content, flavonoids, nonflavonoids, lycopene, such as and the antioxidant activity of tomato fruits at different ripening stages.

MATERIAL AND METHODS

Tomato cultivation: The experiment was conducted in closed type geothermal greenhouse of Technological Educational Institute of Thessaly. The system water recycling, be based on shallow geothermal energy. The energy requirements of greenhouse for cooling, heating and converting the water vapor into water, covered by closed circuit exchangers that are constructed adjacent to the greenhouses at a depth of 100 meters. The greenhouse, for dehumidifying the air and for the water collection has a special metallic conduit that recycles part of the air in the greenhouse environment. For the air conditioning of greenhouse there is the optimal heating and cooling system with both heat pumps. The overall flow of water with in the greenhouse is controlled by modern automation, which continuously adjusts the flow in the system.

Tomato plants (var. Sandin F1) was cultivated in the hydroponic system during October 2015 to May 2016. Substrate stone wool slabs, were placed in double rows, with a distance of plants in each slab of 30 cm. Secondary pipes were placed in a specially designed table, in order to reduce heat loss to the environment and to heat the plants in the root zone. The crop was fertilized through a stably chemical nutritive solution at the rates of 58.9 ml/min for 3 repetitively 4 times a day. The nutritive solution consisted of Ca^{2+} =169meq/L, K^{+} = 253.4 meq/L, Mg^{2+} = 64.8meq/L, NH_4^{+} = 18.3 meq/L, H^{+}= 112meq/L, Fe^{2+} = 0.6 meq/L, $N0_3^{-}$ = 281.3meq/L, PO_4^{3-} = 143.3 meq/L and $S0_4^{2-}$ = 193.5 meq/L, while, its pH was about 6 and electrical conductivity EC about 2 dS /m.

Over the seasons examined, tomato fruits were collected were assessed during four ripening stages, based on color (S1,S2,S3, and S4), such as mature green, mature pink, mature red and over ripening stage, respectively. The annual production was 90 tn/ha (3.4 Kg/plant) with mean fruit weight 0.26 Kg.

Four tomato fruit with uniform size, shape and color were harvested for analysis at each maturity stage. Tomato fruits immediately were carefully cut in four equal parts, were frozen by pouring into liquid nitrogen and homogenized using a blender.

Preparation of the ethanol extracts: For the determination of phenols and antioxidant activity, 20 g of samples were two rounds treated by 20 ml of 80 % aqueous ethanol. Samples were incubated for 24 h in the extractant at stirring. The extract was gathered after centrifugation and filtration. The pellet was re-treated with 20 ml of 80 % aqueous ethanol for 2 h at stirring at ambient temperature. The extract was gathered

after centrifugation/filtration and the volume was made up to 50 ml with aqueous ethanol and used for further chemical analysis (Kanner et al. 1994).

Methods of analyses: The amount of total polyphenols (TP) in the tomato fruits was determined with the Folin-Ciocalteu (F.C.) reagent according to the method by (Singleton and Rossi, 1965) and were expressed as gallic acid equivalent (GAE) in mg kg^{-1} fresh weight.

The content of nonflavonoid phenols (NFP) was determined with the F.C. reagent after removing the flavonoid phenols with formaldehyde according to the method by (Kramling and Singleton, 1969) and was expressed as gallic acid equivalent (GAE) in mg kg^{-1} fresh weight.

The content of flavonoid phenols (FP) were determined as a difference between the content of total phenols and nonflavonoid phenols. Their amount was evaluated as gallic acid equivalent in mg kg^{-1} fresh weight.

The antiradical activity (DPPH) of the ethanol extracts were evaluated using the stable free radical 2,2′-diphenyl-1-pycrylhydrazyl radical (DPPH•), as a reagent, according to the method by (Brand-Williams et al. 1995) and the results were expressed as μmol DPPH kg^{-1} fresh weight.

The ferric reducing antioxidant power (FRAP) of fruits extracts was evaluated according to the method by (Benzie and Strain, 1999) and the results were expressed as μmol FRAP reagent kg^{-1} fresh weight.

The lycopene content was determined in fruit extract taken from 1.0 g homogenized fruit sample using 20 ml of acetone-ethanol-hexane in volume ratio 1:1:2, according to the method by (Ravelo-Perrez et al. 2008). The result was expressed in $mg.kg^{-1}$ fresh weight.

Data analysis was made using the MINITAB (Ryan et al. 2005) statistical package. The results are means of four parallel samples. Analysis of variance was used to assess treatment effects. Mean separation was made using Tukey's test when significant differences (P=0.05) between treatments were found.

RESULTS AND DISCUSSION

The changes in total phenolic content of tomato fruits during ripening stages are presented in Table 1. Ripening stages affects the content of the total phenols of tomato fruits. The content of TP of tomato fruits in the ripening stages studied ranges from 130.2 to 235.0 mg (GAE) kg^{-1} FW. In particular, in the mature red colour of tomato fruits the highest polyphenols content was observed, while in the mature green colour the lowest polyphenols content was observed. In addition, from the mature red colour to over ripening stage colour there was a significant reduction of total phenolic content of the fruits by 19 %. These results are consistent with to other studies, proving that the content of total phenols decreases after maturity stage of tomato fruits (Raffo et al. 2002).

The content of flavonoid phenols (FP) of tomato fruits in the ripening stages studied ranges from 97.7 to 162.2 mg (GAE) kg^{-1} FW (Table 1). In particular, in the mature red colour of tomato fruits the highest polyphenols content was observed, while in the mature green colour the lowest polyphenols content was observed. The FP content in the ripening stages studied constitute from 52 % to 75 % respectively of TP amount (Table 1). In addition, from the mature red colour to over ripening stage colour there was a significant reduction of flavonoid phenols content in the fruits by 39 %.

The content of nonflavonoid phenols (NFP) of tomato fruits in the ripening stages studied ranges from 32.5 to 91.4 mg (GAE) kg^{-1} FW. From the mature red colour to over ripening stage colour there was a significant increase of nonflavonoid phenols content in the fruits by 25.6 %.

The lycopene increased from 12 to 143 mg kg^{-1} FW during tomato ripening. In the first two maturity stages tomatoes had very small quantity of lycopene, while the red maturity stage had great quantity. The lycopene synthesis continued during over-ripe stage (143 mg kg^{-1} FW), on the contrary with other research finding (Kozukue and Friedman, 2003).

Table 1

Changes in total phenolic content, flavonoid phenols, nonflavonoid phenols and lycopene at different ripening stages of tomato fruits

Ripening stages (colour)	TP	FP	NFP	FP % of TP	Lycopene
	mg (GAE) kg^{-1} FW				mg kg^{-1} FW
S1, mature green	130.2c	97.7c	32.5c	75	12d
S2, mature pink	195.5b	136.9b	58.6b	70	31c
S3, mature red	235.0a	162.2a	72.8b	69	112b
S4, over ripening stage	190.4b	99.0c	91.4a	52	143a

Columns with the same letter do not differ significantly according to the Tukey's test (P=0.05).

The changes in antioxidant activity FRAP of tomato fruits during maturation are presented in Table 2. The antioxidant activity FRAP from the mature green stage until the over-ripe stage, significantly increased from 114 to 24970 µmol FRAP kg^{-1} FW. The results showed that tomato fruits containing the highest total phenolics content do not containing and the highest antioxidant activity. The antioxidant FRAP activity was correlated with the quantity of lycopene and TP and the following significance levels were obtained r^2=0.8699 and 0.4119 respectively. High correlation between lycopene and antioxidant FRAP activity during ripening of tomato has reported and in other studies (Ilahy et al. 2011). The antiradical activity DPPH in the tomato fruits for the ripening stages studied ranged from 62 to 989 µmol DPPH kg^{-1} FW. The antiradical activity DPPH was correlated with lycopene and total phenols content and the following significance levels were obtained r^2=0.6937 and 0.6776 respectively. The antiradical activity DPPH and the antioxidant activity FRAP in the tomatoes, obtained by the combination of all individual antioxidant compounds activity found in the tomatoes.

Table 2

Changes in antiradical activity DPPH and antioxidant activity FRAP at different ripening stages of tomato fruits

Ripening stages (colour)	DPPH	FRAP
	µmol DPPH kg^{-1} FW	µmol FRAP kg^{-1} FW
S1, mature green	62d	114d
S2, mature pink	710c	2150c
S3, mature red	822b	3100b
S4, over ripening stage	989a	4970a

Columns with the same letter do not differ significantly according to the Tukey's test (P=0.05).

CONCLUSIONS

The results showed that in the first two ripening stages of hydroponically cultivated tomato of geothermal greenhouse the total phenols are in high quantity, while the lycopene content is negligible. From green to over-mature stage the content of TP, NFT, FP and lycopene increased by 46.2 %, 181%, 1.3 % and 1091 % respectively.

In the over-ripening stage the total phenol and flavonoid content decreased compared to the red mature stage, while lycopene and nonflavonoid content increased compared to the red mature stage. Also, the DPPH assay and the Ferric reducing antioxidant power (FRAP) increased up to over-ripening fruit stage.

REFERENCES

Alesiani D., Canini A., D'Abrosca B., DellaGreca M., Fiorentino A., Mastellone C., Monaco P., Pacifico S., 2010, Antioxidant and antiproliferative activities of phytochemicals from Quince (Cydonia vulgaris) peels. Food Chemistry, 118,199–207.

Benton J.J., 2008, Tomato plant culture: In the field, greenhouse and home Garden 2nd Edition CRC press Taylor and Francis Group.

Benzie I.F., Strain J.J., 1999, Ferric reducing/antioxidant power assay: direct measure of total antioxidant activity of biological fluids and modified version for simultaneous measurement of total antioxidant power and ascorbic acid concentration. Methods in enzymology, (299), 15-27.

Bloomfield K.K., Moore J.N. and Neilson R.N., 2003, Geothermal energy reduces greenhouse gases, Geothermal Resources Council Bulletin 32, (2), 77-79.

Brand-Williams W., Cuvelier M.E., Berset C.L.W.T., 1995, Use of a free radical method to evaluate antioxidant activity. LWT-Food science and Technology, 28(1), 25-30.

Domingues D.S., Takahashi H.W., Camara C.A., Nixdorf S.L., 2012, Automated system developed to control pH and concentration of nutrient solution evaluated in hydroponic lettuce production. Computers and Electronics in Agriculture, 84, 53-61.

Gougoulias N., Papachatzis A., Kalorizou H., Vagelas I., Giurgiulescu L., Chouliaras N., 2012, Total phenolics, lycopene and antioxidant activity of hydroponically cultured tomato sandin F1. Carpathian Journal of Food Science and Technology, 4(2), 46-51.

Gougoulias N., Giurgiulescu L., Kalfountzos D., Papachatzis A., Vagelas I., Ftakas D., Pateras D., Chouliara A., 2015, Coir Employed as Soilless Cultivation Substrate and its Interference With Nutrien Solution During Two Tomatoes Cropping Periodes (Case Study). Studia UBB Chemia, LX, 2, Tom 1, 177-185.

Heuvelink E., 2005, Tomatoes. CABI Publishing, 339 p.

Ilahy R., Hdider C., Lenucci M. S., Tlili I., Dalessandro G., 2011, Antioxidant activity and bioactive compound changes during fruit ripening of high-lycopene tomato cultivars. Journal of Food Composition and Analysis, 24(4-5), 588-595.

Jaganath I. B., Crozier A., 2010, Dietary flavonoids and phenolic compounds. Plant phenolics and human health: biochemistry, nutrition, and pharmacology, 1, 1-50.

Kanner J., Frankel E., Granit R., German B., Kinsella J. E., 1994, Natural antioxidants in grapes and wines. Journal of Agricultural and Food Chemistry, 42(1), 64-69.

Kramling T.E., Singleton V.L., 1969, An estimate of the nonflavonoid phenols in wines. American Journal of Enology and Viticulture, 20(2), 86-92.

Kozukue N., Friedman M., 2003, Tomatine, chlorophyll, β-carotene and lycopene content in tomatoes during growth and maturation. Journal of the Science of Food and Agriculture, 83(3), 195-200.

Manach C., Scalbert A., Morand C., Rémésy C., Jiménez L., 2004, Polyphenols: food sources and bioavailability. The American journal of clinical nutrition, 79(5), 727-747.

Preedy V. R., Watson R.R., 2009, Tomatoes and Tomato Products: Nutritional, Medicinal and Therapeutic Properties. Nutrition & Food Science, 39(6), 702-702.

Raffo A., Leonardi C., Fogliano V., Ambrosino P., Salucci M., Gennaro L., Bugianesi R., Giuffrida F., Quaglia G., 2002, Nutritional value of cherry tomatoes (Lycopersicon esculentum cv. Naomi F1) harvested at different ripening stages. Journal of Agricultural and Food Chemistry, 50(22), 6550-6556.

Ravelo-Pérez L.M., Hernández-Borges J., Rodríguez-Delgado M.A., Borges-Miquel T., 2008, Spectrophotometric analysis of lycopene in tomatoes and watermelons: a practical class. The Chemical Educator, 13, 11-13.

Ryan B.F., Joiner B.L., Cryer J.D., 2005, MINITAB Handbook: Updated for release 14, 5th edition.

Sies H., 2015, Oxidative stress: a concept in redox biology and medicine. Redox biology, 4, 180-183.

Singleton V.L., Rossi S.A., 1965, Colorimetry of Total Phenolics with Phosphomolibdic-phosphotungstic Acid Reagents. J Enol Viticult, 16, 144-158.

Tommonaro G., Nicolaus B., De Prisco R., De Giulio A., Strazzullo G., Poli, A., 2008, Antioxidant compound studies in different tomato cultivars. Tomatoes and tomato products: Nutritional, medicinal and therapeutic properties, 333.

Valko M., Rhodes C., Moncol J., Izakovic M. M., Mazur M., 2006, Free radicals, metals and antioxidants in oxidative stress-induced cancer. Chemico-biological interactions, 160(1), 1-40.

Zhang L., Yue P., Jiang J., Fan J., Gao X., 2016, Effect of phenolic compounds on antioxidant activity in 8 blueberry (Vaccinum spp.) juices. Carpathian Journal of Food Science and Technology, 8(2), 178-186.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

RESEARCHES REGARDING SOME OF THE ABNORMALITIES IN POLLEN TUBES PEACH AND NECTARINE

Iordache Maria[1*], Dumitru Maria[1], Ilie Alina[1], Coroianu Lenuta[1]

[1]Research Development Station for Fruit Trees-Growing Baneasa of Bucharest, Romania, 4 Ion Ionescu de la Brad Blvd, sect 1
*Correspondence author. E-mail: mioaraiordache@yahoo.com

Keywords*: pollen tube, germination abnormalities.*

ABSTRACT

This study presents the analysis through microscopic methods of the pollen tubes, that develops during germination through different cultural back grounds (media culture), under experimental laboratory and highlighting some "particular" specific aspect and development that may arise during their progress. Pollen tubes are not always suitable beins crossed by the pestle during the sprouting process "in vivo". It follows that during pollen germination "in vitro", in both the peach and nectarine were observed abnomalies in percent of 1 % and 5 % in pollen tubes. The microscopic examination was done in transmited light and phase contrast.

INTRODUCTION

Testing "in vitro" the germination capacity of pollen, it gives us an objective indication of the apporturities in obtaining satisfying crops from the fruit trees. The pollens vitality represents the biological potential, at that moment, for the flowers fertility. It takes a complex of possibilities for the pollen cell to provide, such as: compatibility high germination capacity, proper viability, pollen to be produced in sufficient quantity (abundant stigma). The characteristics are determined by genotype, but to manifest it is mandatory a favorable agreement between the climatic factors and the biological stage (Ivaşcu A.,et al. 2001-2002). If pollen germination, by analogy process was named "autotrophic", the development of the pollen tube, in its tissue style, was named "heterotrophic", because this stage is a coordinated relationship, pollen-tube stylar secretions (Hedhly A.,et al. 2004). The development of the pollen tube depends on the genetic factors controlling the biology of the pollen granule and also the physiology and the pestle genome (Herrero and Arbeloa, 1989 quoted by Hedhly A. et al. 2004, in his work on cherry.). A particular importance for the pollen germination ability, it has the temperature effect an the development of the pollen tube. Temperature has a clear effect on the kinetics of the pollen tube and on the lenght
required for the pollen tube to reach the stylish base (Hedhly A. et al. 2004). The favorable temperature growth of pollen tube is between 10 ºC and above 20ºC for the fruit trees (Weinbaum et.al 1984, quoted by Hedhly A. et al. 2004, in his comparative study of two varieties of Prunus avium L., from Spain and Canada). The temperatures below 10 ºC and above 20 ºC, decreases the rate of germination and the growth of the pollen tube. For each species or variety, are characteristic some certain critical temperatures which triggers the "heat stress" that affects the formation of the male gametophytes (Egea J. et al. 1992, quated by the same author in 2004). Also, the

germination process is stimulated by different temperatures other than those favorable to the pollen tubes growth in style, because they represent different stages in the fertilization process. The moderate temperature stimulates the stigma secretion, increases and favors the adhereance of pollen germination; slightly higher temperature accelerates the growth of the pollen tube (Hedhly A. et al. 2004). In studies of Vitis vinifera and Ampelopsis, the author (Pădureanu S. 2007), has analyzed the reasons for the abnormal forms that may occur during germination of the pollen tubes. Nationally, the nutrient environments of pollen cited in the consulted literature contain agar of 1,5 % with some exceptions. The sucrose concentration on which the pollen germination was tested, was generally 10 % - 20 % (Butac M. et al. 2006; Blidariu A. et al 2008; Ivaşcu A. 2001-2002, Cociu V., Oprea St., 1989).

Exceptionally the concentration of sucrose was of 25 % and 45 % (Pădureanu S. 1998-2000, of Ampelopsis brevipedunculata, Ampelopsis aconitifolia, Vitis vinifera). The germination temperatures wereon average of 18 ºC, 20 ºC, 25 ºC (Butac M. et al. 2006; Pădureanu S. 1998-2000; Blidariu A. etal 2008). The boric acid was added in a medium concentration of 0,01 % (Butac M. et al. 2006; Cociu V., Oprea St., 1989). It was studied the germination rate, which has been followed at every 3,6,12,24,36, hours. Generally, the maximum germination occurred within 6-12 hours (Butac M. et al. 2006). Staining methods of methyl blue and carmine acetic were used in pollen for apple, pear,cherry, plum trees. In this paper we have proposed “in vitro” pollen testing on a liquid environment in sight of its germination, aiming – pollen analysis by microscopic methods and determination of its vitality. As a novelty of this work, we wanted to point out the manifestation of some features “particularities” and development of pollen tubes that can occur during pollen germination using sucrose solutions of different concentrations and different methods of staining with methyl blue and separately with carmine acetic acid. The varieties of fruit trees investigated and evaluated are mainly Romanian peaches and nectarine. The analysis was based on the documentation referring to the research stage in the field concerned our research correlating with the specialized literature.

MATERIAL AND METHODS

Sampling was done in the second decade of April 2011(the year of our research). The peach flowering started on 18 April 2011 and the nectarine bloom started on 13 April 2011. The trials consisted in open flowers (at anthesis) and the blooming threshold in bud stage. It was analised the pollen of flowers from three varieties of peach, Amalia, Congres and Splendid and from two varieties of nectarine, Tina and Mihaela. It was also envisaged that to the choise of varieties, to be included all three periods of repening(early, medium and late).To represent more accurately the biological potential of pollen at the time, it was made homogenous for each variety, another one antheres sample, taken from several flowers. Both for evaluation of pollen viability (V %) and to asses the ability germinative (G %) of a certain variety, anthers with pollen were detached from the staminal filaments of floral buds and has been and then deposited (in multiple parallel copies) for each variety on a microscopic glass-slides /blade (port-object), in the presence of 2-3 drops of distilled wather for each, then the pollen to adhere better and to facilitate the release of pollen from the anthers. The content of pollen on each microscopic (slide) glass-blade, is an average trial (an experiment) for the species examined. According to experimental results from previous years (Iordache M. et al. 2010), it was chosen for seeding the media only with pre-hydrated pollen (Xie B. et al. 2010; Cresti M. 1978; Kaufmane E. 2004; Hedhly A. et al. 2004). For the viability assessment a method of specific enzimatic was applied, to determine pollens viability, using 2,3,5-TTC-triphenyl-tetrazolium-chloride (Andrei M.,Paraschivoiu R. 2003). Alwais

the viability is working only on pollen, without anthers. Viability was expressed as a percentaje (V %) by dividing the total number of viable pollen grains from the microscopic fields examined. A separete step followed by the evaluation of germination capacity (G %) of the pollen.On the average sample of each variety, were made in different concentrations of sucrose, seeding (insemination) germinating media. The media used to evaluate pollen germination were liquid media of distilled water. For checking and for the safety of the results, a total of 3 identical repetitions of complete germination (paralel insemination) were made. At pollen seeding were used, sucrose culture media in 2 conceltrations, respectively 15 % and 20 %, for both peach and nectarine. In addition each culture media, contained boric acid 0,01 % (H_3BO_3), used to reduce the risk of contamination and to avoid alternation in the germination environment. Also, all ustensils such as tweezers, glass-slides, filter paper and the culture media, etc., have been sterilized in advance. The glass slides were mentained at 17ºC to 20 ºC in a humid athmosphere, so that the liquid medium not to be evaporate. Thus the concentration of the culture medium is avoided by evaporation of the wather and consequently keeping the concentration of boric acid (H_3BO_3) and sucrose constant. The humid atmosphere was maintained by placing/inserting, each microscopic variant (port-object glass-blade) in Petri glass boxes of 8,5 cm diameter, lined internally with moistened filter paper with distilled sterilized wather (Andrei M., Paraschivoiu R. 2003; Andrei M., Radulescu Di. 1972). After seeding, the first laboratory test were made after a verification period of 5 hours and another verification at 24 hours. The control, examination and shooting , were done at the optical microscope IOR-LM.4-M, in transmited light and in contrast to the 10 x ocular phase and the lenses-objectives of 10 x, 20 x, 40 x (Iordache M., et al. 2010). The germination capacity was expressed a procentage (G %) by reporting pollen germinated to the total of existing and cuanted field grains. As is currently practiced, granules having the pollen tube length at least equal to twice the diameter of the pollen, have been considerated germinated. For staining the citoplasmatic contents, it was used blue methyl and separately acetic carmine. The results obtained from the 3 repetitions/experiment, were expressed as percentage on the basis of the corresponding arithmetic mean. Then the germination values (G %) were also reparted viability values (V %) coresponding to the variety (G/V). The pollen germination yield was obtained %R(G/V).

RESULTS AND DISCUSSIONS

Microscopic analisis of the pollen germination *"in vitro"* in the liquid medium, is superior to the control with the stereo magnifying glass (on solid agar medium), as it allows observation of normal cell migration in the pollen tube. Pollen germination was homogeneous on all experimental microscopic lamellae. During *"in vitro"* germination of the pollen, both on peach and nectarine, it has been observed since the first microscopic examination made immediately after the dispersion of the pollen granules in the culture medium, it has been noticed, that some pollen granules consists only of exin, beeing partially or even totaly devoid of protoplasmatic (cellular) content. These granules are implicitly unsustainable, and their presence is explained as being possible in certain disorders of the microsporogenesis (in anther wallpaper). Consequently the pollen germination capacity was only reported for mature and viable pollen granules. Also from a microscopic point of view it was observed that the mature pollen granules with an oval appearance (viewed through the meridian optical section) as well as those with triangular aspect (viewed through the equatorial-polar optic section) have the characteristic appearance of species and have normal cellular content. Also the apertures (germinating pores) are sufficientely developed to allow the formation of the germinating papillaeand finally the pollinic tube with the apical toe formation. At the microscopic examination of

viable grains germination, it was observed that the germination onset did not occur simultaneous ly to all granules for 3 days, and the number of granules that developed the pollen tube was increasing. After the third day when germination stagnated, the final counting was done and the proportion of germinated and non-germinated granules aut of the total of viable granules was settled. In terms of using the two dyes the most significant results were obtained with, methylene blue, which more clearly showed the cellular content of the mature pollen grains sa well as the migration of the protoplasme from the granule into the pollinic tube during germination. Immature pollen grains did not stain. On peaches, the mature pollen has shown V %= 39 %-67 % (using 2,3,5-TTC), G %= 30 %-53 % and % R(G/V)= 74 %-82 %, having as a leader Amalia variet, folowed by the Splendid variety, the Congres recorded the weachest germination. To nectarine the mature pollen presented V %=40 %-79 % (using the 2,3,5-TTC substance), G %=18 %-33 % and % R(G/V)=23 %-82 %, having as a leader Michaela variety and the Tina variety had a low germination. The best germination of all varieties analyzed by peach and nectarine was recorded in the liquid medium with sucrose 20 % and H_3BO_3-0,01 %. The results G % / V % express a vital correlation for variety/species, also very impressive for the practical consequence of fruit binding and fruit - trees production. In practice, a germinating capacity of 30 % pollen secure the fruit binding and normal fruit production. Also, with respect to the development and opperance of the pollen tube, 2 types of “particularities” in 1 % and 5 % percent were observed. The first "peculiarity" which I noticed in both varieties of nectarine, it was like the pollinic tubes can have the bifurcated end in the apical area. In this situation the two branches in which the pollen tube ends may or may not be equal (Figure 1, Figure 2 and Figure 3). The bifurcated pollen tube, generally has a normal growth at the beginning in the first one-two hours, and then a branch appears that is usually, approximately equal to the other free portion of the pollen tube and (thus) the final aspect is the biffurcation.

Figure 1. Pollen tube with apical bifurcation (anomaly) in the advanced phase to nectarine.

Figure 2. Pollen tube with the bifurcation trend (anomaly) in the early phase to nectarine.

Figure 3. Microspore with cytoplasmatic content turned out through aperture (anomaly) to nectarine.

Figure 4. Pollen tube with deformation (anomaly) to peach.

The second (feature) ”particularity”, consists of spiraling the free end, usually in the apical zone. These deviations are more rare than bifurcations; sometimes the spiraling is reduced to only one or two spirales or even simple bents of the pollen tube. The bents are pronounced because the two bented portions form stright line or even sharp angles (figure 4).

Tabel 1

The relationship between germination (G %), viability (V %) and yield in germination % R (G / V) at peach and nectarine (2011) on culture media with 15 % and 20 % sucrose

No.	Species and variety	Germination max. of the total pollen (G %)		Viability (V %)*	Spin yield % R (G / V) **	
		Sucrose 15 %	Sucrose 20 %		Sucrose 15 %	Sucrose 20 %
1	Piersic AMALIA	50	53	67	74	79
2	Piersic CONGRES	32	30	39	82	77
3	Piersic SPLENDID	45	45	60	75	75
4	Nectarin TINA	18	27	79	23	34
5	Nectarin MIHAELA	23	33	40	57	82
(*) Viability determined by the staining method with 2,3,5 TTC-Triphenyltetrazole chloride. (**) Spin yield % R (G / N) calculated by ratio between germination and viability (%)						

CONCLUSIONS

As a result of these experiments in estimating of the pollen vitality as an aspect and others as well as of these characteristics, called by us, "peculiarities" of aspect and developing of pollen tubes that may appear during the pollen germination, the folowing conclusions are: To peach, the leader in grminative capacity was Amalia variety and then Splendid variety.

The Congress variety recorded the worst germination. To nectarine, the leader in germinative capacity was Mihaela variety, and the Tina variety had a low germination. The best germonation capacity of all varieties analized by peach and nectarine on the liquid medium with sucrose 20 % and H_3BO_3-0,01 %, was recorded.

The manifestation of these "peculiarities" occurring *"in vitro",* in the development of the pollen tube, suggests that there are some “germination abnormalities” in percent of 1 %and 5 %, depending mainly on the species being not only a characteristic of the variety. As a result, the pollen tubes are not always adequate (suitable) the *“in vitro”* germination.

The experimental results from our research period are new contributions to the studied subject refering to the assortment of Romanian varieries, not studied until now. The Romanian peach and nectarine varieties analyzed have yielded fruits in 2011 to the specific potential of each, and confirm the good and proper germination and binding of the fruits not being disturbed by the meteorological conditions from microsporogenesis and flowering period.

REFERENCES

Andrei, M., Paraschivoiu, R. M., 2003, Microtehnica Botanică , Edit, Niculescu Bucureşti:1-223.

Andrei, M., Rădulescu, D., 1972, Caiet pentru tehnica preparării şi conservării materialului biologic – tehnica obţinerii preparatelor microscopice, Univ.Buc.Fac.Biologie:1-83.

Blidariu, A., Iordănescu, O., Micu, R., Drăgunescu, A., 2008. Researches concerning pollen’s germination and viability of some sour cherries varieties in the plain area of Banat. Bulletin UASVM, Horticulture, vol. 65(1):505-507.

Butac, M., Militaru, M., 2006, Fertilitatea şi capacitatea de germinare a polenului la unele genotipuri de măr, păr, prun, cireş şi vişin utilizate ca genitori potentiali în lucrările de ameliorare. Lucrarile Stiintifice ale ICDP Piteşti Mărăcineni, vol. XXII:20-27.

Cociu, V., Oprea, St., 1989, Metode de cercetare în ameliorarea plantelor pomicole. Edit. Dacia Cluj-Napoca: 82-87.

Cresti, M., 1978, Studio ultrastrutturale dell ‘ effetto delle radiazioni gamma sul tessuto transmittente stilare di cilegio (Prunus avium), Societa Orticola Italiana Sezione Frutticoltura Bologna, 577-583, Italia.

Cresti, M., 1978, L’autoincompatibilita e la sua importanza nel miglioramento delle piante coltivate, (Autoincompatibilitatea şi importanţa migrarii la plantele cultivate), Societa Orticola Italiana Sezione Frutticoltura Bologna, pp.330-349,Italia.

Egea, J., Burgos, L., Garcia, J.E., 1992, Influence of temperature on the in vitro germination of pollen of apricot (*Prunus armeniaca* L.), Journal of Horticultural Science vol. 67:247-250.

Hedhly, A., Hormaza, Ji, Herrero, M., 2004, Efect of temperature on pollen tube kinetics and dynamics in sweet Cherry Prunus avium (Rosaceae), American Jurnal of Botany 91(4):558-564.

Herrero, M., Arbeloa, A., 1989. Influence of the pistil on pollen tube kinectics in peach (P. persica), (Influența pistilului în cinetica tubului de polen in piersic), American.J.Bot. 76 (10), 1441-1447, Zaragoza/Spain.

Iordache, M., Şesan, T., Andrei, M.,.2010, Researches on viability and germinative capacity of the pollen in some romanian appricot varieties, Symposium ISHS-ICDP-Piteşti Mărăcineni, Scientific Papers of the R.I.F.G. Piteşti, vol XXVI: 46-50.

Ivaşcu, A., Toma, St., 2001. Autofertilitatea nectarinului si influenta unor fungicide asupra germinarii polenului. Lucr. St. ale ICPP Pitesti Maracineni, vol. XX: 62-68.

Ivaşcu, A., 2002(B). Să redescoperim piersicul. Ed. Universitas Company. Bucureşti: 13-221.

Kaufmane Ed., Gunars L., 2004, Winter hardy apricote and picies with good fruit quality in Letonia, (Rezistenţa caiselor de calitate în Letonia cu iarna grea), Journal of Fruit and Ornamental Plant Research, vol.12, 2004, Special ed.,pp.321-329.

Pădureanu S., 2007. Citologia germinarii polenului de Ampelopsis brevipedunculata (Maxim.) Trautv. Lucr. St. Universitatea Al. Ioan Cuza. Iaşi, vol. 50: 237-242.

Pădureanu, S., 2007. Anomalii aparute in procesul de germinare al polenului la unele Vitaceae, Lucr.St. Universitatea Al. Ioan Cuza Iaşi, vol. 50: 231-236.

Xie, B., Wang, X., Hong, Z., 2010, Precocious pollen germination in Arabidopsis plants with altered callose deposition during microsporogenesis, Springer, Planta 231:809-823.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

EFFECT OF PLANT DENSITY, IRRIGATION AND N-FERTILIZATION LEVELS ON POLYPHENOL CONTENTS AND ANTIOXIDANT ACTIVITY OF LEAVES *CANNABIS SATIVA*

Kamvoukou Christina- Anna[1,2,3], Gougoulias Nikolaos[1]*, Wogiatzi Eleni[1], Giannoulis Kyriakos[1]

[1]Department of Agronomy Technology, Technological Educational Institute of Thessaly, Larissa, Greece.
[2]School of Pharmacy, Aristotle University of Thessaloniki, Greece
[3]Department of Biochemistry and Biotechnology, University of Thessaly,
*Correspondence author: email: ngougoulias@teilar.gr

Keywords: *Cannabis; total phenols; ABTS•+ capacity; DPPH activity; FRAP activity*

ABSTRACT

Cannabis sativa cultivated at the Experimental Farm of the TEI of Thessaly, plant density was at two different populations (160 plants m^{-2} and 80 plant m^{-2}), N-fertilization at two levels (244 Kg N he^{-1} and 184 Kg N he^{-1}), and irrigation at two levels (100 % and 60 % of ETo), at harvest have been studied the leaves for evaluating and comparing their polyphenols content and antioxidant properties. The content of TP in the leaves studied ranges from 24.48 to 30.25 mg (GAE) g^{-1} DW, FP from 15.91 to 22.69 mg (GAE) g^{-1} DW, NFP from 6.4 to 11.48 mg (GAE) g^{-1} DW, antioxidant activity FRAP varies within the limits of 44.3 to 61.5 µmol FRAP g^{-1} DW, antiradical activity DPPH from 7.9 to 12.8 µmol Trolox g^{-1} DW, and total antioxidant capacity from 51.5 to 69.5 µmol Trolox g^{-1} DW. The leaves Cannabis grown with plant density 160 plants m^{-2} using irrigation 100 % ETo and fertilization 244 Kg N he^{-1}, they showed highest polyphenols content, antiradical activity DPPH and total antioxidant capacity, in comparison with the other treatments.

INDRODUCTION

The increased interest in polyphenol compounds in the human and animal food is associated with their numerous health benefits and first of all with their antioxidant properties. The generation of free radicals in the human and animal cells induces the oxidation of biological macromolecules as lipids, proteins and nucleic acids**.** Polyphenols of the plants and fruits neutralise the active free oxygen and nitrogen containing radicals (Pokorny et al. 2001). Polyphenols of the plants, manifest many nutritive actions as anti-inflammatory, antimicrobial, antifungal, etc. (Morello et al. 2002).

The leaves of many plant species contain polyphenols and have been used as spices, drinks or sources for the preparation of natural antioxidants (Benavente-Garcıa et al. 2000), whereas others are studied in view of possibilities for use as forages (Ruan et al. 2008). Leaves extracts from some fruit species, rich in essential oils and phenol compounds, are used as substitutes of the toxic synthetic pesticides in biological agriculture (Rhouma et al. 2009).

The Cannabis plant contain a large number of chemical compounds as cannabinoids, terpenes and polyphenols. The cannabinoids represents a group of C21 terpenophenolic compounds found in the cannabis sativa (Brenneisen 2007). In cannabis, about 20 flavonoids have been identified (Flores-Sanchez and Verpoorte,

2008), while phenolic compounds such as cannabisin D and bibenzyl stilbenes are contained also in Cannabis leaves (Marti et al. 2014).

The purpose of the present research is to evaluate the effect of plant density, irrigation and N-fertilization levels on polyphenol contents and antioxidant activity of leaves Cannabis sativa under environmental conditions of central Greece.

MATERIAL AND METHODS

Cannabis sativa was cultivated at the Experimental Farm of the Technological Educational Institute of Thessaly. A modern cereal seeding machine was used (on April 2017), applying 22.5 and 45 kg ha^{-1} of seed cv. Fibranova, in a row-distance of 25 and 12.5 cm, respectively. A split-plit-plot design 2 × 2 × 4 with four replications was used and the plot size was 14 m^2. Plant density was at two different populations (D1 = 160 plants/m^2 and D2 = 80 plant/m^2). Two fertilization levels (F1= 244 Kg N per hectare and F2= 184 Kg N per hectare), and two irrigation levels were used (I1 = 100 % ETo, I2 = 60 % ETo, the evapotranspiration is 500 mm).

Complete weather data were recorded in an automatic meteorological station which was installed next to the experimental field. The study area is characterized by a typical Mediterranean climate with cold humid winters and hot-dry summers. In particular, the average air temperature ranged to 22.9 ^oC while the noticed precipitation was 290 mm during the growing period of cannabis.

At the harvest period the leaves from each combination of treatments were dried in a dark place at room temperature, finely ground and kept at 4^oC.

Preparation of the ethanol extracts: Two g of finely ground leaves Cannabis were two rounds treated by 20 ml of 80 % aqueous ethanol. Samples were incubated for 24 h in the extractant at stirring; The extract was gathered after centrifugation and filtration. The pellet was re-treated with 20 ml of 80 % aqueous ethanol for 2 h at stirring at ambient temperature. The extract was gathered after centrifugation/filtration and the volume was made up to 50 ml with aqueous ethanol and used for further chemical analysis (Kanner et al. 1994).

Methods of analyses: Soil was analyzed using the following methods which are referred by (Page et al. 1982). The Texture of soils was determined by the method Bouyoucos. Soil pH and electrical conductivity, (EC), measured in the extract (1 part soil : 5 parts H_2O). The calcium carbonate was determined by the method Bernard.

Organic matter was analyzed by chemical oxidation with 1 mol L^{-1} $K_2Cr_2O_7$ and titration of the remaining reagent with 0.5 mol L^{-1} FeSO4. Inorganic nitrogen was extracted with 0.5 mol L^{-1} $CaCl_2$ and estimated by distillation in the presence of MgO and Devarda's alloy, respectively.

Available P forms (Olsen P) was extracted with 0.5 mol L^{-1} $NaHCO_3$ and measured by spectroscopy. Exchangeable form of potassium was extracted with 1 mol L^{-1} CH_3COONH_4 and measured by flame Photometer (Essex, UK).

The amount of total polyphenols (TP) in the leaves of Cannabis was determined with the Folin-Ciocalteu (F.C.) reagent according to the method of (Singleton and Rossi, 1965) and were expressed as gallic acid equivalent (GAE) in mg g^{-1} dry weight.

The content of nonflavonoid phenols (NFP) in the leaves of Cannabis was determined with the F.C. reagent after removing the flavonoid phenols (FP) with formaldehyde according to the method of (Kramling and Singleton, 1969) and was expressed as gallic acid equivalent (GAE) in mg g^{-1} DW. Flavanoid phenols (FP) in the in the leaves were determined as a difference between the content of total phenols (TP) and nonflavonoid phenols (NFP). Their amount was evaluated as gallic acid equivalent in mg g^{-1} DW.

The radical scavenging activities by antioxidants in the leaves extracts were evaluated using the stable free radical 2,2′-diphenyl-1-pycrylhydrazyl radical (DPPH•), as a reagent, according to the method by (Brand-Williams et al. 1995) and the results were expressed as μmol Trolox/g dry weight. The inhibition coefficient (IC_{50}), represents 50 % reduction in the colour intensity of the DPPH radical by the total phenols in the studied extracts after plotting the dependence of the TP content on the bleaching of DPPH• solutions. The inhibition coefficient (IC50) was calculated using the following equation:

% inhibition = [(E0 – Ex)/E0] × 100

where E0, is the extinction of the radical solution before the reaction and Ex, after polyphenols addition (Yen and Duh, 1994), percent inhibition curves of extracts were used to determine of the inhibition coefficient (IC_{50}).

The ferric reducing antioxidant power (FRAP) of the leaves was evaluated according to the method by (Benzie and Strain, 1999) and the results were expressed as μmol FRAP g^{-1} dry weight. The total antioxidant capacity (TAC) was determined using the stable radical cation ABTS•+ (2,2-azinobis-(3-ethylbenzothiazolin-6-sulphonic acid), according to the method of (Re et al. 1999) and was presented as Trolox equivalent in μmol Trolox g^{-1} dry weight.

Data analysis was made using the MINITAB (Ryan et al. 2005) statistical package. The results are means of four parallel samples. Analysis of variance was used to assess treatment effects. Mean separation was made using Tukey's test when significant differences (P=0.05) between treatments were found.

Table 1 shows the chemical properties of the soil before sowing Cannabis.

Table 1

Soil chemical properties before the sowing of Cannabis

Properties	Soil depth 0-30 cm	Soil depth 30-60 cm
Texture	Sandy Clay Loam	Sandy Clay Loam
pH	7.26 ± 0.05	6.92 ± 0.04
EC, dS m^{-1}	0.20 ± 0.01	0.15 ± 0.01
Organic matter (%)	1.44 ± 0.07	0.70 ± 0.03
N-inorganic (mg kg-1)	381.5 ± 17.8	490 ± 19.90
K-exchangeable (mg kg^{-1})	555.8 ± 30	390 ± 21.9
P -Olsen (mg kg^{-1})	17.2 ± 1.50	10.0 ± 1.10
$CaCO_3$ (%)	2.42 ± 0.14	2.42 ± 0.11

Data represent average means and standard deviation (SD), n=4; Soil pH and Electrical conductivity (EC), measured in the extract (1 part soil : 5 parts H2O).

RESULTS AND DISCUSSION

The content of total phenols (TP) in the leaves of Cannabis for all treatments studied ranges from 24.48 to 30.25 mg (GAE) g^{-1} DW (Table 2). In particular, for plant density 160 plants m^{-2} (D1) using irrigation 100 % ETo and fertilization 244 Kg N per hectare, the highest polyphenols content was observed. For plant density 80 plants m^{-2} (D2) using irrigation 60 % ETo and fertilization 184 Kg N he^{-1}, the highest polyphenols content was observed. Comparing all treatments in the two plant densities, in the plant density 80 plants m^{-2} (D2) using irrigation 100 % ETo and fertilization 184 Kg N he^{-1}, the lowest polyphenols content was observed.

The content of flavonoid phenols (FP) in the leaves of Cannabis for all treatments studied ranges from 15.91 to 22.69 mg (GAE) g^{-1} DW (Table 2). In particular, for plant density 80 plants m^{-2} (D2) using irrigation 60 % ETo and fertilization 184 Kg N he^{-1}, the highest flavonoid phenols content was observed, while for plant density 80

plants m^{-2} (D2) using irrigation 100 % ETo and fertilization 184 Kg N he^{-1}, the lowest flavonoid phenols content was observed. The FP content in the leaves studied constitute from 61 % to 77 % respectively of TP amount (Table 2). The content of non-flavonoid phenols (NFP) in the leaves of Cannabis ranges from 6.4 to 11.48 mg (GAE) g^{-1} DW (Table 2). In particular, for plant density 160 plants m^{-2} (D1) using irrigation 100 % ETo and fertilization 184 Kg N he^{-1}, the highest polyphenols content was observed. Contrary, for plant density 160 plants m^{-2} (D1) using irrigation 60 % ETo and fertilization 184 Kg N he^{-1}, the lowest non-flavonoid content was observed.

The antioxidant activity FRAP of the leaves Cannabis varies within the limits of 44.3 to 61.5 μmol FRAP g^{-1} DW. For plant density 160 plants m^{-2} (D1) using irrigation 100 % ETo and fertilization 184 Kg N he^{-1}, the leaves of Cannabis are distinguished by the highest values of antioxidant activity FRAP (Table 3).

The antiradical activity DPPH in the leaves of Cannabis studied ranges from 7.9 to 12.8 μmol Trolox g-1 DW. In particular, for plant density 160 plants m^{-2} (D1) using irrigation 100 % ETo and fertilization 244 Kg N he^{-1}, the leaves of cannabis are distinguished by the highest values of antiradical activity DPPH.

Table 2

Content of TP, FP and NFP in the leaves of Cannabis, during harvest

Treatments	TP	FP	NFP	FP % of TP
	mg (GAE) g^{-1} dry weight			
Plant density 160 plants m^{-2} (D1)				
I1F1	30.25a	19.36bc	10.89b	64
I1F2	29.43b	17.95de	11.48a	61
I2F1	25.93d	18.41cd	7.52d	71
I2F2	26.67cd	20.27b	6.40e	76
Plant density 80 plants m^{-2} (D2)				
I1F1	27.58c	17.38e	10.20b	63
I1F2	24.48e	15.91f	8.57c	65
I2F1	27.71c	20.78b	6.93de	75
I2F2	29.47b	22.69a	6.78de	77

I1F1, 100 % ETo and 244 Kg N he^{-1}; I1F2, 100 % ETo and 184 Kg N he^{-1}; I2F1, 60 % ETo and 244 Kg N he^{-1}; I2F2, 60 % ETo and 184 Kg N he^{-1}. For each chemical property, columns with the same letter of the table do not differ significantly according to the Tukey's test (P=0.05).

The total antioxidant capacity of the leaves Cannabis for all treatments studied is determined using the free stable cation ABTS•+ and ranges from 51.5 to 69.5 μmol Trolox g^{-1} DW (Table 3). In particular, for plant density 160 plants m^{-2} (D1) using irrigation 100 % ETo and fertilization 244 Kg N he^{-1}, the leaves of cannabis are distinguished by the highest values of total antioxidant capacity.The results expressed as inhibition coefficient (IC50) are demonstrated in Table 3. The lower IC_{50} value 120 μg ml^{-1}, which indicated higher antioxidant potential, were observed in the leaves with plant density 160 plants m^{-2} (D1) using irrigation 100 % ETo and fertilization 244 Kg N he^{-1} (Table 3). The antioxidant activity of the ethanol extracts of the investigated leaves is not only due to the monomeric polyphenols contained, but also in a synergistic action of the polyphenols with other compounds.

Table 3

Total antioxidant capacity ABTS•+, FRAP activity, DPPH-scavenging activity in the leaves of Cannabis, during harvest

Treatments	FRAP	DPPH•	ABTS•+	IC_{50}
	μmol FRAP g^{-1}	μmol Trolox g^{-1}	μmol Trolox g^{-1}	μg ml^{-1} extract
Plant density 160 plants m^{-2} (D1)				
I1F1	54.5b	12.8a	69.5a	120
I1F2	61.5a	12.7a	58.3c	123
I2F1	44.3d	8.2cd	51.5e	230
I2F2	52.6b	8.7c	67.4ab	210
Plant density 80 plants m^{-2} (D2)				
I1F1	47.8cd	11.0b	57.4cd	152
I1F2	49.4c	7.9d	55.3d	287
I2F1	49.9c	11.0b	65.4b	155
I2F2	53.7b	11.5b	66.3b	139

I1F1, 100 % ETo and 244 Kg N he^{-1}; I1F2, 100 % ETo and 184 Kg N he^{-1}; I2F1, 60 % ETo and 244 Kg N he^{-1}; I2F2, 60 % ETo and 184 Kg N he^{-1}. For each chemical property, columns with the same letter of the table do not differ significantly according to the Tukey's test (P=0.05).

CONCLUSIONS

The leaves of Cannabis under environmental conditions of central Greece, grown with different plant density, irrigation and N-fertilization levels, differ in their content of TP, NTP and FP and their antiradical (DPPH) activity, ferric reducing antioxidant power (FRAP) and total antioxidant capacity (TAC) as well. The leaves Cannabis grown with plant density 160 plants m^{-2} using irrigation 100 % ETo and fertilization 244 Kg N he^{-1}, they showed highest polyphenols content, antiradical activity DPPH and total antioxidant capacity, in comparison with the other treatments.

Considering the content of total, non-flavonoid and flavonoid phenols, as well as the antioxidant activity, the investigated leaves of cannabis can be regarded as potential sources of bioactive phenol compounds for pharmaceutical purposes and for natural pesticides.

REFERENCES

Benavente-Garcıa O., Castillo J., Lorente J., Ortuno A., Del Rio J. A., 2000, Antioxidant activity of phenolics extracted from Olea europaea L. leaves. Food Chemistry, 68(4), 457-462.

Benzie I.F., Strain J.J., 1999, Ferric reducing/antioxidant power assay: direct measure of total antioxidant activity of biological fluids and modified version for simultaneous measurement of total antioxidant power and ascorbic acid concentration. Methods in enzymology, (299), 15-27.

Brand-Williams W., Cuvelier M.E., Berset C.L.W.T., 1995, Use of a free radical method to evaluate antioxidant activity. LWT-Food science and Technology, 28(1), 25-30.

Brenneisen R., 2007, Chemistry and analysis of phytocannabinoids and other Cannabis constituents. In Marijuana and the Cannabinoids. Humana Press, 17-49.

Flores-Sanchez I. J., Verpoorte R., 2008, Secondary metabolism in cannabis. Phytochemistry reviews, 7(3), 615-639.

Kanner J., Frankel E., Granit R., German B., Kinsella J. E., 1994, Natural antioxidants in grapes and wines. Journal of Agricultural and Food Chemistry, 42(1), 64-69.

Kramling T.E., Singleton V.L., 1969, An estimate of the nonflavonoid phenols in wines. American Journal of Enology and Viticulture, 20(2), 86-92.

Marti G., Schnee S., Andrey Y., Simoes-Pires C., Carrupt P. A., Wolfender J. L., Gindro K., 2014, Study of leaf metabolome modifications induced by UV-C radiations in representative Vitis, Cissus and Cannabis species by LC-MS based metabolomics and antioxidant assays. Molecules, 19(9), 14004-14021.

Morello M. J., Shahidi F., Ho C. T., 2002, Free Radicals in Foods: Chemistry, Nutrition, and Health. In ACS symposium series. Washington, DC; American Chemical Society; 1999, 1-11.

Page A.L, Miller R.H., Keeney D.R., 1982, Methods of Soil Analysis. Part 2, Chemical & Microbiological properties. Agronomy (9), ASSSA, Mad. Wisc. USA.

Pokorny J., Yanishlieva N., Gordon, M. H., 2001, Antioxidants in food: practical applications. CRC press.

Re R., Pellegrini N., Proteggente A., Pannala A., Yang M., Rice-Evans C., 1999, Antioxidant activity applying an improved ABTS radical cation decolorization assay. Free radical biology and medicine, 26(9-10), 1231-1237.

Rhouma A., Ben Daoud H., Ghanmi S., Ben Salah H., Romdhane M., Demak, M., 2009, Antimicrobial activities of leaf extracts of Pistacia and Schinus species against some plant pathogenic fungi and bacteria. Journal of Plant Pathology, 339-345.

Ruan Z. P., Zhang L. L., Lin Y. M., 2008, Evaluation of the antioxidant activity of Syzygium cumini leaves. Molecules, 13(10), 2545-2556.

Ryan B.F., Joiner B.L., Cryer J.D., 2005, MINITAB Handbook: Updated for release 14, 5th edition.

Singleton V.L., Rossi S.A., 1965, Colorimetry of Total Phenolics with Phosphomolibdic-phosphotungstic Acid Reagents. J Enol Viticult, 16, 144-158.

Yen G.C., Duh P.D., 1994, Scavenging effect of methanolic extracts of peanut hulls on free-radical and active-oxygen species. Journal of Agricultural and Food Chemistry, 42(3), 629-632.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

FOLIAR FERTILIZATION IN EARLYTOMATOES CULTIVATED IN AN AREA OF N.P.K REDUCED AGROFOND, IN RESPECT OF PRODUCTION AND RENTABILITY RATE

Lascu Nicolae, Căpruciu Ramona, Puţică Ionuţ Adrian

University of Craiova, Faculty of Horticulture, A.I. Cuza Street, No. 13, Craiova,
e-mail: niclascu@yahoo.com

Keywords*: hybrid tomatoes, foliar fertilization, production, rate of profitability*

ABSTRACT

The paper presents preliminary results regarding the effect of foliar fertilization on the quantity and quality level of production as well as the rate of profitability. to the Tolstoi F1 hybrid grown in unprotected space on a reduced agrofond, namely N_{60} P_{60} K_{60}, CROPMKAX products at a dose of 1 l / ha / application, Aminogreen 16 at a dose of 5 l / ha / application, and F-111 in a dose of 5 l / ha / application, and an amount of 500 l / ha / application. The application of three foliar fertilizations to an inerval for 10 - 12 days after planting resulted in an increase of the production per unit area by up to 10,1 t / ha, compared to the control variant, depending on the applied foliar fertilizer, an increase of fruit weight by up to 15.8 % and the rate of profitability was 143.1 % for the CROPMAX fertilized variant and 122.2 % for the F 111 fertilized variant.

INTRODUCTION

Research conducted at the USAMV Cluj-Napoca highlighted the fact that foliar fertilizers have a quantitative and qualitative effect on tomato production in technologies where they have been applied to base N.P.K fertilization, and an organic resource (residual compost from the mushrooms) (Crăciun Minerva,2011, p. 8).

The application of N.P.K complex fertilizers to tomato field cultivation, the Unirea variety, has led to an increase in the efficiency of fruit production. The increase in tomato production was statistically ensured after the first fertilization with $N_{100}P_{100}K_{100}$ and the maximum fruit production was obtained at fertilization with $N_{200}P_{200}K_{200}$, reaching 62,40 t / ha (Heitz et al., 2011, p. 236)

The foliar application of the Golden Foliar fertilizer to the tomato cultivar of Rome at a dose of 1600 ml / 100 L showed significant effects by increasing the average fruit weight from 80.77 g to 94.35 g, ascorbic acid from 16.35 mg / 100g to 17.14 mg / 100g, production at the surface of the plants in Peshawar agro-climatic conditions (Anwar Ali, 2015, Pakistan)

MATERIAL AND METHODS

The studies were carried out in a private property in the Izbiceni locality, Olt County, in 2017, the experience being placed in the field on chernozem soil in 4 rehearsals, and the early tomato hybrid TOLSTOI F1 was used as a biological material. Aminogreen foliar fertilizers 16 to 5 l / ha / application, F 111-5 l / ha / application and CROPMAX – 1 l/ha/application were tested compared to the control variant (foliar nefertilized water spray), the amount of solution used was 500 l / ha / application, the

first application being 14 days after planting, and the following at intervals of 10 - 12 days between them.

The N_{60} P_{60} K_{60} agrofond was carried out by basic fertilization with: Concentrated superphosphate Ca (H_2PO_4) $2N_2O$ (38 % P_2O_5); Potassium Chloride KCl (60 % K_2O); ammonium nitrate NH_4NO_3 (34.5 % NO_3).

Determinations were made on average yield, average fruit weight for each experimental variation, calculation and interpretation of experimental data, and profit rate

RESULTS AND DISCUSSIONS

The application of foliar fertilizers in tomato culture to vegetation on a N_{60} P_{60} K_{60} agrofond pointed out that under the pedo-climatic conditions of this year and the applied technology, the absolute yields obtained at the surface unit, on the experimental variants, at the the Tolstoi F1 hybrid cultivated in the unprotected system (Figure 1) was 42.6 t / ha for the foliage not fertilized, taken as a reference, by the applied foliar fertilizers determined an increase of the production per unit area by 7.5 % of 45.8 t / ha in the variant fertilized with Aminogreen 16, of 50.2 t / ha in the variant fertilized with F 111, and of 52.4 t / ha to 23.7 % in the variant fertilized with Cropmax.

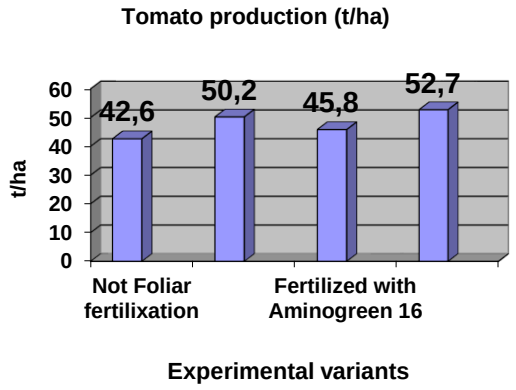


Fig. 1. Tomato production (t / ha) based on experimental variants for the tomato Tolstoi F1 hybrid

Statistically analyzing the production results obtained on the experimental variants, the Tolstoi F1 hybrid versus the non-fertilized leaf variant (V1), taken as a reference, from the data in Table 1 it is shown that fertilization in vegetation with Cropmax (V4) led to obtaining the highest production at the experimental parcel, ie 31.6 kg / 6 m2, representing a 23.4 % increase, the positive difference of 6.3 kg / 6 m2 being statistically assured to a distinctly significant degree. Foliar fertilization with F 111 also showed an absolute production increase of 17.6 %, the positive difference of 4.5 kg / 6 m2 being statistically assured to a significant degree. Fertilization in vegetation with Aminogreen 16 resulted in a yield of 27.48 kg / 6 m2 t / ha, close to the witness, the positive difference of 1.9 kg / 6 m2 not being statistically assured, falling within the error variance limits.

Table no.1

The significance of the production differences

Foliar fertilized variant	Production kg/6 m^2	Relativ production %	Differences ± kg/6 m^2	Significance
Cropmax	31.6	123.4	+ 6.3	* *
F 111	30.1	117.6	+ 4.5	*
Aminogreen 16	27.5	107.4	+ 1.9	
Reference	**25.6**	**100.0**		

DL 5 % = 4.26 kg/6 m^2
DL 1 % = 5.21 kg/6 m^2
DL 0,1% = 7.66 kg/6 m^2

Figure 2 shows that foliar fertilization in vegetation with the three types of fertilizer applied 3 times to the Tolstoi F1 hybrid grown in unprotected system on a N_{60} P_{60} K_{60} fertilizer agrofond resulted in an increased fruit weight from 114.9 g to 133.1 g. Thus, compared to the non-fertilized leaf variants (V1), fertilization in vegetation with F 111 (V2) resulted in an increase of fruit weight by 8.6 units Percentage fertilization in vegetation with Aminogree 16 (V3) caused the fruit weight to increase by 4.4 percentage points and the fertilization in vegetation with Cropmax (V4) caused the increase in fruit weight by 15.8 percentage points.

Graphically plotting the fruit weight variation on the Tolstoi F1 hybrid grown in unprotected system on a N_{100} P_{100} K_{100} crop fertilization agrofond, depending on the specificity of the experimental variants in Fig. no. 3 it is found that in the non-fertilized variant in vegetation, taken as a reference (V1), this production attribute showed an unevenness, namely, the graph has two peaks, one with the highest frequency at the center value of 115 g class, and the second peak at the value of the center of class 95g.

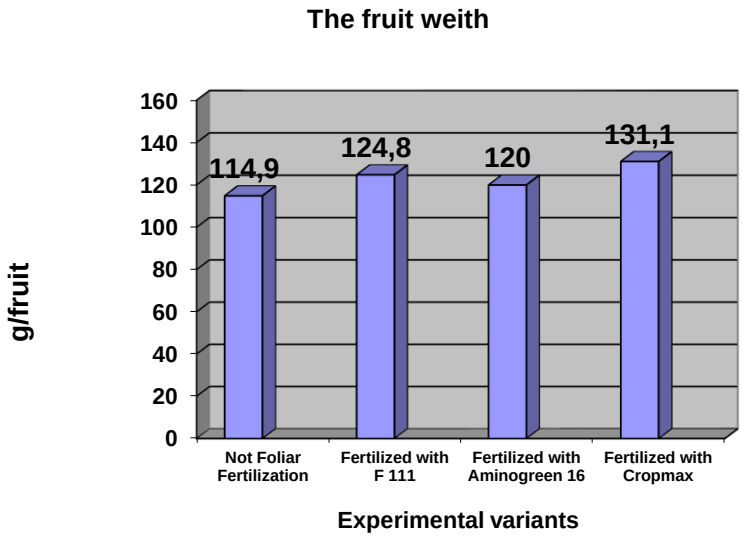


Fig. 2 Average fruit weight by experimental variants for the tomato Tolstoi F1 hybrid

Applying in the vegetation three foliar fertilizations with the studied products determined an increase in the uniformity of the values of this character besides the increase in the average weight of the fruits. The most uniform distribution of the mean fruit weight values was made to the Aminogreen 16 (V3) fertilized variant, followed by the foliar fertilized variant with Cropmax. (V4)

The profitability rate, which reflects the economic efficiency as much as possible, is 143.1 % for the fertilized variant with CROPMAX, and 120.2 % for the fertilized variant with F 114, which means that the invested amount was 1.431 and respectively 1.202 RON profitability.

Table 2

Total costs, additional income and profitability rate

Variant	Total cost - lei/ha -	Income - lei/ha -	Profit - lei/ha -	Profitabiliy rate %
Foliar fertilization with Cropmax	14119	20200	6081	143,1
Foliar fertilization with F 111	12650,3	15200	2549,7	120,2

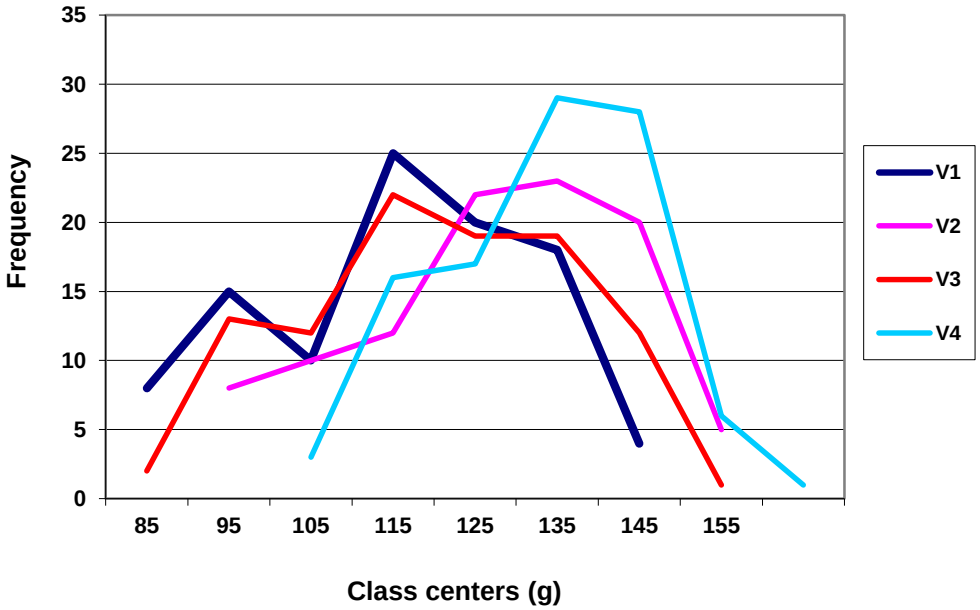


Fig. 3. String of variation of fruit weight by experimental variants at the tomato Tolstoi F1 hybrid

CONCLUSIONS

Based on the results obtained and their interpretation, the following conclusions were drawn:

- Applying the foliar fertilizers studied in tomato culture in vegetation, Tolstoi F1 hybrid cultivated in an unprotected system on a N_{60} P_{60} K_{60} fertilizer culture, pointed out that under the pedo-climatic conditions of this year and the applied technology, the yields increased by up to 10.1 t / ha, from 42.6 t / ha to 52.7 t / ha respectively;

- Statistically analyzing the production results obtained on the experimental variants, it was found that the three-fold fertilization of the crop with Cropmax resulted in the highest production, representing a 23.7 % increase, and the fertilization with F 111 a production increase of 17.8 %, the positive differences being statistically ensured to a distinctly significant and significant degree compared to the non-fertilized foliar variant;

- The application of Cropmax fertilizer to vegetation resulted in an increase in the average weight of the fruit by 15.8 %, the fertilization with F 111 an increase of 8.6 %, and the fertilization with Aminogreen 16 a 4.4 % increase compared to the nonfertilized foliar variant ;

- The profitability rate, which reflects the economic efficiency as much as possible, is 143.1 % for the fertilized variant with CROPMAX, and 120.2 % for the variant fertilized with F 111, which means that 1 RON invested generated 1,43 lei and 1.20 lei profit respectively.

REFERENCES

ANWAR Ali, Ijaz Hussain, Humaria Gul, Shah Masoud, Ayub Hhan, Fazli Wahab, Junaid Khan,2015, Pakistan, Effect of different doses of foliar fertilizer on yield and physiochemical characteristics of tomato (Lycopersicon esculentum Mill) cultivars under the agro climatic condition of Peshawar.Tomato, Foliar fertilizer doses, Physiochemical Characteristics and Yield.International journal of bioscinces 3(10), 280 - 287. http://dx.doi.org/10.12692/ijb/3.10.28087.

CRĂCIUN, M. Minerva, 2011 Research on fertilization systems differentiated in tomato culture, Doctoral thesis. Summary, USAMV Cluj-Napoca, Faculty of Agriculture

HEITZ Minerva, Janina CĂPUŞAN, Alexander Kurt HEITZ, Lidia CHIPER, Aurelia RADU, Maria POJAR - FENESAN, 2011, Fertilization Systems in Tomato Crop in the Field, Scientific papers, B series - Volume 68 (ISSUE 1/2011), Horticulture USAMV - Cluj-Napoca;

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

TRADITION AND QUALITY OF ROMANIAN VITICULTURE

Mărăcineanu Liviu[1]*, Giugea Nicolae[1], Perţ Carmen[1], Căpruciu Ramona[1]

[*]University of Craiova, Faculty of Horticulture,
**Correspondence author e-mail: maracineanulc@yahoo.com*

Keywords*: viticulture, tradition, native varieties, oenotourism*

ABSTRACT

The paper presents the result of a bibliographic study that focuses on the traditional and current assortment of the Romanian viticulture. The old varieties contributed obviously to the prestige of the viticulture in Romania, although nowadays few varieties from that assortment are still cultivated on large surfaces. Some of them can only be identified on small areas belonging to small owners, others are lost or preserved in ampelographic collections. Therefore, an effort is needed to reevaluate them by introducing these varities into selection and improvement programs because the current assortment tends to be dominated by foreign varieties. The oenotourism can help to value these old varieties.

INTRODUCTION

The vine culture dates back to few millennia in the history of Europe, being an occupation that was practiced without major incidents. Each nation has obtained through empirical selection better and better varieties, more adapted to the local conditions and quality expectations. The alcoholic fermentation, once discovered, has boosted this activity, so that the viticulture gradually emerged as a profitable economic activity.

The main selling product was the wine, white or red. Each country has developed its own viticulture, based on native varieties, using customized cuttings, technologies and wine blends that have created the fame of the former wines. In France, a landmark of viticulture and oenology, in the Bordeaux region, the wine was and it is blended using the qualitative characteristics of Merlot and Cabernet - Sauvignon varieties. The same thing happened in Romania too. For example, the famous Drăgăşani wine consisted of a blend of Braghină (30 %), Crâmpoşie (30 %), Gordan (30 %) and Tămăioasă Românească (10 %); the Mehedinţi wine was obtained by blending Negru vârtos (50 %) and Negru moale (50 %). Unfortunately, these wines can no longer be obtained, the main reason being the abandonment of the concerned varieties.

MATERIAL AND METHODS

This paper represents a bibliographic study that allowed the assimilation of the existing information and provided possibilities of critical interpretation, processing and synthesis of the bibliographic material. We consider that a proper number of credible sources were consulted when elaborating the paper, mainly specialized books or on-line sources. Their reading was carefully and critically conducted in both cases. The bibliographic study does not appeal to a marginal literature, the information included in the study is fully scientifically proven.

RESULTS AND DISCUSSIONS

The Romanian viticulture has a tradition of over 2000 years. In the meantime, it has mainly developed on the basis of native varieties until Europe faced a dangerous parasite for vines. In 1880, Arad was the first reported area in Romania for an insect whose presence proved unsustainable for viticulture: *Phylloxera vastatrix*. Four years later it reached the vineyards of Dealu Mare, later affecting all the viticulture of Romania, along with the European one (Mihalca A. cited by Oprea St., 1995).

What is worth mentioning for the Romanian viticulture during the pre-philoxic period is the fact that local varieties or associations of varieties have been used in each vineyard, the latter being considered by I.C. Teodorescu cited by Olteanu I in 2007 that *they were so wisely conceived that it is almost impossible to recover the original state of the viticulture.*

Indeed, the subsequent recover of viticulture has opened the way for the import of foreign, noble varieties or hybrid varieties used for production, amid the desire to accelerate the plantation periods and the insufficiency of native varieties seedlings. Some countries noticed very early the mediocre quality of hybrid varieties and decided to perpetuate the native ones by grafting. Let`s not forget the French argument that says the cultivation of such varieties compromises the tradition of the country's viticulture.

This reason is also apllied very well in the case of Romania, a country with a long viticultural tradition oriented on quality wine. In this way the vine growers' interest in our traditional varieties gradually diminished. As a result, much of the old Romanian varieties, which brought the fame to the old wines, are no longer in production or occupy small surfaces within the plantations of small owners, while others are now only in the ampelographic collections, while many are already lost (Table 1, after Puşcă I.M., 2006).

This trend continued on one hand due to the lack of vine seedlings from the old native varieties, and on the other hand, due to the lack of interest of the breeders that had to orient their research on these varieties, only with few exceptions, which do not have a large representation in production (Table 2, source MADR, 2018).

Among them, Crâmpoşia is still cultivated in the form of improved *selected Crâmpoşie* with some other prephiloxeric varieties: Fetească albă, Fetească neagră, Tămâioasă românească, Busuioacă de Bohotin, Zghihară de Huşi, Băbească neagră, Galbenă de Odobeşti and maybe others with a low share in plantations.

Table 1

The old Romanian varieties that are no longer cultivated

Variety	Technological characteristics	Production
Alb mare	Variety of high production	white wines
Berbecel	150-240 g / l carbohydrates, production up to 15-50 t / ha	white wines
Braghină	170-252 g/l sugars, 15-20 t/ha, wine acidity of 5-6 g/l H_2SO_4	white and rosé wine
Bătută neagră	160-200 g/l carbohydrates, up to 40 t/ha	white, red and rosé wine
Crâmpoşie	max. 200 g/l providing a production of 10-20 t/ha; the wines acidity max. 5.8 g/l H_2SO_4	white wines
Cruciuliţa	130-190 g/l sugars, 20-30 t/ha, acidity 4-4.5 g/l H_2SO_4	white wines
Epuroaica	Very productive variety	White, rosé and red wines
Gordan	160-200 g/l sugars, 25-50 t/ha, wine acidity of 4-5 g/l H_2SO_4	white wines

Variety	Technological characteristics	Production
Negru moale	accumulates 170-210 g/l carbohydrates, 20-40 t/ha and a high acidity of the wine (about 5 g/l H_2SO_4)	Red wines
Negru vârtos	accumulates 170-210 g/l carbohydrates, 18-30 t/ha and a wine acidity of 4 g/l H_2SO_4	Red wines
Plop		white wines
Razachie albă	provides max. 20 t/ha and 200 g/l of sugars	Table grapes
Razachie roşie	provides 15-20 t / ha and 170 g / l of sugars	Table grapes
Scuturătoare		Red wines
Ţiganca		Red wines
Vulpea	Provides 15-25 t / ha and 160-190 g/l of sugars	Red wines

For this reason the current vine growers continue to import and cultivate foreign varieties: Syrah, Viognier, Touriga Nacional, Marselan. It is expected that some of them will adapt very well to the ecological conditions in the vineyards where they are cultivated, but the issue with the lack of seedlings from the old and/or new varieties still remains.

For example, the fame of the well-known wines nowadays is assured by native varieties, such as (Keevil S., 2010):

- In France, Champagne sparkling wine is a blend between Chardonnay, Pinot noir and Pinot meunier; in Bordeaux, the blend between Cabernet-Sauvignon, Merlot and Cabernet franc wines varies and ensures a quality wine;

- In Italy, the varieties such as Barbera, Sangiovese, Nebbiolo, Nerello Mascalese, Montepulciano, Cortese, Dolcetto produce well-known, deep or sparkling wines in the regions of Tuscany, Piedmont and others.

- In Spain, Tempranillo brings the fame of the wines in Rioja and Albariño in Galicia;

- in Portugal, Touriga Nacional, Touriga franca, etc. are blended in order to obtain the famous Porto wine, while Vinho verde is a major product of Loureiro and Trajadura.

In contrast, the official list of varieties in Romania in 2015 (source MADR) contains many newly created varieties, little spread in production and which will have to convince the consumer by quality, e.g.: Astra (1995)[1], Balada, Blasius (1994), Golia (1999), Oana (2006), Olivia (2003), or the very *famous* Fetească regală (1920), Negru de Drăgăşani (1993), Novac (1987) and Şarba (1972). The last four have already become famous on the domestic consumer market.

Table 2

The main wine grape varieties cultivated in Romania (2017)

Variety	Surface (ha)	Share (%)
Fetească regală	13834	15.81
Merlot	11693	13.35
Fetească albă	9836	11.24
Blend of noble varieties	6763	7.72
Riesling italian	5622	6.42
Aligote	4962	5.66
Sauvignon	4853	5.54

[1] the value in brackets represents the year of homologation

Variety	Surface (ha)	Share (%)
Cabernet-Sauvignon	4725	5.39
Muscat-Ottonel	4828	4.61
Băbească neagră	2726	3.11
Fetească neagră	2665	3.05
Roşioară	1984	2.27
Others	13861	15.83
Total	87552	100

The same catalog hosts only 11 traditional (prephiloxeric) Romanian varieties, out of a total of 53 varieties, intended for wine making: Băbească neagră (reported on the territory of Romania in the 14th century), Busuioacă de Bohotin (considered a native variety because it has been cultivated for centuries in Romania, but it is of Greek origin), Feteasca albă (cultivated for centuries in Romania), Fetească neagră (Dacian variety), Frâncuşă (cultivated for centuries in Romania), Galbenă de Odobeşti, Grasă de Cotnari (attested in Moldavia during Stephen the Great period), Iordană, Mustoasă de Măderat, Plăvaie (cultivated for hundreds of years in Moldovia) and Tămâioasă românească (native variety with the same description as in the case of Busuioacă de Bohotin).

However, we must bear in mind that the vine growing activity must focus on the tradition, one of the components being the valorization of the old native varieties. That is why we consider it useful to extend the areas cultivated with such varieties, including the reconsideration of the *preserved* ones in the ampelographic collections. For example, we still have Berbecel, Braghină, Gordan, Gordin, Om rău, Cioinic, Negru vârtos etc. at the Drăgăşani Research and Development Centre For Viticulture And Oenology and they are included in the evaluation, selection and improvement programs.

The tradition in viticulture is particularly present in the great vine growing countries among which we must also include Romania. For this reason, the restructuring of the varieties for wine-making, by cultivating new varieties, can only succeed with difficulty and should not replace the old native varieties.

For example, a summary statistic on the varieties grown in Oltenia shows that 31 % of all cultivated varieties are native, the remaining 69 % being foreign ones. Of the native ones, 1/3 are for red wines and 2/3 for white wines. If we refer to foreign ones, 45 % are intended for white wines and 55 % for red wines. Out of these, about 8 varieties have consolidated their share in the culture over the last decades, accounting approximately 30 % of all the cultivated varieties. Therefore, in terms of the number of varieties, the viticulture in Oltenia is dominated by foreign varieties.

The preservation of native varieties in ampelographic collections is a measure that must be continued and amplified so that the vine growers, the seedling producers and the breeders have the biological material necessary for the *re-launch* of the varieties on the viticultural market because the latter have contributed to the *branding* of Romania as an important viticultural country.

It is imperative to capitalize this genuine national resource, helping to preserve the national identity in the vine-growing sector. Many vineyards have a proper infrastructure for oenotourism, creating opportunities in this respect.

CONCLUSIONS

The viticultural activity on the territory of Romania is constant, but the varieties structure is variable. The re-evaluation of the native varieties, especially the old ones, must be taken into account for the *revival* of the varieties and wines on the viticultural market that contributed to the branding of Romania as an important vine-growing country. This can be integrated into the oenotourism activities as many wine cellars in Romania have an adequate infrastructure for these activities.

REFERENCES

Keevil S. (coord), 2010, Vinurile lumii. Edit. Litera, Bucureşti;

Olteanu I., Mărăcineanu L.C., 2007, Agroecosistemele viticole şi protecţia mediului. Edit. Sitech, Craiova;

Oprea Şt., 1995, Cultura viţei de vie, Edit. Dacia, Cluj-Napoca;

Puşcă I.M., 2006, Vechi soiuri româneşti de viţă de vie. Edit. Tipografia Intact, Bucureşti;

***http://www.madr.ro/horticultura/viticultura-vinificatie.html (accesat 16.09.18);

*** MADR, ISTIS, Catalogul oficial al soiurilor de plante de cultură din Romania pentru anul 2015.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓*Biology*
✓*Horticulture*
✓*Food produce processing technology*
✓*Environmental engineering*

XERISCAPING

Mandă Manuela[1]*, Salahoru Cătălina [1]

*University of Craiova, Craiova, e-mail: manda_manu@yahoo.com

Keywords*: xeriscape, concept, principles, species*

ABSTRACT

At present, more and more areas in Romania are characterized by high temperatures and low precipitation in the summer period. With an emphasis on water and energy conservation, xeriscape is a creative landscape approach addressed to this purpose. Even under these circumstances, the possibilities for arrangements of public green spaces or private gardens are extremely varied. This paper provides information on this concept which constitutes a practical and sustainable alternative in the design of gardens.

INTRODUCTION

Landscape is a vital component of the urban environment that can provide environmental, human health, psycho-social and economic benefits (Lee et al. 2015); it is also a large user of water (Lazarova et al. 2005). Water scarcity is a critical issue that affects more than 40 per cent of the global population (Karimian et al. 2017) and it is due to the increase in world population, climate change related to global warming, pollution and unconscious consumption of water resources. In landscaping, incorrect plant choices and the use of grass in expansive areas may also increase pressure on limited water resources. In summer, scenes of yellow, dry, and even dead landscaping designs are increasingly common where correct landscaping designs are not employed (Çetin et al. 2018).

The biggest consumption of water used especially in the urban green areas such as parks and gardens has required the development of new forms of landscaping (xeriscape approach) which is using water as little as possible (Sarı & Karaşah 2015).

The word and concept of xeriscape occurred in the south-west of the United States, during the drought at the beginning of the 1980s (Sovocool et al. 2006; Özyavuz A. & Özyavuz, M. 2012).

Xeriscaping, also known as "xerogardening" is, in essence, a type of landscape arrangement which requires a minimum amount of water (Hilaire et al. 2008) and incorporates seven water-conserving principles: 1. Planning and design; 2. Efficient irrigation systems, properly designed and maintained; 3. Use of mulch; 4. Soil preparation; 5. Turf alternatives and proper maintenance; 6. Water-efficient plant material; 7. Appropriate maintenance.

In addition, xeriscaping requires low cost maintenance, the use of species with resistance or tolerance to drought, it requires fewer fertilizers and herbicides, thus contributing to the conservation of the environment.

This method of green spaces arrangements is ideal in places where water is not easily available and in places where climatic conditions require the use of large

quantities of water for irrigation (areas with seasonal fluctuations of precipitation and heavy droughts).

Through the implementation of principles the xeriscaping can reduce the water consumption in the exterior with up to 50 %. Some significant savings can be reached by a simple change in the irrigation scheme, the use of the most effective method of irrigation, the right choice of plants used in the arrangement.

In the recent years, the interest in the Xeriscape arrangements for exterior decoration has increased.

The Xeriscape concept has been adopted in many areas of the world experiencing drought or long term dry conditions, and actual Xeriscape practices have evolved differently in various places. The goal of a xeriscape is to create a visually attractive landscape that uses plants selected for their water efficiency (Özyavuz A. & Özyavuz M. 2012), without compromising functionality and beauty of the urban landscape (Hilaire et al. 2008).

In Romania, the arrangement of public and private gardens and the expansion of green urban areas involves a systematic increase in the demand of water. And if we take into account the fact that in Romania there are areas with the tendency of desertification as well as areas with periodic droughts (lack of rain for 2-3 months), the rational use of water could become a matter of priority. On the basis that in Romania this landscape approach is not known, this paper provides information on this concept which constitutes a practical and sustainable alternative in the design of gardens.

MATERIALS AND METHOD

With an emphasis on water and energy conservation, xeriscape is a creative lanscape approach addressed to this purpose. Even under these circumstances, the possibilities for arrangements of public green spaces or private gardens are extremely varied. In addition to the research relating to the concept of "xeriscaping", in this paper, we proposed the presentation of an assortment of species showing resistance or tolerance to drought, suitable for this landscape approach, in the climatic conditions in Romania.

RESULTS AND DISCUSSIONS

Vegetation is the most important component of any landscape project. Sustainability, biodiversity and low maintenance are the main issues underlying the current trends in landscape designing (Ochoa et al. 2009). The success of this trend depends on appropriate plant selection (Franco et al. 2006).

Contrary to the wrong impression that xeriscaping involves only the planting of cacti, succulents on areas covered with gravel, many ornamental herbaceous and woody plants can be used for this type of arrangement. Thus, the assortment designed for this type of arrangement may include species of trees, shrubs, grasses, perennial and annual plants (figure 1).

Figure 1: Xeriscape design that uses plants selected for their drought resistance (*Stachys byzantina*, *Iberis umbellata, Pennisetum setaceum* Rubrum, *Juniperus sabina, Miscanthus sinensis, Lavandula angustifolia, Yucca filamentosa*)

The succulent plants represent a good choice for this type of arrangement because of their reduced requirements concerning water and nutrients, they require a small area of nutrition and grow slow (Anton et al. 2006). Also, many of the self-sown plants which exist in our country may be included in the xeriscape decoration. The association of some xerofite species with heights, shapes, colors and different textures can create interesting combinations (figure 1).

To determine the assortment of species in order to achieve a xeriscape arrangement, one must follow a number of criteria: requirements concerning water, soil, light, height, shape and texture of plants; decorative elements; the type of plant; minimal maintenance; resistance to disease and pests.

Many different and interesting woody and herbaceous plants already in popular use qualify for xeriscaping (Bosmans 2001).

Table 1 contains ornamental species that may be used for xeriscape arrangements in Romania's climatic conditions. The suggested assortment also includes: resistant species to drought with persistent leaves which can decorate throughout the year (*Juniperus, Euonymus, Aucuba, Ophiopogon* etc).

The central Xeriscape theme for conserving water is to reduce turfgrass that does not have practical value with other plant materials (Cisar 2004).

The problems of the classic lawn are related to the consumption of water, use of chemicals, as well as the neccessary time required for its maintenance. The traditional lawn requires much more water and effort for its maintenance than most ornamental plants used in outside arrangements. As a result, xeriscaping can use some species which may replace the traditional sod, these being selected according to the purpose and the local conditions. Alternative species for lawns:

Figure 2: Ornamental woody and herbaceous plants for xeriscape arrangements (*Acer palmtum, Hibiscus syriacus, Juniperus scopulorum*, *Euonymus japonica* Albomarginata*, Aucuba japonica, Ophiopogon japonicus)*

- *Trifolium repens* (white dwarf clover), the set up is a little more complicated than the one of the sod, however, it is much more resistant to traffic and drought, it can be trimmered more rarely and it requires minimum fertilisation.
- The mixture of self-sown plants and field flowers - for rustic gardens - especially in the hilly areas or the mountainous ones it is recommended this variant which is very comfortable.

In addition to the variants generic called "grass", there are some species of plants whose development leads to the formation of a vegetation carpet - the so-called groundcover plants, which allow the traffic on the surface of the lawn:

- *Vinca minor* and *Vinca major* - is a perennial plant, with dark green leaves, which bloom abundantly in spring, having purple-blue colored flowers. They resist in the sun rays, but also in the semi-shadow.
- *Hedera helix* - can be a good option to cover an area of land. Mature leaves are dark green, persistent, and in spring the young leaves are light green, which creates an attractive contrast with the dark green leaves of the previous years.
- *Ophiopogon japonicus* (mondo grass) and *Liriope muscari* (lilyturf) - asian species grown widely as a groundcover.
- *Euonymus fortunei* Silver Queen - is an evergreen creeping or climbing shrub, with attractively variegated leaves. They prefer the sun, and they grow slow.

Although it is not suitable for areas with heavy traffic, *Cotoneaster damerii* is a creeping shrub which grows fast and that may cover wide areas, regardless of the lighting conditions.

No matter the option one choses, it should be noted that none of the variants presented will provide the level carpet provided by the lawn.

Table 1

Ornamental species for xeriscape arrangements in the climatic conditions of Romania

	Species
Trees	*Acer camperstre, Acer palmatum, Cercis canadensis, Fraxiunus americana, Ginkgo biloba, Gleditsia triacanthos, Magnolia grandiflora, Quercus rubra, Picea pungens* Glauca*, Pinus sylvestris, Platanus occidentalis, Robinia pseudoacacia, Ulmus minor.*
Shrubs	*Amelanchier alnifolia, Aucuba japonica, Berberis thunbergii, Buxus microphylla, Buxus sempervirens, Buddleia marrubifolia, Callicarpa bodinieri, Calycanthus floridus, Euonymus japonica, Hibiscus syriacus, Ilex sp., Jasminum nudiflorum, Juniperus chinensis, Juniperus sabina, Juniperus squamata, Juniperus scopulorum, Juniperus virginiana, Mahonia aquifolium, Osmanthus heterophyllus, Pinus mugo, Punica spp., Rhus typhina, Viburnum macrocephalum, Viburnum lantana.*
Undergrowth	*Yucca filamentosa, Genista tinctoria, Ruscus aculeatus, Ruscus hypoglossum*
Annual	*Centaurea cyanus, Dianthus chinensis, Eschscholzia californica, Gomphrena globosa, Helichrysum bracteatum, Portulaca grandifloria, Tithonia rotundifolia, Tagetes spp, Zinnia elegans*
Perennials	*Achillea filipendula, A. millefolium, Aster sp., Aquilegia chrysantha, Bergenia cordifolia, Coreopsis spp, Echinacea purpurea, Echinops spp., Iberis umbellata, Gaillardia aristata, Gypsophila paniculata, Heuchera sanguinea, Lavandula angustifolia, Limonium latifolium, Kniphofia uvaria, Ophiopogon japonicus, Penstemon sp., Phlox subulata, Solidago spp., Rudbeckia hirta*
Ornamental grasses	*Festuca cinerea, Festuca glauca, Helictotrichon sempervirens, Miscanthus sinensis, Muhlenbergia rigens, Pennisetum setaceum*
Mosaic plant	*Cerastium tomentosum, Cineraria maritima, Stachys byzantina*
Succulents	*Sedum spectabile, S. pallidum, S. spurium, S. rupestre, Sempervivum spp*
Lianas	*Lonicera japonica, Parthenocissus quinquefolia, Tecoma, Vitis sp., Wistera sp.*
Native plants	*Aster alpinus, Erigeron sp., Galium odoratum, Lychnis coronaria, Luzula luzuloides, Salvia pratensis, Xeranthemum annuum*

CONCLUSIONS

There are numerous reasons why this type of arrangement should be taken into consideration: lowered consumption of water, reduce maintenance and less cost to maintain, reduced waste and pollution, reduce fertilizer use (NPK).

A well-planned xeriscape landscape, besides the presented benefits can be as succesful as any other type of garden design. Although it involves conserving water it can be attractive, colorful and it utilizes a variety of styles (even formal style), shapes and textures.

Contrary to the impression that "xeriscaping" shall include only cacti and succulents, many ornamental herbaceous and woody plants can be used for this type of arrangement.

The common qualities of the plants intended for "xeriscape" landscapes justify the use of certain groups of ornamental plants, as well as species: spontaneous, succulent, decorative herbs, some perennial and annual species.

REFERENCES

Anton D., Nicu C., Mandă M., 2006, Floricultură specială – vol. II, Edit. Universitaria, Craiova.

Bosmans R., 2001, Xeriscaping and Conserving Water in the Landscape, University of Maryland Extension. https://extension.umd.edu/sites/

Cisar, J. L., 2004, Managing turf sustainably. In New directions for a diverse planet'in Proceedings of the 4th International Crop Science Congress, Vol. 26.

Çetin N., Mansuroğlu S., & Önaç A. K., 2018, Xeriscaping Feasibility as an Urban Adaptation Method for Global Warming: A Case Study from Turkey, Polish Journal of Environmental Studies, 27(3).

Hilaire R. S., Arnold M. A., Wilkerson D. C., Devitt D. A., Hurd B. H., Lesikar B. J., Pittenger D. R., 2008, Efficient water use in residential urban landscapes. HortScience, 43(7), 2081-2092.

Franco J. A., Martínez-Sánchez, J. J., Fernández J. A., & Bañón S., 2006, Selection and nursery production of ornamental plants for landscaping and xerogardening in semi-arid environments. The Journal of Horticultural Science and Biotechnology, 81(1), 3-17.

Karimian, Z., Samiei, L., & Nabati, J., 2017, Evaluation of drought resistance in Nitraria schoberi as a native plant by irrigation intervals for applying in arid urban landscape. Acta Scientiarum Polonorum-Hortorum Cultus, 16.

Lazarova, V., Bouwer, H., & Bahri, A., 2005, Water quality considerations. Water Reuse for Irrigation: Agriculture, Landscapes, and Turf Grasses, CRC Press, Boca Raton, FL, (0.2), 0-4.

Lee A. C. K., Jordan H. C., & Horsley J., 2015, Value of urban green spaces in promoting healthy living and wellbeing: prospects for planning. Risk management and healthcare policy, 8, 131.

Ochoa J., Munoz M., Vicente M. J., Martínez-Sánchez J., Franco, J. A., 2009, Native ornamental species for urban landscaping and xero-gardening in semi-arid environments. In II International Conference on Landscape and Urban Horticulture 881 (pp. 425-428).

Özyavuz, A. and Özyavuz, M., 2012, Xeriscape in Landscape Design, Landscape Planning, Dr. Murat Ozyavuz (Ed.), ISBN: 978-953-51- 0654-8, InTech.

Sarı, D., & Karaşah, B., 2015, Green Roofs and Xeriscape Planting that Contribute to Sustainable Urban Green Space. Conference: ICSAUD 2015: 17th International Conference on Sustainable Architecture and Urban DesignAt: Kyoto, JapanVolume: 17 (11).

Sovocool Kent A., Mitchell Morgan And Doug Bennett, 2006, An In-Depth Investigation Of Xeriscape As A Water Conservation Measure. Journal American Water Works Association, Vol. 98, No. 2, pp. 82-93.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

VIBRATION METHOD FOR WALNUTS (*JUGLANS REGIA* L.) HARVESTING

Manthos Ioannis[1]*, Botu Mihai[2,3], Tsampas Theodoros[2], Rouskas Dimos[1]

[1]Institute of Plant Breeding & Genetic Resources, Dept. of Nut Trees, HAO-DEMETER, Lamia, Greece
[2]University of Craiova, Faculty of Horticulture, Department of Horticulture and Food Science, Craiova, Romania
[3]University of Craiova - SCDP Vâlcea, Rm. Vâlcea, Romania
* *Correspondending author. E-mail*: manthosjo@yahoo.gr

Keywords*: Juglans regia L., vibrator, mechanical harvesting*

ABSTRACT

The aim of the present study was to evaluate the appropriate conditions for mechanical harvesting of walnuts (Juglans regia L.), when vibration technique is applied. For the purpose of the study a vibrator of heavy-type was used. The vibrator was attached to the rear of a tractor and it carried a movable arm that ended into two cylinders, which were attached to the tree trunk. The tests were carried out on: (a) 20 year old trees of the Hartley and 'Franquette' varieties, and (b) on 20-year-old trees of the 'Gustine' and 'Pedro' lateral varieties. The results revealed that the appropriate stage for harvesting walnuts with the mechanical method of vibration is when about 80 % of the fruit presents cracks in the pericarp and mesocarp. Trunk vibration time for satisfactory harvesting is about 5 seconds, while the time required for approaching-vibrating-removing the vibrator from the tree is about 110-120 sec.

INTRODUCTION

The walnut cultivation in Greece is in a developmental and transitional phase, since the traditional cultivation consisting of native trees, are gradually being replaced by modern walnuts cultivation methods, in which excellent varieties are utilized. At the same time, a great effort is being made by the Department of Nut Trees (DNT) of Institute of Plant Breeding and Genetic Resources, HAO – DEMETER, so that the walnuts cultivation can be mechanized, as much as possible, concerning the required cultivation works and especially harvesting. However, in Greece in this sector, not only small cultivators, but also new cultivators, with a sustainable cultivated area, are lagging behind. In most cases, ripping is the only way to harvest walnuts, and in the case of failure, they are waiting for the walnuts to fall from the tree. The latter case results in severe deterioration of fruit quality. In studies implemented by DNT of HAO – DEMETER, it was found that experienced workers required for manually collecting fruit from the ground, emptying nuts, etc., about

a) 90 minutes for collecting the walnuts of a tree of 'Hartley' or 'Franquette' variety, in full production of approximately 45 kg;

b) approximately 45 minutes for 'Chandler' and 'Pedro' variety with a productivity of approximately 30 kg. In contrast, the performance of tree vibrators ranges from 40 to 80 trees per hour (Rouskas, 2002; Karakosta, 2005).

Moreover, mechanical harvesting is of great importance, because it greatly reduces production costs, improves fruit quality and greatly facilitates the execution of the

work. In countries where the walnut is systematically harvested, the fruits are harvested in mechanical ways, the effectiveness of which will depend on the good organization of all the individual works. The size of trees, planting distances, the extent of the walnut, variety are some of the factors that a walnut cultivator must take seriously into account when select the appropriate harvesting method. Besides the problem of harvest time and cost, there is also the problem of finding seasonal staff and even experienced skills. Ultimate solution to the problem of harvesting is given by the vibration machines for tree trunk. The mechanical harvest of walnuts has been used by producers in France and California for years. Today the vibrators have evolved a lot and do not create any problem in the trunk and the root system of the tree (Rouskas, 2002; Karakosta, 2005).

The mechanization has brought many benefits in agriculture, but more research is necessary. Feasibility of performing mechanized harvesting at low costs also in steep ground, improvement of conditions for workers safety, are also essential matters to be solved (Rouskas, 2002).

The present study concerns the evaluation of the appropriate conditions for mechanical harvesting of walnuts, when vibration technique is applied.

MATERIAL AND METHODS

The present study was implemented in the Department of Nut Trees of Institute of Plant Breeding and Genetic Resources of Hellenic Agricultural Organization - DEMETER, in the framework of the mechanical harvest of walnuts trees (*Juglans regia* L.). For the purpose of the study a vibrator (AMB Rousset Beaulieu, France) of heavy-type was used, along with an agricultural tractor with a hippo power of at least 80 HP. The vibrator was attached to the rear of the tractor, and was obtained movement from the tractor. It also carried a movable arm that ended into two cylinders of 35 cm diameter with adjustable opening, which were attached to the tree trunk (Figures 1 and 2). The trees were selected to have a clean trunk without branches, for at least 60 cm, so as to allow the vibrator arm to be applied.

The harvest criterion was walnuts having about 80 % cracked pericarp and mesocarp. The tests were carried out on:

(a) 20 years old trees of the ‘Hartley’ and ‘Franquette’ terminal varieties, trained as vase-shaped, at planting distances of 10 x 10 m, with an average tree height of about 8 m and a maximum crown width of 7.4 m;

(b) on 20 years old trees of the ‘Gustine’ and ‘Pedro’ lateral varieties, trained as free axis, at 9 x 8 m planting distances, with an average tree height of about 7 m and a maximum crown width of 6.4 m.

RESULTS AND DISCUSSIONS

Regarding the results of the applications tested, it was observed that the specific method of walnut harvesting with the particular vibrator creates a strong and wide oscillating space of an approximately inverted truncated cone shape. The oscillating diameter progressively increases according to the application zone of the vibrator arm to the trunk and is approximately the following:

a) 4 m at a height of 2 m from the application zone;
b) 6 m at a height of 4 m from the application zone;
c) 8 m at a height of 6 m from the application zone;
d) 10 m at a height of 8 m from the application zone.

The fall of ripe nuts was more effective when it was within the oscillation space. The entire crown of trees, formed in free axis, was in the oscillation space. In the vase-shaped trees only a few nuts were located outside the swinging space, at a relatively low height (1.5 - 3 m above the ground), which accounted for about 8 % of the crown of the trees.

Figures 1 and 2. Mechanical harvesting of walnuts trees with a trunk vibrator accessory to a tractor of hydraulic type.

The most effective duration of vibration was 5 seconds in all cases. The total adjustment-vibration-removal time of the tree from the vibrator ranged from 90 to 110 seconds. The 1800 - 2000 revolutions of the agricultural tractor machine per minute gave the drive shaft coupled with the vibrator 400 - 440 rpm. At the above revolutions with vibration duration of five (5) seconds the drop of ripe walnuts, was achieved. Of these fallen walnuts, about 20 % - 30 % was released from their green pericarp. The 2000 to 2200 rpm of the engine, corresponding to 440 to 480 rpm on the drive shaft, with vibration duration of five (5) seconds, resulted to the fall of ripe and cracked walnuts. At the 2200 - 2400 rpm of the engine, which corresponds to 480 - 520 rpm of the drive shaft, with vibration duration of five (5) seconds, all ripe walnuts were dropped, even without any cracking of the pericarp and mesocarp.

Before the vibration, nets were placed around the tree. After vibration completed, workers furled net and gathered walnuts in plastic containers. Then, walnuts were transferred into hulling-washing facility, specialized for walnuts. The facility used (Figures 3-5) was of horizontal cylindrical type, 3 kilowatts / h power and approximately 300 kg walnuts (with pericarp and mesocarp) capacity. Hulling and washing time took 5-10 minutes. Hulling capacity was approximately 1000 kg per hour of clean product (hulled and washed).

Figures 3 - 5. Hulling and washing of walnuts.

The use of dehydrating facility provides a definitive solution and benefits in terms of saving labor and ensuring the quality of products, under all circumstances, in comparison to drying walnuts with the traditional method of sun drying. The dehydrating

facility used was equipped with a sloping holed bottom (Figure 6), with the following features: 4 kilowatts electrical power, capacity 2.2 cubic meters, providing a strong hot air stream of about 1500 cubic meters per hour per square meter of dryer bottom. The best temperature of the hot air stream to maintain the quality of walnuts was at approximately 30°C-32°C, according to recommendations of Rouskas (2013).

Figures 6 - 7. Drying and packing of walnuts.

The results revealed that the appropriate stage for harvesting walnuts with the mechanical method of vibration is when about 80 % of the fruit presents cracks in the pericarp and mesocarp. Trunk vibration time for satisfactory harvesting is about 5 seconds, while the time required for approaching - vibrating - removing the vibrator from the tree is about 110 - 120 sec.

CONCLUSIONS

Mechanical harvesting of walnuts using the vibrator method seems to be not only a less costly method, but it also improves kernel quality. When applied, the appropriate stage for harvesting walnuts is when about 80 % of the fruit presents cracks in the pericarp and mesocarp. In total requires about 110 - 120 seconds per tree to approach - vibrate - remove and only 5 seconds to hurl the walnuts.

In conclusion, vibration is an effective harvesting method because it diminishes production cost, improves fruit quality and decreases labor efforts. Walnut cultivation in Greece turns from a traditional situation to a new one with a strong character. The mechanization of cultivation techniques, harvesting and post-harvesting applications, are very important issues today for the Greek walnut industry. This new trend in the walnut industry is quite desirable from the majority of producers who, thanks to this, may have higher incomes.

ACKNOWLEDGMENT

Authors would like to thank BIO.GE.KAT.I.K.E. PAPAKONSTANTINOY ANDREAS, for providing us with the hulling-washing and drying facilities.

REFERENCES

Karakosta L., 2005. Walnut cultivation in Fthiotida County and its mechanization. Department of Agricultural Technology, Technological Educational Institute of Kalamata.

Rouskas D., 2002. Application of mechanical harvesting and peeling – ablution of nuts in the walnut. NAGREF Journal, 10 (23), 22.

Rouskas D., 2013. Walnut cultivation. Agriculture-Livestock. 10, 41-58.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

CONTROL OF WINE QUALITY PARAMETERS AND THEIR DEVELOPMENT IN TIME

Muntean Camelia[1]*,Scarlat Elena Mihaela[1],

[*]University of Craiova
* *Correspondence author. E-mail*: camelia_muntean@hotmail.com

Keywords*: wine, maturation, physico-chemical constituents, anthocyanins, chromatic structure*

ABSTRACT

Maturing refers to all wines, ranging from current consumption to high class. For quality red wines, their maturation can only be conceived naturally in oak wood vats, in specially designed environments, to obtain some the physico-chemical qualities and organoleptic characteristics corresponding to the type of wine proposed, regardless of the time required for this, given that they achieve very high quality levels that compensate for the losses incurred. At the end of maturation, the wine is personalized, that is, it is distinguished by its qualitative.

INTRODUCTION

The maturation phase is between the first prick and the bottling of the wine. At this stage, the essential factor that favors the processes that define it is oxygen (Gómez -Plaza, 2002). In the secondary, they can exert certain influences as well: temperature, some enzymes, elements with variable valences (iron and copper) which can cause changes in the oxidoreducting potential (Băducă, 2016).Changes in several wine composition sizes and indices, such as density, extract, ash content, alcohol, aldehydes, etc., as well as significant changes in sensory characteristics, are also taking place (Bueno, 2010).

Dissolves of wood constituents of the vessels do not occur under the action of alcohol and other constituents. Extracts, especially hydrolysable tannins and some aromatic substances, such as vanilla aldehyde and the syringes aldehyde, can give off the lilac flower odor (Stoica, 2015). There are still: transformation, condensation and deposition of phenolic compounds. The condensation and polymerization processes of the phenolic compounds occur via C-C type linkages.C-C bridges also produce the associations between anthocyanins and non-hydrolyzable (catechinic) tannins, but also the combinations of anthocyanins and the resulting products, in turn, by condensing leucoanthocyanidins with each other or with catechins. During maturation changes also occur on the contents of other constituents of wines: ethyl alcohol and terpenic compounds are decreasing; the acetic aldehyde may be enhanced by oxidation of the alcohol and may be reduced by combining with anthocyanins and ethyl alcohol in the case of acetal formation; acetals and esters know insignificant increases; volatile acidity increases, but differently depending on multiple conditions; Fixed acidity shows some decreases when precipitations of tartrates occur; diminutions know the contents in extract and ashes, but in limited (Vladu, 2007, Muntean, 2012).

MATERIAL AND METHODS

The study tracked the evolution of red wine during maturation, from the time of alcoholic fermentation to bottling. The wine was obtained in the Drăgăşani vineyard of Merlot grape variety 2016 production. The grapes were harvested on September 19, 2016 and had sugar: 229 g/L and acidity of 4.30 g/L H_2SO_4

After the first prick, Merlot wine was stored for maturation in 3 different types of pots: stainless steel pot, used wooden pot with a capacity of 2000 l and a new barrel with a capacity of 225 l. At the time of introduction into the container at 3, 9, and 12 months, the wines were analyzed based on the basic physico-chemical constituents and the polyphenolic composition. In each variant, the alcohol content was determined in terms of volume, total and volatile acidity g/LH_2SO_4, non-reducing extract, mg/L anthocyanin content, participation of the three categories of pigments and chromatic properties, color intensity and temptation. The wine concentration in alcohol was determined by the ebuliometric method based on the principle of the difference between the boiling temperature of the water and that of the wine, the acidity of the wine was determined titrimetrically by neutralizing the acids from a quantity of wine with an alkaline solution of the known titre

Based on the amount of basic solution used for titration, the acidity of the wine was calculated. The volatile acidity of the wine was determined by a direct method based on the following principle: the volatile acids in the wine are separated by a repeated distillation process under special conditions, and then titrated in. The non-reducing extract was obtained by subtracting the total sugars from the total dry extract determined by the method of the densimetric method (Tabarie) based on the relationship between the density of the aqueous solution of the extract, the density of the wine and the density of the alcoholic distillate. Wine anthocyanins were determined spectrophotometrically by pH difference (RibereauGayon - Stonestreet method). The color of the red wines was determined with a UV-VIS spectrophotometer in the visible field at the wavelengths of 420, 520 and 620 nm. Based on readings at the three wavelengths, chromatic properties, color intensity and color tint were calculated.$Ic = DO_{420\ nm} + DO_{520\ nm} + DO_{620\ nm}$;$Tc = DO_{420\ nm}/DO_{520\ nm}$. The weight of each color in the overall color of the wine is given by the percentages of the optical densities relative to the color intensity.%yellow pigments$[DO_{420\ nm}/I_c) \times 100]$; % red pigments $[(DO_{520\ nm}/ I_c) \times 100]$; % of blue pigments $[(DO_{620\ nm}/ I_c) \times 100]$.

RESULTS AND DISCUSSIONS

The main physico-chemical characteristics of Merlot wine stored for maturation in the stainless steel vessel, the used wooden vessel and the new barrier evolve over time according to the data given in Table1.

The degree of alcohol is continuously diminishing - from one stage to another - to all three types of recipients. At each stage, however, the smallest decreases occurred in the stainless steel container, and the largest ones at the barrier. Compared to the situation when the wine was introduced into the pot, alcohol losses in the 12 months maturation were: 0.40 % vol. - on the stainless steel vessel, 0.45 % vol. - for the used wood vat and 0.52 % for barrels.

Table1.

Evolution of the main constituents of Merlot wine matured in containers of different types

Compositional characteristic	Vesseltype	Moment of storage	3 months	9 months	12 months
Acohol %vol.	Stainless steel vessel	13.47	13.38	13.12	13.07
	Wooden vessel	13.47	13.35	13.25	13.02
	Barrique	13.47	13.35	13.18	12.59
Total acidity g/l H_2SO_4	Stainless steel vessel	4.31	4.33	4.38	4.40
	Wood barrel	4.31	4.32	4.42	4.45
	barrique.	4.31	4.36	4.45	4.50
Volatile acidity g/l H_2SO_4	Stainless steel vessel	0.35	0.36	0.40	0.39
	Wood barrel	0.35	0.37	0.41	0.42
	Barrique	0.35	0.40	0.44	0.45
Non-reducing extract g/l	Stainless steel vessel	2.15	26.13	26.04	26.01
	Wood barrel	26.15	26.12	26.00	25.94
	Barrique	26.15	26.32	26.30	26.25

The loss of alcohol in the case of the use of wooden containers is that the evaporation takes place permanently through the pores of the wood. In the case of barrier maturation, the evaporation was even more intense even with regard to the used wooden pot, as the pores of the donuts in the new pot are not filled with tartaric salts and other constituents of the wine.Total acidity evolves with minor oscillations during the ripening process within the same container type as well as on all three types of vessels for the same time during the evolution. In contrast to the evolution of alcohol, acidity takes place in the opposite direction. Total acidity is higher for barred wine and records the smallest changes in wine in the stainless steel vessel. Thus, after 12 months of maturation, the total acidity as compared to the initial content of 4.31 g/l g/l in H_2SO_4 is as follows: 4.40 g/l g/l H_2SO_4 in stainless steel vessel; 4.45 g/l g/l of H_2SO_4 in the old wooden bowl; 4.50 g/l H_2SO_4 at barrel.

Volatile acidity increases continuously, from one stage to the next, with some increase in wine stored in the barrel. After 12 months, the increases in volatile acidity relative to the initial content were: by 11.1 % for the stainless steel vessel; 12 % on the used wooden pot and 12.8 % on the barrel. This increase, which is quite slow, is mainly due to a non-enzymatic oxidation process, whereby a very small part of the alcohol is converted to acetaldehyde and then to acetic acid, the main component of volatile acidity. The non-reducing extract decreases continuously - from one stage to the next - when using the stainless steel tank and the used wooden vessel. Thus, after 12 months, when using the stainless steel container, the extract decreased from 26.15 g / l to 26.01 g / l, and in the case of the old vessel it reached 25.94 g/l. In case of barrel involvement, the extract non-irreducible, there is a continuous increase of this oenological size in the first 6 months, after which there are decreases, finally reaching 26.25 g / l. In the case of the barrier, colloidal phenomenon losses, followed by precipitations that naturally occur in wines, are compensated for by the extraction of new organic and mineral.

The most significant decreases occurred in keeping the wine in a stainless steel tank, which was, during 12 months, 147 mg/l (21.1 %), and the lowest loss of anthocyanins occurred in wine of barriers, reaching 117 mg/l (16.5 %). For wine

preserved for aging in an old wooden vessel the losses were intermediate of 128 mg/l (18.5 %) (Figure 1). In the case of barrier, lower anthocyanin losses can be explained by the contribution of tannins extracted from the new wood to increasing the stability of anthocyanide coloring matter.

Based on the optical density values at 420 nm (yellow pigments), 520 nm (red pigments) and 620 nm (blue pigments) listed in (Table 2) the chromatic characteristics were calculated: color intensity and color tint.

The color intensity developed by decreasing continuously over time and to all three types of containers, but differently (Table 3).

For wine stored in stainless steel, the rate of dye reduction is more sustained, so this oenological size reaches 12 months from 1,530 to 0.992. In wooden pots, the decrease is slower, with a mention on the subject in the case of the new vessel, where after one year the intensity of the color intensity was the highest. This finding for swept wine in a new wooden vessel, some of which are more important in elagotanin, existing in the new oak tree. The color tone (Table 3), by constantly changing the relationship between the yellow-orange pigments and the red ones, grows, as the maturing time elapses, to all three types of containers. Thus, the stainless steel vessel grew from 0.713 at the time of storage at 0.741 to 12 months, the used wood vat reached 0.745 and in barrel at 0.752.

For equal maturation periods, it is found that the highest value of the color tone is recorded in the wine from barrel. This is due to the increase in the proportions of yellow-orange pigments, with higher rates than red pigments, although increases are also recorded in the latter. Analyzing the evolution of the chromatic complex it is found that this is particularly favorable to the color of the wine preserved in wooden pots and especially in the barrel.

CONCLUSIONS

Red wine, as we know it, can be done in two extremely varied variants, both as production technology and economically-qualitative: red consumer wines currently available to a wide range of consumers, purchased at a relatively low price and top quality red wines, obtained with strict preservation of the parameters in the case of correct natural maturation, wines of exceptional quality appreciated on the national and international market, whose high price, their special organoleptic qualities justify full.

It is fully elucidated that high class red wines are obtained under conditions of natural preservation (6-12 months) in oak barrels, in specially arranged premises for obtaining the physico-chemical qualities and organoleptic characteristics corresponding to the type the proposed wine is not supported by techniques or procedures for stimulating or improving quality by using different additives, which are considered as fraud.

The basic chemical composition of Merlot, ripened in containers of different types evolves positively but differently. Thus, the alcohol content continuously decreases in all three types of containers. The highest alcohol leakage, for the same period of time, is recorded at the barrier, due to continuous evaporation through pores. In the barrel situation, the evaporation was even more intense even with the used wooden vessel, as the pores of the stave in the new pot are not filled with tartaric salts and other constituents of the wine.

Volatile acidity increases with something extra in the case of the barrel, but the increase is insignificant. The non-reducing extract decrease from one stage to the next, in the use of stainless steel containers and even in old buds, and gradual increases in the wine retained in new barriers, extracting organic and mineral constituents from the new stave, surpassing the precipitous combinations specific to maturation.

In anthocyanins, after 12 months of maturation, the most significant decreases occur in the wine stored in the stainless steel vessel and the smallest is recorded in the

barium wine, in both situations the color intensity develops at lower rhythms and the color tone increases as much the flow of time, the wine of the barrel.

REFERENCES

Băducă Cîmpeanu C., 2016- Oenologie. Bazele ştiinţifice şi tehnologice ale vinificaţiei, Ed. Universitaria, Craiova

Bueno, M., Culleré, L., Cacho, J. & Ferreira, V., 2010. Chemical and sensory characterization of oxidative behavior in different wines. Food Res. Int. 43, 1423-1428.

Gómez-Plaza, E., Gil-Munõz, R., López-Roca, J.M., Martínez-Cutillas, A. & Fernández-Fernández, J.I., 2002. Maintenance of colour composition of a red wine during storage: Influence of prefermentative practices, maceration time and storage. Lebensm. Wiss. Technol. 35, 46-53.

Muntean Camelia, 2012 – Tehnologii în industria vinicolă, Ed. Sitech, Craiova

Stoica Felicia**,** (2015) The main parameters and indicators that define the quality and authenticity of white wines from vineyard Drăgăşani - Romania, Carpathian Journal of Food Science and Technology, *Vol. 7, No 4*,139-144

Vladu Cristina, 2007 – Studiul unor compuşi chimici în parcursul de maturare şi supramaturare a strugurilor în condiţiile complexului natural din central viticol Stîrmina şi evoluţia acestora în procesul de vinificare şi învechire la barique, Teză de doctorat, Universitatea din Craiova

Tabel 2

Optical densities of Merlot wine matured in different containers

Optical density	Stainless steel vessel				Wood barrel				Barrique			
	MS	3 m	9 m	12 m	MS	3 m	9 m	12 m	MS	3 m	9 m	12 m
OD420nm	0.423	0.418	0.405	0.309	0.423	0.420	0.431	0.413	0.423	0.420	0.412	0.389
OD520nm	0.593	0.565	0.542	0.512	0.593	0.574	0.557	0.512	0.593	0.579	0.561	0.521
OD620nm	0.137	0.121	0.107	0.091	0.137	0.117	0.100	0.097	0.137	0.092	0.070	0.043

JET 1mm
MS - Moment of storage
m -months

Tabel 3

Evolution of components of the dye complex in Merlot wine matured in different containers

Cromathic characteristic	Stainless steel vessel				Wood barrel				Barrique			
	MS	3 m	9 m	12 m	MS	3 m	9 m	12 m	MS	3 m	9 m	12 m
Total antocianinsmg/l	687	646	603	540	687	659	622	559	687	663	644	570
Color intensity (Ic)	1.153	1.104	1.054	0.992	1.153	1,111	1.086	1.022	1.153	1.091	1.065	1.053
Color Tone (Tc)	0.713	0.719	0.727	0.741	0.713	0,721	0.728	0.745	0.713	0.725	0.736	0.752

MS - Moment of storage
m -months

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

STUDY ON THE USE OF ASFAK IN *LACTUCA SATIVA* L. CULTURE

Neață Gabriela[1], Hoza Gheorghița[1*], Dobrescu Aurelia[1], Basarabă Adrian[1], Mohammed Jasin Mohammed[1]

[18] University of Agronomical Sciences and Veterinary Medicine Bucharest, Horticulture Department, Bd.Mărăști, 59, Bucharest, Romania, e-mail:hozagh@yahoo.com
* *Correspondence author. E-mail* e-mail:hozagh@yahoo.com

Keywords*: biostimulator Asfac, lettuce culture, yield*

ABSTRACT

The research was conducted in the solarium of the Department of Horticulture at USAMV Bucharest in year 2017. Six varieties of Lactuca sativa L: Touareg, Analena, Shangore, Centore and Sotalis were used. The behavior of the Lactuca sativa L. was followed when the Asfak biostimulator was applied in different doses during vegetation periods. Phenological observations, biometric measurements, agrochemical determinations of Lactuca sativa L. quality, and production were recorded. The results were statistically interpreted.

INTRODUCTION

In the last years the use of biostimulants in agriculture grow to $2 billion in sales by 2018 (Calvo et al., 2014). So, it is neccesary to establish a legal framework for the marketing as products in EU (EBIC, 2012).Biostimulators are defined as “containing substance(s) and/or micro-organisms whose function when applied to plants or the rhizosphere is to stimulate natural processes to enhance/benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress, and crop quality.”(Patrick Brown and Sebastian Saa, 2015)

Accepting this definition, the biostimulants benefit plant productivity by interacting with plant signaling processes thereby reducing negative plant response to stress. This hypothesis recognizes the wealth of recent research demonstrating that plant response to stress is regulated by signaling molecules that may be generated by the plant or its associated microbial populations (Marasco et al., 2012; Bakker et al., 2014; Vandenkoornhuyse et al., 2015).

In Romania SC ROMCHIM PROTECT SA has been developing biostimulators for agricultural crops, horticultural resectation. These new products include ASFAC-BCO-4, a biodegradable product that has auxinic action in plant physiological processes, entering the plant's absorbing complex and favoring the growth of chlorophyll's essential component in the photosynthesis process.

The product has a role in increasing plant vigor and increasing production. It is used as a foliar fertilizer in different concentrations.

The research was conducted in the solarium of the Department of Horticulture at USAMV Bucharest in 2017. 6 varieties of Lactuca sativa L: Touareg, Alanis, Analena, Shangore, Centore and Sotalis were used. The behavior of the salad was followed when applying the Asfac biostimulator at different doses administered during vegetation.

MATERIAL AND METHODS

Our proposed experience was in 2017 in the solariums of the Department of Vegetables, the Faculty of Horticulture at the University of Agronomic Science and Veterinary Medicine Bucharest.

In the experiment, two variants of Asfac concentration of 0.1 % and 0.3 % respectively were applied to the Lactuca sativa L. plants in the first vegetation phases.

Table 1.

Scheme of experimental variants

No.	Cultivar	Experimental variant	Tratment
1	**TUAREG**	Control	Control
2		V1	Asfac 0.1 %
3		V2	Asfac 0.3 %
4	**ALANIS**	Control	Control
5		V1	Asfac 0.1 %
6		V2	Asfac 0.3 %
7	**SHANGORE**	Control	Control
8		V1	Asfac 0.1 %
9		V2	Asfac 0.3 %
10	**ANALENA**	Control	Control
11		V1	Asfac 0.1 %
12		V2	Asfac 0.3 %
13	**CENTORE**	Control	Control
14		V1	Asfac 0.1 %
15		V2	Asfac 0.3 %
16	**SOTALIS**	Control	Control
17		V1	Asfac 0.1 %
18		V2	Asfac 0.3 %

The biological material used was made up of 6 Lactuca sativa L. hybrids: Tuareg, Alanis, Analena, Shangore, Centore and Sotalis. Lactuca sativa L. was planted on March 6, 2017 with a 0.4 x 0.3m = 8plants / m^2 plot. After planting, the two doses of Asfac 0.1 % and 0.3 % were sprayed twice at two weeks.At the harvest, the average diameter of the Lactuca sativa L. plant and average / head / variant weight were determined. At the same time, analyzes were made regarding the quality of Lactuca sativa L. for consumption and the amount of nitrates, phosphates and potasiu absorbed by the plants.The methods used in the analyzes were: Griess method, spectrophotometric for nitrates, nitrites and Duval reagent and spectrophotometric phosphorus dosing, and for flame spectrophotometry. These methods are according to the standards in our country: ISO 9001.(Metodologia de analiza a solului si plantei. ICPA, 1987). The results were statistically interpreted by variance analysis.

RESULTS AND DISCUSSIONS

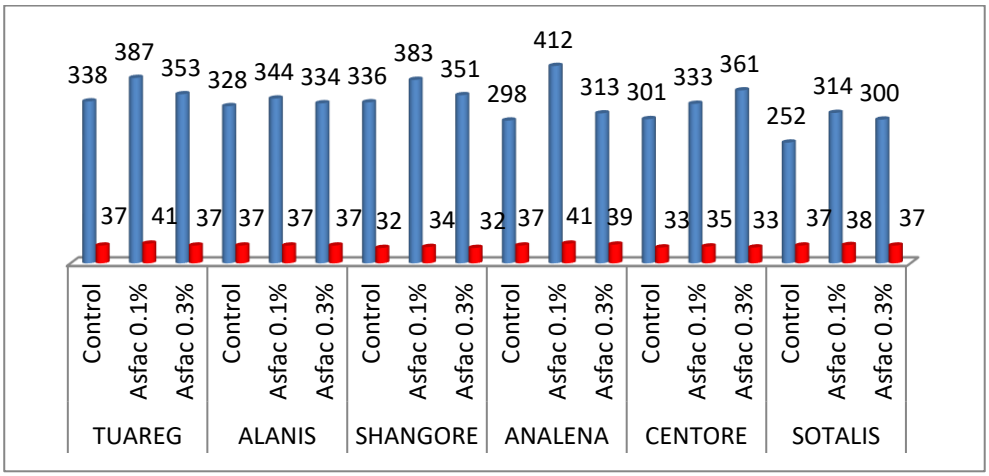


Figure.1.The average diameter (cm) and the average weight (g) of Lactuca sativa L. captains is each variant

The average *Lactuca sativa* L. average / variant results are shown in Figure 1. The largest diameter of 41 cm was obtained at Tuareg and Analena, followed by Sotalis 38 cm, Alanis 37 cm and Shangore 34 cm.

In terms of fertilization with Asfac in all variants of Lactuca sativa L. hybrids variant 1 with 0.1 % Asfac gave the best results. However, we can mention that Alanis in all fertilization variants obtained the same diameter of 37cm and in Sotalis the difference between variant 1 and variant 2 was only 1cm small.

In the case of medium weight (g / plant / variant), it can be seen that in Tuareg, Alanis, Shangore, Analena and Sotalis the fertilization variant 1 with 0.1 % Asfac resulted in a high weight gain compared to the control and variant 2. The only hybrid Centors recorded a higher weight gain in Fertilizer Option 2 with 0.3 % Asfac.

Lactuca sativa L. production (Table 2) ranged from 1.94kg / m^2 to Sotalis and 2.88kg / m^2 to the Shangore hybrid. Fertilization with Asfac in varying proportions led to gains of 3.04 % for Analena V2 and 25.22 % for Analena V1.

The statistical interpretation shows that only Analena V1 and Centore V2 recorded very significant increases statistically ensured at Asfac 0.1 %, the other variants recording only significant increases at the same fertilization.

Table 2

Statistical Interpretation of Production Outputs in the 6 Hybrids from the point of view of aplication of Asfac

No	Hybride	Tratment	Production kg/m2	Diference ±	Percent, %	Significant
1	**TUAREG**	Control	2,43	-	100.00	-
2		Asfac 0.1 %	2,73	+0.30	123.46	*
3		Asfac 0.3 %	2,56	+0.13	105.35	ns
6	**ALANIS**	Control	2.32	-	100.00	-
7		Asfac 0.1 %	2.56	+0.24	110.34	*
8		Asfac 0.3 %	2.48	+16	106.89	ns
9	**SHANGORE**	Control	2.4	-	100.00	-
10		Asfac 0.1 %	2.85	+0.45	118.75	***
11		Asfac 0.3 %	2.7	+0.30	112.5	*
12	**ANALENA**	Control	2,3	-	100.00	-
13		Asfac 0.1 %	2,88	+0.58	125.22	***
14		Asfac 0.3 %	2,37	+0.07	103.04	ns
15	**CENTORE**	Control	2,19	-	100.00	-
16		Asfac 0.1 %	2,5	+0.31	114.15	*
17		Asfac 0.3 %	2,68	+0.49	122.37	***
18	**SOTALIS**	Control	1,94	-	100.00	-
19		Asfac 0.1 %	2,36	+0.42	121.65	**
20		Asfac 0.3 %	2,20	+0.26	113.40	*

DL 5 % = 0.232 kg/m2
DL 1 %=0.345 kg/m2
DL 0.1 % = 0.454 kg/m2

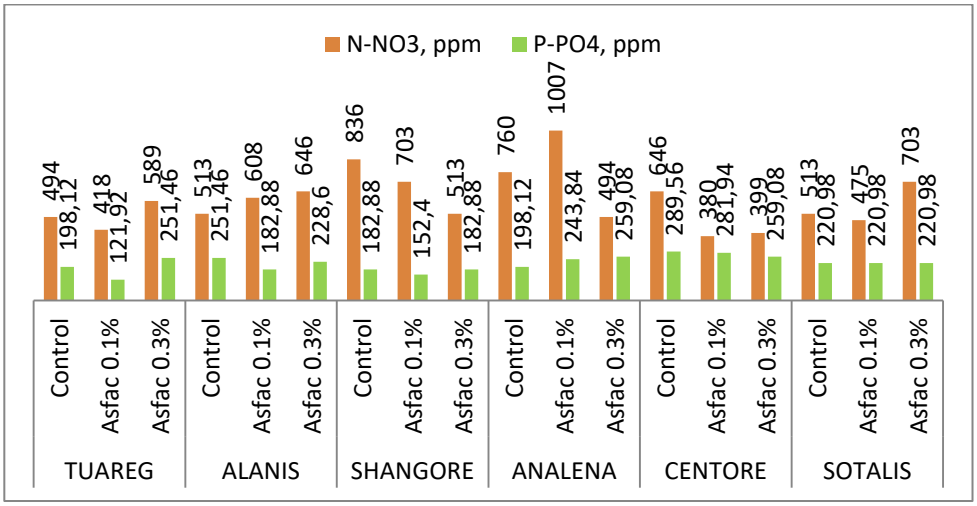


Fig.2. Variation in the nitrate and phosphate content of lettuce

The *Lactuca sativa* L. quality analyzes (Fig. 2 and 3) show that it absorbed nitrates in amounts ranging from 418ppm to Tuareg V1 and 1007ppm at Analena V1, well below the maximum permissible limit of 3000ppm in human consumption (Wang et al., 2002; Santamaria, 2006).

Phosphates have accumulated in small quantities ranging from 121.92ppm to Tuareg V1 and 289.56ppm at Centore-Control. The values are considered small compared to the values presented by the literature for this element of 200-400m (Santamaria, 2006). This low accumulation can affect the quality of Lactuca sativa L. consumption. The plants remain small, fragile, with a diminished quantity and quality production.

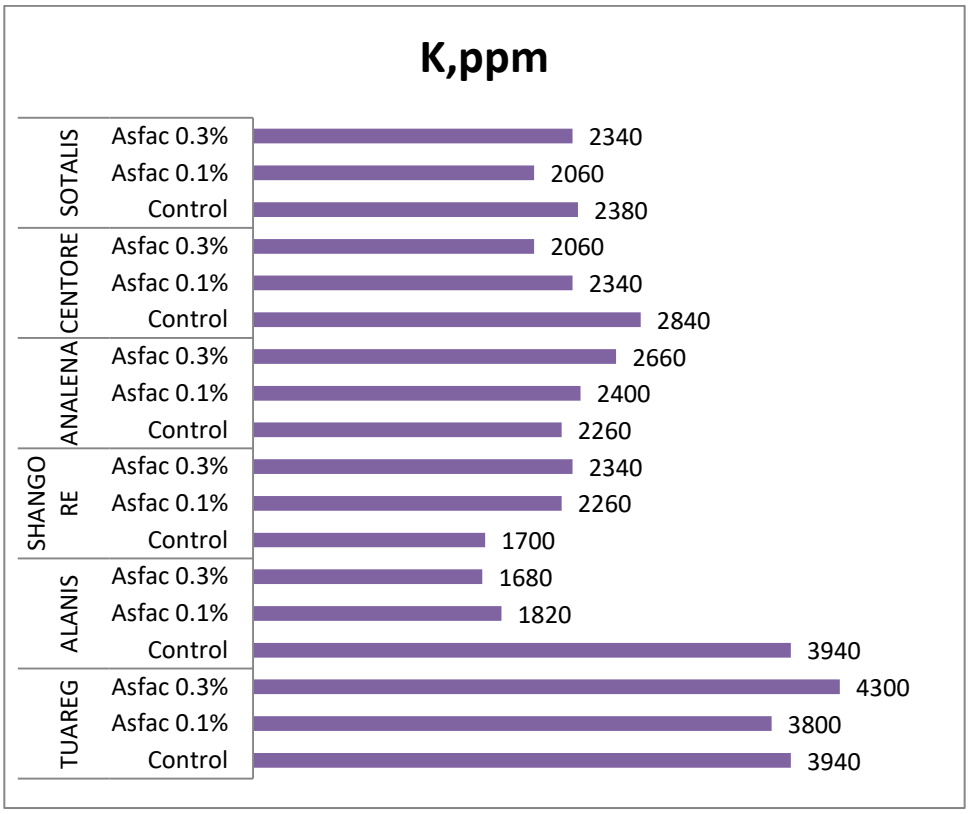


Figure 3. Variation of potassium content in lettuce

The accumulation of the potash is very good oscillating between 1680pm at Alanis V2 and 4300ppm at Tuareg.

CONCLUSIONS

Lactuca sativa L. experiences highlight the beneficial role of using the Asfec biostimulator:

- Spray variant V1 with 0.1 % Asfac produced the best results on plant diameter and weight in all hybrids tested except for the Alanis hybrid;
- The *Lactuca sativa* L. quality of consumption revealed by the nitrate, phosphate and potassium analysis in the green plant shows a good accumulation of all the elements.
- Further experience with Asfac is required to confirm its influence on crops.

REFERENCES

Bakker M. G., Schlatter D. C., Otto-Hanson L., Kinkel L. L. (2014). Diffuse symbioses: roles of plant-plant, plant-microbe and microbe-microbe interactions in structuring the soil microbiome. Mol. Ecol. 23, 1571–1583. 10.1111/mec.12571

Calvo P., Nelson L., Kloepper J. W. (2014). Agricultural uses of plant biostimulants. Plant Soil 383, 3–41. 10.1007/s11104-014-2131-8

EBIC (2012). What are biostimulants? Available online at: http://www.biostimulants.eu/about/what-are-biostimulants

Marasco R., Rolli E., Ettoumi B., Vigani G., Mapelli F., Borin S., et al. . (2012). A Drought resistance-promoting microbiome is selected by root system under desert farming. PLoS ONE 7:48479. 10.1371/journal.pone.0048479

Vandenkoornhuyse P., Quaiser A., Duhamel M., Le Van A., Dufresne A. (2015). The importance of the microbiome of the plant holobiont. New Phytol. 206, 1196–1206. 10.1111/nph.13312.

Wang Z.H., Zong Z.Q., Li S.X., Chen B.M. Nitrate accumulation in vegetables and its residual in vegetable fields. Environ. Sci. 2002;23:79–83.

Santamaria P. Nitrate in vegetables: Toxicity, content, intake and EC regulation. J. Sci. Food Agr. 2006;86:10–17. doi: 10.1002/jsfa.2351.

*** Metodologia de analiza a solului si plantei. ICPA, 1987

*** www.giberelina.ro

***https://www.asfac.ro/

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE INFLUENCE OF POT SIZE AND CYCOCEL ON GROWTH AND FLOWERING OF *ABUTILON HYBRIDUM* Hort. ex Voss PLANTS

Nicu Carmen[1]*, Manda Manuela[1]
*University of Craiova, Faculty of Horticulture, e-mail: alexa25nicu@yahoo.com

Key words*: ornamental plant, height control, pot size, growth retardant, foliar treatment*

ABSTRACT

Abutilon x hybridum Hort. ex Voss is particularly appreciated for the flowers and the attractive maple-like leaves, as a decorative potted indoor plant, but it can also be placed on terraces, balconies and even in the garden during the summer. The paper presents the results regarding the influence of the pot size (10, 12, 14 cm) and foliar treatments with Cycocel (1000 ppm) on vegetative growth and flowering of plants. The aim of the experiment was to control height and improve the decorative aspect of plants. The results obtained show that the main morphological characteristics were influenced by the reduction of substrate volume and the growth regulator application. The minimum values of the analyzed parameters were recorded by the plants grown in 14 cm diameter pots, to which foliar treatments with Cycocel 1000 ppm were applied, followed by the untreated plants cultivated in pots with a diameter of 10 cm.

INTRODUCTION

The *Abutilon* genus of the Malvaceae family comprises about 150 species of shrubs, small trees, perennial and annual plants from tropical and subtropical regions.

Abutilon x hybridum Hort. ex Voss (sin. *A. globosum*) is a branched shrub of 1.5-2 m high. The leaves are persistent, ovate, 3-lobed or 5-lobed, 10 to 20 cm in length and they are green or can be variegated with white and yellow. The solitary, cup-shaped or bell-shaped flowers have five overlapped petals, which are white, pink, red, yellow or orange, depending on the variety and an abundant and long-lasting flowering from spring until autumn.

One of the most important aspects in the production of ornamental plants grown in pots is the control of the plant growth. The growth control is required in order to maximize the production per unit area, to reduce the transportation costs and to obtain a desired visual quality (Bergstrand, 2017). The consumers generally prefer compact, well-branched plants, with rich flowering and high decorative value.

The flower industry uses plant growth regulators, considered as helping tool in the modern production system of ornamentals. Their exogenous application helps to improve the different economically important and market desirable characteristics of ornamental plants (Sajjad et al., 2017).

The use of plant growth regulators has many advantages such as high efficiency on plant growth and development, improved plant appearance by maintaining plant size in proportion with the pot, increase of the plant tolerance to temperature and drought stress and to handling and shipping (Latimer & Whipker, 2012).

The response of ornamental plants to growth regulators depends on the species and cultivar, the age and vigor of the plant, number of treatments applied, doses, frequency and method of application, environmental and cultural conditions.

Many growth retardants are commercially available for potted plant production in greenhouse. Researches on numerous flower species shows that chlormequat chloride (Cycocel) has led to the reduction of plant height (Warner & Erwin, 2003; Currey & Lopez, 2010; Wazir, 2015; Taherpazir & Hashemabadi, 2016), early flowering and higher flower numbers (Latimer & Whipker, 2012) and stimulate basal or lateral branching (Karunananda & Peiris, 2010; Renu & Srivastava, 2013; Manda & Nicu, 2016).

On the other hand, it is less effective under high temperature conditions, can lead to phytotoxic response (it causes discoloration of leaves) at higher concentrations, and the effect on plants is temporary, so in general there are necessary multiple applications.

In order to limit the environmental impact of chemical growth retardants, alternative methods of controlling the plant growth are used, such as: root restriction by using of small containers (Nesmith & Duval, 1998; Poorter et al., 2012); manipulation of photoperiod and light quality (Chapman & Lyons, 1988; Bergstrand & Schüssler, 2016); spectral filters (Lykas & Katsoulas, 2008); water deficit (Nicu & Manda, 2012; Alem et al., 2015); DIF- differential day/night temperatures (Kresten-Jensen & Andersen, 1992; Hendriks & Ueber, 1995); nutrient management - limiting the amount of nitrogen or phosphorus (Hansen & Nielsen, 2000); pinching; mechanical conditioning (Zheng et al., 2004).

The aim of this study was to evaluate the effect of pot size and treatments with Cycocel on growth and flowering of *Abutilon x hybridum* plants, in order to produce potted plants with *high* aesthetic and *commercial value.*

MATERIAL AND METHODS

The biological material consisted of shoot tip cuttings derived from *Abutilon hybridum* plants, grown in pots under greenhouse conditions. The cuttings were planted after rooting, in a substrate of peat and perlite (2:1), in pots of different sizes and they were pinched for branching.

The research was conducted between 2016 and 2017, in the greenhouse of the Floriculture discipline of the Faculty of Horticulture of Craiova.

The experimental variants were: V1 (control plant) - pots of 14 cm diameter/ untreated plants; V2 - pots of 14 cm diameter/plants treated with Cycocel 1000 ppm (three foliar treatments were applied at two weeks interval); V3 - pots of 12 cm diameter/untreated plants; V4 - pots of 10 cm diameter/untreated plants.

In order to evaluate the influence of the pot size and Cycocel treatments on the growth and flowering of plants, observations and biometric measurements were conducted, which took into account the average plant height, the average number of shoots/plant, the average length of the shoots, the average leaves sizes (length and width), the average diameter and length of flowers.

RESULTS AND DISCUSSIONS

The plants of *Abutilon x hybridum* tend to grow excessively with long, thin stems and a small number of leaves, so they need to be pinched regularly, during the intense growth period, in order to stimulate branching and flowering. Prunings are also made, in early spring or autumn, after the end of the flowering period in order to obtain quality, compact, small-sized plants with high ornamental value.

The results obtained show that the methods used for plant growth control, namely, the application of foliar treatments with growth retardants (the chemical method) and the reduction of the nutrition space, by using small pots (the alternative method), influenced the average height of plants of *Abutilon x hybridum*.

The plants treated with Cycocel 1000 ppm (V2) and those grown in a small volume of substrate (V4 - pot of 10 cm diameter), recorded the lowest values of this

parameter, namely 26.5 cm, respectively 29.7 cm, compared to the untreated control plants (V1-14 cm diameter), whose average height was 35.0 cm (graph 1).

The average number of shoots per plant was not significantly influenced by the Cycocel treatments and pot size, having similar values at all variants but below the control plant, during the observations and measurements period. The lowest number of shoots was recorded by the plants cultivated in pots of 10 cm diameter (V4), namely 2.0 shoots/plant, compared to the control plants, which recorded an average number of 4.7 shoots/plant (graph 2).

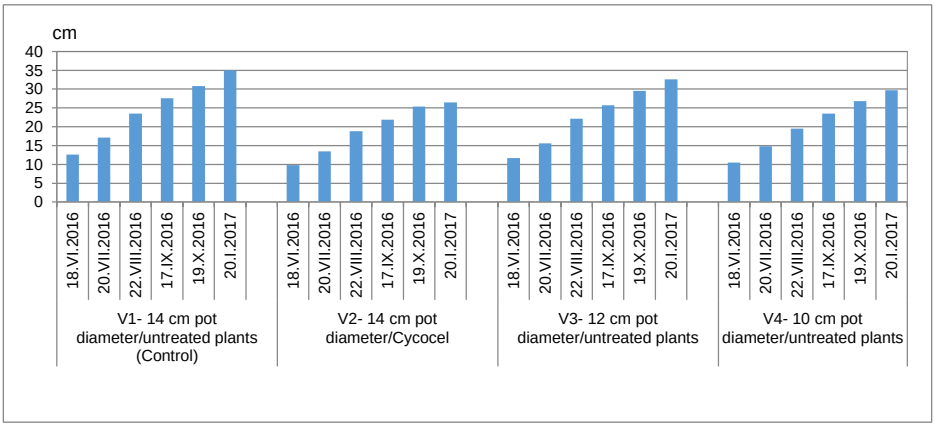
According to the analysis of the results obtained, there is a reduction in the length of the shoots of *Abutilon x hybridum* plants to the other variants compared to the control plants (V1). The average length of the shoots had the lowest values for the plants treated with Cycocel 1000 ppm (V2 - 7.4 cm), compared to the untreated plants (V1 - 13.8 cm) (graph 2).

Regarding the average leaf sizes, the dynamic analysis of the recorded data shows the highest value at V1 - control plants (15.5 cm length and 11.5 cm width). At V2, the leaves had the lowest values of length and width, namely 10.8 cm, respectively 8.7 cm, as a result of foliar treatments with Cycocel, the plants showing a distinctive decorative aspect, due to the intensifying of leaf colour, compared to the other variants (graphs 3 and 4).

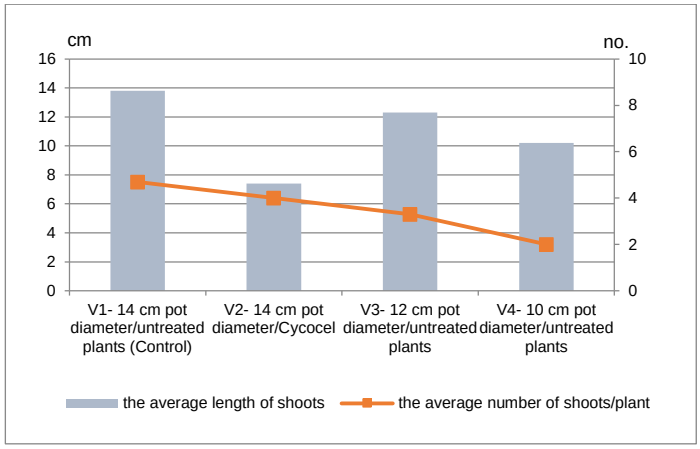
The flower length, diameter and colour are important plant qualitative characteristics with decorative value.

The reduction of the substrate volume and foliar application of plant growth regulators have resulted in a reduction of flower length. Graph 5 shows that V4 (pot of 10 cm diameter) and V2 (Cycocel 1000 ppm), recorded the lowest values of the average flower length, namely 3.8 cm, respectively 4.2 cm, compared to the control plants, whose flowers had an average length of 5.0 cm.

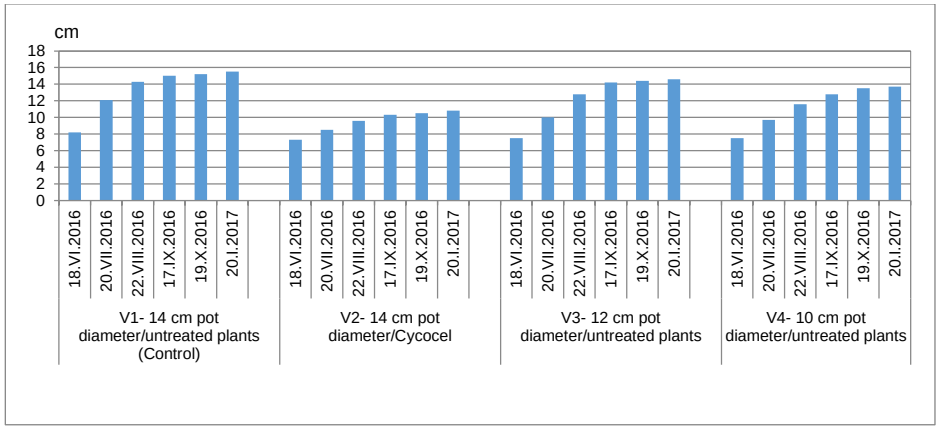
The plants grown in 10 cm pots recorded also the lowest flower diameter (4.1 cm), followed by the plants treated with Cycocel (4.8 cm). The control variant recorded the highest value of the flower diameter (5.5 cm), and to the plants grown in 12 cm pots, the flowers had an average diameter similar to the control.



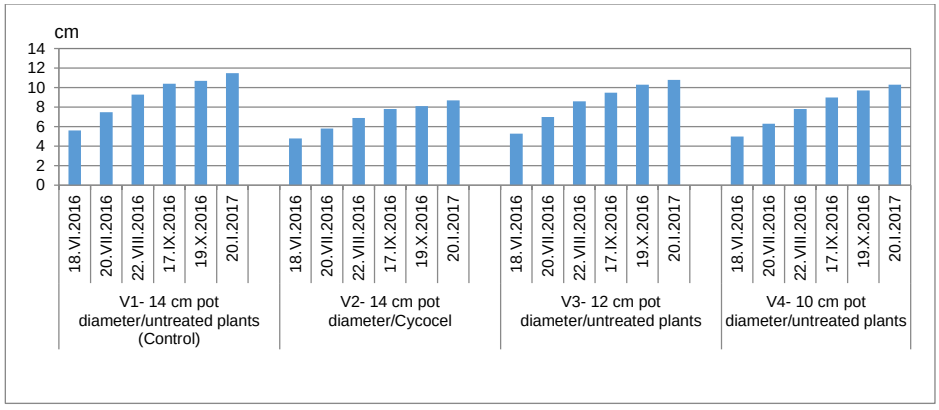
Graph 1. The average height of plants



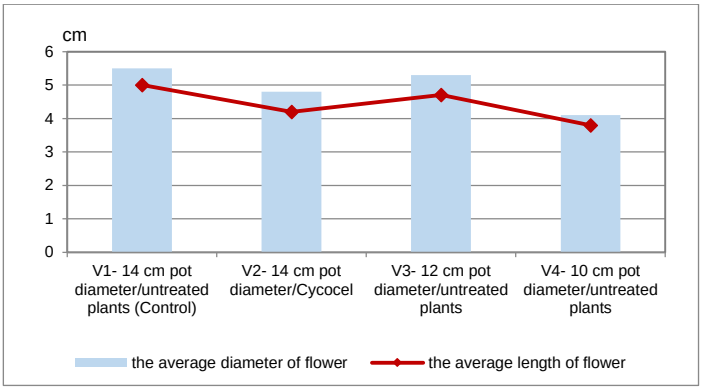
Graph 2. The influence of pot size and Cycocel on shoots length and number of shoots/plant



Graph 3. The average length of leaves



Graph 4. The average width of leaves



Graph 5. The influence of pot size and Cycocel on length and diameter of flower

CONCLUSIONS

The lowest values of the main analyzed morphological characteristics (plant height, number of shoots/plant and shoots length, leaf length and width, diameter and length of the flowers) were recorded by the plants treated with Cycocel 1000 ppm and by those grown in pots with a diameter of 10 cm.

The application of foliar treatments with Cycocel has led to reduce the height of plants and improve the decorative aspect, by intensifying the colour of leaves and flowers.

REFERENCES

Alem P., Thomas P.A., Van Iersel M.W., 2015, Controlled water deficit as an alternative to plant growth retardants for regulation of *Poinsettia* stem elongation. HortScience 50 (4): 565-569.

Bergstrand K.J., Asp H., Schüssler H.K., 2016, Growth control of ornamental and bedding plants by manipulation of photoperiod and light quality. Acta Horticulturae, 1134:33-40.

Bergstrand K.J., 2017, Methods for growth regulation of greenhouse produced ornamental pot-and bedding plants - a current review. Folia Hort. 29/1: 63-74.

Chapman B.M., Lyons R.E., 1988, Controlling height of *Abutilon* hybrids with ancymidol, mechanical pinching and photoperiod. Scientia Horticulturae, Vol. 36 (1-2): 125-129.

Currey C.J., Lopez R.G.., 2010, Applying plant growth retardants for height control. Purdue University Cooperative Extension Publication HO-248-W.

Hansen C.W., Nielsen K., 2000, Non-chemical growth regulation of ornamental plants. Grøn Viden, 121, 1-4.

Hendriks L., Ueber E., 1995, Alternative methods of regulating the elongation growth of ornamental plants: a current assessment. Acta Hort. 378: 159-167.

Karunananda D.P., Peiris S.E., 2010, Effects of pinching, Cycocel and B-nine treatments on branching habit of pot poinsettia (*Euphobia pulcherrima* Willd). Tropical Agricultural Research Vol. 21 (3): 284-292.

Kresten-Jensen, H.E., Andersen H., 1992, Effects of high temperatures and DIF on potted foliage plants. Acta Hort., 305:27–36.

Latimer J.G., Whipker B., 2012, Selecting and using plant growth regulators on floricultural crops. Virginia Polytechnic Institute and State University, Virginia Cooperative Extension: Blacksburg, Virginia, Publication 430-102.

Lykas C., Kittas C., Katsoulas N., 2008, *Gardenia jasminoides* height control using a photoselective polyethylene film. HortScience 43:2027-2033.

Manda M., Nicu C., 2016, The influence of growth retardants and substrate volume on growth of *Hemigraphys repanda* L. Annals of the University of Craiova, Series Biology, Horticulture, Food produce processing technology, Environmental engineering, Vol. XXI (LVII), p. 131-136.

Nesmith D.S., Duval J., 1998, The effect of container size on plant growth. HortTechnology, October-December, 8 (4): 495-498.

Nicu C., Manda M.**,** 2012, The influence of water stress and substrate volume on growth and development *Beloperone guttata* Brandeg. plants. Annals of the University of Craiova, Series Biology, Horticulture, Food produce processing technology, Environmental engineering, Vol. XVII (LIII), p. 281-286.

Poorter H., Bühler J., van Dusschoten D., Climent J., Postma J.A., 2012, Pot size matters: a meta-analysis of the effects of rooting volume on plant growth. Functional Plant Biology 39: 839-850.

Renu K., Srivastava R., 2013, Effect of cycocel and alar on the growth and flowering of poinsettia cv. SINGLE, Asian Journal of Horticulture, 8(1): 313-316.

Sajjad Y., Jaskani M.J., Asif M., Qasim M., 2017, Application of plant growth regulators in ornamental plants: a review. Pakistan Journal of Agricultural Sciences, Vol. 54 (2), 327-333.

Taherpazir S., Hashemabadi D., 2016, The effect of cycocel and pot size on vegetative growth and flowering of Zinnia (*Zinnia elegans*). Journal of Ornamental Plants, 6(2):107-114.

Warner, R.M., Erwin J.E., 2003, Effect of plant growth retardants on stem elongation of *Hibiscus* species. Horttechnology, 13(2): 293-296.

Wazir J.S., 2015, Studies on the effect of growth retardants on growth and flowering in potted Fuchsia. International Journal of Agricultural Sciences and Veterinary Medicine, Vol. 3 (1): 85-89.

Zheng C., Kim K., Matsui S., 2004, Effect of brushing on dwarfing, branching and flowering of *Dendranthema indicum* var*. hortense.* Horticultural Research, 3, 291-295.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

EVALUATION OF POLYPHENOLS CONTENT AND ANTIOXIDANT ACTIVITY OF LEAVES FROM EIGHT VARIETIES ORANGE TREES UNDER ENVIRONMENTAL CONDITIONS OF PELOPONNESE REGION, GREECE

Papachatzis Alexandros[1], Gougoulias Nikolaos[1*], Stavropoulos Georgios-Christos[1], Koutinas Nikolaos[2], Zakynthinos Georgios[3], Ntalla Maria-Nektaria[4]

[1]Department of Agronomy Technology, Technological Educational Institute of Thessaly, Larissa, Greece.
[2]Department of Agronomy Technology, Technological Educational Institute of Thessaloniki, Greece.
[3]Department of Food Technology, Technological Educational Institute of Peloponnese, Kalamata, Greece.
[4]Department of Computer Science and Engineering, Technological Educational Institute of Thessaly, Larissa, Greece.
*Correspondence author: email: ngougoulias@teilar.gr

Keywords: *Leaves fruit trees; total phenols; phenol fractions; ABTS•+ activity*

ABSTRACT

Leaves from eight varieties of orange trees (Navelina, Newhall, Merlin, Tarocco, Moro, Valencia, Lane late and Salustiana) from Argos of Peloponnese region, Greece, were analysed for phenolics content and antioxidant activity, using ethanol extracts. It was found that the content of total phenols (TP), varied from 9.104 to 18.35 mg GAE/g DW, Non-flavonoid phenols (NFP) from 2965.0 to 6768.5 μg GAE/g, Flavonoid phenols (FP) from 6139.2 to 13800.0 μg GAE/g DW, and F-3-ols from 1295.3 to 3069.6 μg(CE) /g DW, depending on the variety of orange trees. The leaves of Valencia orange trees exhibited the highest total antioxidant capacity (TAC), equal to 1520.0 μg Trolox/g DW, while the leaves of Moro orange trees exhibited the lowest, equal to 826.0 μg Trolox/g. The leaves from the orange trees under consideration are regarded as potent sources of biologically active phenolic compounds for pharmaceutical purposes.

INTRODUCTION

The creation of free radicals in human cells causes the oxidation of biological macromolecules which are in the basis many debilitating diseases (Shahidi 1997, Pokorny et al. 2001). The increased interest of natural polyphenols is due to their capability to scavenge and neutralize the active free oxygen and nitrogen-containing radicals, reduce the risk of many contemporary diseases.

The leaves of many plant species contain polyphenols and essential oils, and have been used as spices or sources for the preparation of natural antioxidants for industry (Benavente-Garcıa et al., 2000).

The leaves of many wood species being rich in phenol compounds and tannin, are used for industrial purposes, whereas others are studied to be used as forage (Reddy and Elanchezhian 2008, Ruan et al., 2008).

Very few reports could be found about the antioxidant properties and phenol components of leaf mass at the end of vegetation in view of its more rational utilisation.

The purpose of the present research is to evaluate the antioxidant activity, the contents of total phenols and the major phenol fractions in the leaves from some varieties orange trees grown in the Peloponnese region at the end of their active photosynthesis period.

MATERIAL AND METHODS

This study, was conducted in eight orange orchards where are they in the Argos of Peloponnese region, Greece. The distance of the orange orchards from the sea is 5km, and the altitude 5m. The region of Argos (latitude $37^0$36'N, longitude $22^0$47'E) is characterized by a Mediterranean climate with mild dry winters and hot dry summers. Average winter temperature 10.2 ^{0}C, average summer temperature 26.3 ^{0}C and average annual precipitation 480 mm.

Leaves from eight varieties orange trees (*Citrus sinensis*) were the subject, as of study (Navelina, Newhall, Merlin, Tarocco, Moro, Valencia, Lane Late and Salustiana). From all varieties orange trees, the leaves were collected in the first ten-day of September, where it is accepted that the active photosynthesis activity of the leaves is reduced, dried in the sun, ground with the leaf stems in size diameter < 0,15mm. The samples were stored at -18 ^{o}C and were further subjected to various analyses. The soil chemical properties of orange orchards are presented in Table 1 and Table 2.

Table 1

Chemical properties of soils for the respective varieties of orange trees

Varieties of orange trees	Soil depth (0-30) cm				
	Texture	pH	EC	$CaCO_3$	Organic matter
			dS m^{-1}	%	%
Navelina	CL	8.07± 0.37	0.35±0.02	17.08±0.90	2.48±0.15
Newhall	SCL	7.79±0.34	0.18±0.01	17.08±0.89	1.24±0.07
Merlin	SCL	8.46±0.40	0.19±0.01	23.75±1.32	1.91±0.10
Tarocco	SCL	8.07±0.38	0.15±0.01	17.50±0.88	1.24±0.06
Moro	SCL	8.00±0.37	0.09±0.01	14.17±0.83	1.41±0.07
Valencia	SL	8.15±0.37	0.14±0.01	59.17±3.13	1.04±0.06
Lane Late	SCL	7.79±0.41	0.20±0.01	26.25±1.19	1.47±0.07
Salustiana	CL	8.02±0.37	0.17±0.01	24.58±1.26	1.47±0.07

CL, Clay loam; SCL, Sandy clay loam; SL, Sandy loam; EC, Electrical conductivity and pH; extract (1part soil:5parts H_2O). Data represent average means and standard deviation (SD), n=4.

Table 2

Chemical properties of soils for the respective varieties of orange trees

Varieties of orange trees	Soil depth (30-60) cm				
	Texture	pH	EC	$CaCO_3$	Organic matter
			dS m^{-1}	%	%
Navelina	CL	8.16±0.48	0.31±0.03	18.05±1.03	2.02±0.10
Newhall	SCL	7.88±0.38	0.16±0.01	18.33±0.94	1.14±0.06
Merlin	CL	8.55±0.41	0.20±0.01	23.33±1.26	1.84±0.09
Tarocco	SCL	8.02±0.35	0.09±0.01	19.17±0.91	1.19±0.07
Moro	SCL	7.88±0.35	0.15±0.01	13.75±0.71	1.34±0.06
Valencia	SL	8.23±0.36	0.18±0.01	60.12±2.86	0.96±0.05
Lane Late	SCL	7.93±0.42	0.19±0.01	25.83±1.34	1.37±0.08
Salustiana	SCL	7.76±0.40	0.18±0.01	25.42±1.27	1.41±0.07

CL, Clay loam; SCL, Sandy clay loam; SL, Sandy loam; EC, Electrical conductivity and pH; extract (1part soil:5parts H_2O). Data represent average means and standard deviation (SD), n=4.

Preparation of the ethanol extracts

Two g of finely ground leaves were two rounds treated by 20 ml of 80 % aqueous ethanol. Samples were incubated for 24 h in the extractant at stirring; The extract was gathered after centrifugation and filtration. The pellet was re-treated with 20 ml of 80 % aqueous ethanol for 2 h at stirring at ambient temperature. The extract was gathered after centrifugation/filtration and the volume was made up to 50 ml with aqueous ethanol and used for further chemical analysis (Kanner et al. 1994).

Methods of analyses

Total polyphenols (TP): The amount of total polyphenols (TP) was determined with the Folin–Ciocalteu (F.C.) reagent according to the method of (Singleton and Rossi, 1965) using the microvariant proposed by (Baderschneider et al. 1999), and were expressed as gallic acid equivalent (GAE) in mg/g dry weight.

Nonflavonoid phenols (NFP): The content of NFP was determined with the F.C. reagent after removing the flavonoid phenols (FP) with formaldehyde according to the method of (Kramling and Singleton, 1969) and was expressed as gallic acid equivalent (GAE) in µg/g dry weight.

Flavonoid phenols (FP): Flavanoid phenols were determined as a difference between the content of total phenols (TP) and nonflavonoid phenols (NFP). Their amount was evaluated as gallic acid equivalent in µg/g dry weight.

The total flavanols (F-3-ols, catechins and procyanidins) were assayed using p-DMACA reagent after the method of (Li et al. 1996) and were presented as catechin equivalent (CE) in µg/g dry weight.

The total antioxidant capacity (TAC) was determined using the stable radical cation ABTS•+ (2,2-azinobis-(3-ethylbenzothiazolin-6-sulphonic acid), according to the method of (Re et al. 1999) and was presented as Trolox equivalent in µg/g dry weight.

Soil was analyzed using the following methods which are referred by (Page et al. 1982).

Organic matter was analyzed by chemical oxidation with 1 mol L^{-1} $K_2Cr_2O_7$ and titration of the remaining reagent with 0.5 mol L^{-1} FeSO4. Soil pH is determined in (1:5) soil/water extract, pH value is measured by using glass electrode pH meter. Electrical conductivity, (EC) measured in (1:5) soil/water extract, using conductivity meter. The Texture of soils was determined by the method Bouyoucos. The calcium carbonate was determined by the method Bernard.

Data analysis was made using the MINITAB (Ryan et al. 2005) statistical package. The results are means of four parallel samples. Analysis of variance was used to assess treatment effects. Mean separation was made using Tukey's test when significant differences (P=0.05) between treatments were found.

RESULTS AND DISCUSSION

The content of total phenols (TP) in the leaves orange trees from the varieties studied ranges from 9.104 to 18.35 mg GAE/g DW (Figure 1). The highest content was found in the leaves of Valencia orange trees, and the lowest in the leaves of Moro orange trees. These values are higher than those which correspond to leaves of other types fruit trees (Gougoulias, 2015). It has been established that the concentration of the total phenols and of phenol fractions in the leaves different tree species, varies and depends on the cultivar, the season, the climatic conditions, and agricultural techniques (Mayr et al. 1994).

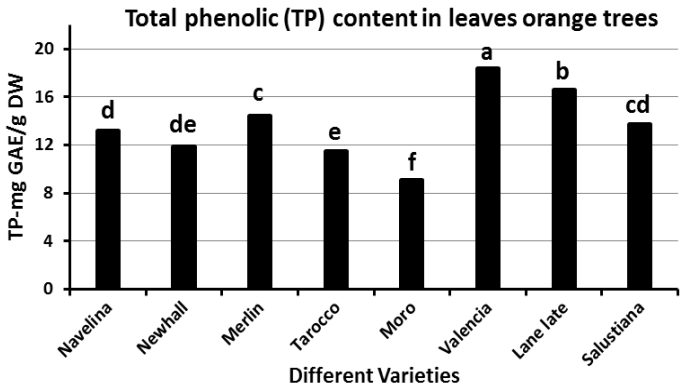


Figure 1. Content of total phenols in the leaves orange trees of the varieties studied.

Columns with the same letter do not differ significantly according to the Tukey's test (P=0.05).

The content of flavonoid phenols (FP) in the leaves orange trees from the varieties studied ranges from 6139.2 to 13800.0 µg GAE/g DW. The highest content was found in the leaves of Valencia orange trees, and the lowest in the leaves of Moro orange trees (Table 3). The FP content in the leaves of Salustiana, Valencia, Newhall, Merlin, Moro and Navelina orange trees constitute 76.3 %, 75.2 %, 70.4 %, 68.0 %, 67.4 % and 64.9 % respectively of TP amount, whereas for the leaves of Tarocco and Lane late orange trees reached 61.7 % % and 59.2 %, respectively. The content of non-flavonoid phenols (NFP) from the varieties studied is higher in the leaves of Lane late orange trees, and the lowest in the leaves of Moro orange trees (Table 3).

Due to the great interest towards the antioxidant properties of flavanols (catechin, epicatechin and procyanidins) we have determined them as a separate fraction.The flavanols is included in the flavonoid fraction. The content of F-3-ols determined as catechin equivalent (CE) in the leaves of orange trees from the varieties studied.The highest content was found in the leaves of Lane late orange trees, and the lowest in the leaves of Moro orange trees (Table 3).

Table 3

Flavonoid phenols (FP), Nonflavonoid phenols (NFP) and Total flavanols (F-3-ols) content in the leaves different varieties of orange tress

Varieties of orange trees	FP	NFP	F-3-ols
	µg GAE/g DW	µg GAE/g DW	µg CE/g DW
Navelina	8598.7bc	4643.8b	2214.5bc
Newhall	8399.3c	3528.6c	1838.7d
Merlin	9836.0b	4623.6b	2030.6cd
Tarocco	7077.0d	4388.4b	2414.5b
Moro	6139.2e	2965.0d	1295.3e
Valencia	13800.0a	4554.4b	2374.6b
Lane late	9808.9b	6768.5a	3069.6a
Salustiana	10498.5b	3255.2cd	1601.9d

Columns with the same letter do not differ significantly according to the Tukey's test (P=0.05).

The total antioxidant capacity (TAC) of the leaves orange trees from the varieties studied is determined using the free stable cation ABTS•+ and varies within the limits of

826–1520 µg Trolox /g DW (Figure 2). And again the leaves of Valencia orange trees are distinguished by the highest values of TAC and the leaves of Moro orange trees by the lowest.

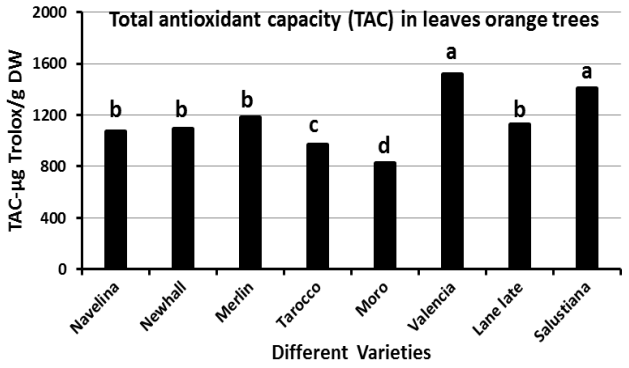


Figure 2. Total antioxidant capacity (TAC) in the leaves different varieties orange tress.

Columns with the same letter do not differ significantly according to the Tukey's test (P=0.05).

CONCLUSIONS

The leaves of the investigated eight varieties of orange tree, differ in their content of TP, NTP, FP, F-3-ols and total antioxidant capacity (TAC). The leaves of Valencia orange trees, contain the highest amount of TP and FP which correspond to the highest total antioxidant capacity (TAC). Considering the content of total, non-flavonoid and flavonoid phenols, as well as the antioxidant activity, the leaves from the investigated orange trees varieties can be regarded as potential sources of bioactive phenol compounds for pharmaceutical purposes, ecological farming and forage industry.

REFERENCES

Baderschneider B., Luthria D., Waterhouse A.L., Winterhalter P., 1999, Antioxidants in white wine (cv. Riesling): I. Comparison of different testing methods for antioxidant activity. Vitis, 38(3): 127-131.

Benavente-Garcıa O., Castillo J., Lorente J., Ortuno A., Del Rio J. A., 2000, Antioxidant activity of phenolics extracted from Olea europaea L. leaves. Food Chemistry, 68(4), 457-462.

Gougoulias N., 2015, Evaluation of antioxidant activity and polyphenol content of leaves from some fruit species. Oxidation Communications, 38(1), 35-45.

Kanner J., Frankel E., Granit R., German B., Kinsella J. E., 1994, Natural antioxidants in grapes and wines. Journal of Agricultural and Food Chemistry, 42(1), 64-69.

Kramling T.E. and Singleton V.L., 1969, An estimate of the nonflavonoid phenols in wines. American Journal of Enology and Viticulture, 20(2): 86-92.

Li Y.G., Tanner G., Larkin P., 1996, The DMACA–HCl protocol and the threshold proanthocyanidin content for bloat safety in forage legumes. Journal of the Science of Food and Agriculture, 70(1): 89-101.

Mayr U., Batzdorfer R., Treutter D. and Feucht W., 1994, Surfactant-induced Changes in Phenol Content of Apple Leaves and Fruit Skins. Acta Hortic, 381: 479 -487.

Page A.L, Miller R.H., Keeney D.R., 1982, Methods of Soil Analysis. Part 2, Chemical & Microbiological properties. Agronomy (9), ASSSA, Mad. Wisc. USA.

Pokorny J., Yanishlieva N., Gordon M. H., 2001, Antioxidants in food: practical applications. CRC press.

Re R., Pellegrini N., Proteggente A., Pannala A., Yang M., Rice-Evans C., 1999, Antioxidant activity applying an improved ABTS radical cation decolorization assay. Free radical biology and medicine, 26(9-10), 1231-1237.

Reddy, D. V., Elanchezhian, N., 2008, Evaluation of tropical tree leaves as ruminant feedstuff based on cell contents, cell wall fractions and polyphenolic compounds. Cellulose (ADF-ADL), 14(21.58), 17-52.

Ruan Z. P., Zhang L. L., Lin Y. M., 2008, Evaluation of the antioxidant activity of Syzygium cumini leaves. Molecules, 13(10), 2545-2556.

Ryan B.F., Joiner B.L., Cryer J.D., 2005, MINITAB Handbook: Updated for release 14, 5th edition. Brooks/Cole-Thomson Learning Inc., Kentaky, KY.

Shahidi F., 1997, Natural antioxidants: chemistry, health effects, and applications. The American Oil Chemists Society.

Singleton V.L. and Rossi S.A., 1965, Colorimetry of Total Phenolics with Phosphomolibdic-phosphotungstic Acid Reagents. J Enol Viticult, 16: 144-158.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓*Biology*
✓*Horticulture*
✓*Food produce processing technology*
✓*Environmental engineering*

EFFECT OF MATURITY STAGE ON THE PHENOLIC COMPOSITION, VITAMIN C AND ANTIOXIDANT ACTIVITY OF AGEN SKOPELOU PLUMS

Papachatzis Alexandros[1], Gougoulias Nikolaos[1]*, Papachatzis Achilleas[2], Lazou Evangelia[1], Tsiountsioura Vassiliki[3]

[1]Department of Agronomy Technology, Technological Educational Institute of Thessaly, Larissa, Greece.
[2]School of Agriculture, Aristotle University of Thessaloniki
[3]Faculty of Medicine, University of Thessaly, Larissa, Greece.
*Correspondence author's email: ngougoulias@teilar.gr

Keywords: *Plum fruits; total phenols; total anthocyanins; vitamin C; FRAP activity*

ABSTRACT

'Agen Skopelou' plums were analyzed for total phenols, total anthocyanins, vitamin C and antioxidant activity FRAP at four different maturity stages based on color (S1,S2,S3, and S4), such as mature green, mature purple, mature blue and mature deep blue respectively. The total phenols content ranged from 2032.6 to 2400.5 mg (GAE) kg^{-1} FW. The total anthocyanins content ranged from 157 to 229 mg kg^{-1} FW, as cyanidin-3-glucoside equivalents. The vitamin C content ranged from 189.6 to 275.3 mg kg^{-1} FW. The antioxidant activity FRAP ranged from 19.38 to 29.64 µmol FRAP g^{-1} FW. The total anthocyanins content and the vitamin C content increased with maturity of 'Agen Skopelou' plums. On the contrary, the changes of antioxidant activity FRAP and the total phenols content evidenced lack of clear trend.

INDRODUCTION

The reactive oxygen and nitrogen, which are formed in the human cells as strong oxidants can cause oxidative damage of biomolecules and the occurrence of many diseases (Sies, 2015). The oxidative destruction of biomolecules can be reduced by using natural antioxidants such as (vitamins and polyphenols) which are contained in fruits and vegetables (Valko et al. 2006).

Phenolic compounds are secondary metabolites of the plants. They are components of many fruits and vegetables and affect the color and taste of the fruit, while exercising potent antioxidant and antimicrobial properties (Duthie 2007, Alesiani et al. 2010).

Plum fruits contain copious high amounts phenolic compounds, such as flavonoids, nonflavonoids, anthocyanins and others that are powerful antioxidants (Chun 2003, Kristl et al. 2011). The content and qualitative composition of phenolic compounds in the fruit depends on the genotype, cultivation techniques and the climatic conditions (Miletic et al. 2012).

In literature little information exists regarding the phenolic composition and the antioxidant activity during plum fruit ripening. The objective of our study was to determine the effect of maturity stage on the phenolic composition, vitamin C and the antioxidant activity of 'Agen Skopelou' plums.

MATERIAL AND METHODS

Fruits of Agen plums were collected from a commercial orchard established in 2002 in island of Skopelos, Greece. Over the seasons examined, fruits were collected in 2016 from the farm Gripioti (3918^{o}N2350^{o}E) at four different stages maturation, based on colour (S1,S2,S3, and S4), such as mature green, mature purple, mature blue and mature deep blue respectively. 15 kg manure per plum tree was added, corresponding to 0.40 kg Nitrogen, 0.35 kg Potassium and 0.13 kg Phosphorus, while no irrigation was used. The area is characterized by a typical Mediterranean climate with cold humid winters and hot-dry summers. In particular, the average yearly air temperature ranges to 17 ^{o}C while the average yearly precipitation is 515 mm.

Thirty samples of fruits with no mechanical injuries or disease indications were selected from three trees on each sampling date, with the same sun exposure, position of the branch on the tree and position of fruit on the branch for best representative samples. The fruits they were stored at -20 °C until the analysis. The edible part of the fruit was used in the study. Plum fruits were carefully cut in four equal parts, were frozen by pouring into liquid nitrogen and homogenized using a blender.

Preparation of the ethanol extracts: Twenty g of samples were two rounds treated by 20 ml of 80 % aqueous ethanol. Samples were incubated for 24 h in the extractant at stirring; The extract was gathered after centrifugation and filtration. The pellet was re-treated with 20 ml of 80 % aqueous ethanol for 2 h at stirring at ambient temperature. The extract was gathered after centrifugation /filtration and the volume was made up to 50 ml with aqueous ethanol and used for further chemical analysis (Kanner et al. 1994).

Methods of analyses: Soil was analyzed using the following methods which are referred by (Page et al. 1982). The Texture of soils was determined by the method Bouyoucos. Organic matter was analyzed by chemical oxidation with 1 mol L^{-1} $K_2Cr_2O_7$ and titration of the remaining reagent with 0.5 mol L^{-1} $FeSO_4$. Soil pH and electrical conductivity, (EC), measured in the extract (1 part soil : 5 parts H_2O). The calcium carbonate was determined by the method Bernard. Available P forms (Olsen P) was extracted with 0.5 mol L^{-1} $NaHCO_3$ and measured by spectroscopy. Exchangeable form of potassium was extracted with 1 mol L^{-1} CH_3COONH_4 and measured by flame Photometer (Essex, UK). Inorganic nitrogen was extracted with 0.5 mol L^{-1} $CaCl_2$ and estimated by distillation in the presence of MgO and Devarda's alloy, respectively.

The amount of total polyphenols (TP) in the plum fruits was determined with the Folin-Ciocalteu (F.C.) reagent according to the method of (Singleton and Rossi, 1965) and were expressed as gallic acid equivalent (GAE) in mg kg^{-1} fresh weight.

Anthocyanins determined with extracting solvent 95 % ethanol / 1.5 N HCl (85:15). The monomeric anthocyanin pigment content of the extracts was determined using the pH-differential method described by (Liu et al. 2002). Pigment content was calculated as mg of cyanidin-3-glucoside equivalents / kg fresh weight, using an extinction coefficient of 26,900 L/cm/mol and molecular weight of 449.2 g/mol.

The vitamin C determined using titrimetric method with 2,6-p-dichlorphenolindophenol. Method is based on vitamin C oxidation by 2,6-p-dichlorphenolindophenol into dehydroascorbic acid, until colour of reagent turns into colorless (AOAC, 2002).

The ferric reducing antioxidant power (FRAP) of the plums extracts was evaluated according to the method of (Benzie and Strain, 1999) and the results were expressed as μmol FRAP reagent g^{-1} fresh weight.

Data analysis was made using the MINITAB (Ryan et al. 2005) statistical package. The results are means of four parallel samples. Analysis of variance was used

to assess treatment effects. Mean separation was made using Tukey's test when significant differences (P=0.05) between treatments were found.

RESULTS AND DISCUSSION

The physicochemical characteristics of soil from studied orchard are presented in Table 1.

Table 1

Soil chemical properties of plum orchard, before fertilizing application

Properties	Soil depth 0-30 cm	Soil depth 30-60 cm
Texture	Sandy Loam	Sandy Loam
pH	6.85 ± 0.06	7.45 ± 0.09
EC, dS m^{-1}	1.12 ± 0.07	0.18 ± 0.02
Organic matter (%)	1.24 ± 0.06	0.72 ± 0.03
N-inorganic (mg kg^{-1})	61.5 ± 4.39	49.0 ± 4.08
K-exchangeable (mg kg^{-1})	85.8 ± 4.05	65 ± 3.42
P -Olsen (mg kg^{-1})	7.2 ± 0.65	4.0 ± 0.29
$CaCO_3$ (%)	0.38 ± 0.02	0.38 ± 0.02

Data represent average means and standard deviation (SD), n=4.

The changes in total phenolic content of 'Agen Skopelou' fruits during maturation are presented in Table 2. Maturity stage affects the content of the total phenols of fruits. The content of total phenols (TP) of the fruits in the maturation stages studied ranges from 2032.6 to 2400.5 mg (GAE) kg^{-1} fresh weight. In particular, in the mature blue colour of fruits the highest polyphenols content was observed, while in the mature green colour the lowest polyphenols content was observed. In addition, from the mature blue to mature deep blue colour there was a significant reduction of total phenolic content of the fruits. Therefore, the total phenolic content increased from S1 to S3 stages, and subsequently decrease until S4 stage. Similar results were obtained by other researches about the influence of maturity stage on phenolic content of Williams cultivars of pear fruits (Amiot et al. 1995).

In most fruits, ripeness degree markedly affected the quantity of the phenolics compounds. The degradation of some phenolics compounds it may be faster or slower than biosynthesis other phenolics compounds. According to other studies, phenolic acids concentrations decrease during ripening, whereas flavonoid phenols concentrations increase during ripening (Manach et al. 2004).

The total phenolics content in fruits of 'Agen Skopelou' which were studied was within the range reported in other plum cultivars (Chun et al. 2004). Furthermore, the total phenolic content in fruits of 'Agen Skopelou' was lower than that previously reported for Prunus salicina cultivars (Cevallos-Cavals et al. 2006), while was higher than that reported for Stanley cultivar (Kim et al. 2003).

Table 2

Changes in total phenolic content, anthocyanin, vitamin C and antioxidant activity FRAP during maturity of Agen Skopelou plums

Maturity stage (colour)	TP	AC	Vitamin C	FRAP
	mg (GAE) kg^{-1} fw	mg cyanidin-3-glucoside kg^{-1} fw	mg kg^{-1} fw	μmol g^{-1} fw
S1, mature green	2032.6d	157c	189.6d	23.89b
S2, mature purple	2234.7b	166c	218.6c	19.38c
S3, mature blue	2400.5a	189b	244.5b	26.46ab
S4, mature deep blue	2102.4c	229a	275.3a	29.64a

Columns with the same letter do not differ significantly according to the Tukey's test (P=0.05).

The changes in total anthocyanin content during ripening of plums are presented in Table 2. The content of total anthocyanins of the fruits in the maturation stages studied ranges from 157 to 229 mg cyanidin-3-glucoside kg^{-1} fresh weight. In particular, from the maturity stages S1 to S4 total anthocyanins increased by 45.8 %. Also, fruit ripening is associated with important changes in colour of fruits and in other quality features. These results show that the anthocyanin content in the plum fruits increases with maturity.

Similar results were obtained by other researches about the influence of maturity stage on anthocyanin content in fruits (Hui and Nip, 2006). The anthocyanin content in fruits of 'Agen Skopelou' which were studied was within the range reported in other plum cultivars (Miletic et al. 2012). Furthermore, the anthocyanin content in fruits of 'Agen Skopelou' was slightly lower than that reported for Prunus salicina cultivars (Cevallos-Cavals et al. 2006), while was higher than that reported for Prunus domestica cultivars (Franke et al. 2004).

The changes in vitamin C content during ripening of plums are presented in Table 2. The content of the vitamin C of 'Agen Skopelou' fruits in the maturation stages studied ranges from 189.6 to 275.3 mg kg^{-1} fresh weight. These results show that the vitamin C content in the plum fruits increases with maturity.

The changes in antioxidant activity FRAP of 'Agen Skopelou' fruits during maturation are presented in Table 2. Antioxidant capacity was also significantly affected by ripening stage of fruits. The antioxidant activity FRAP of the fruits in the maturation stages studied ranges from 19.38 to 29.64 μmol FRAP g^{-1} fresh weight. After the determination on the first sampling, the total antioxidativity of 'Agen Skopelou' fruits slightly decreased and subsequently increased by 38 %. This increase is probably due to the increase of total anthocyanins and of vitamin C. The results showed that plum fruits containing the highest total phenolics content do not containing and the highest antioxidant activity.

DPPH -scavenging activity variations during five harvesting phases were reported by (Miletic et al. 2012) for Stanley plums, no trend being noticed during fruit development. According to Díaz-Mula et al. (2009), the variety during maturation of plum fruits grown under the same conditions has a significant role for antioxidant capacity.

CONCLUSIONS

The results showed that maturity of 'Agen Skopelou' fruits had a significant effect on total anthocyanins content, vitamin C content, total phenols content and antioxidant activity FRAP.

The changes of antioxidant activity FRAP during fruit maturity evidenced lack of clear trend. Also, the changes of total phenols content evidenced lack of clear trend, probably due to different composition of polyphenols. On the contrary, total anthocyanins content and the vitamin C content increased with maturity of 'Agen Skopelou' plums.

REFERENCES

Alesiani D., Canini A., D'Abrosca B., DellaGreca M., Fiorentino A., Mastellone C., Monaco P., Pacifico S., 2010, Antioxidant and antiproliferative activities of phytochemicals from Quince (Cydonia vulgaris) peels. Food Chemistry, 118,199–207.

Amiot M. J., Tacchini M., Aubert S. Y., Oleszek W., 1995, Influence of cultivar, maturity stage, and storage conditions on phenolic composition and enzymic browning of pear fruits. Journal of Agricultural and Food Chemistry, 43(5), 1132-1137.

AOAC., 2002, Official methods of analysis (17th ed.). Washington, DC: Association of Official Analytical Chemists.

Benzie I.F., Strain J.J., 1999, Ferric reducing/antioxidant power assay: direct measure of total antioxidant activity of biological fluids and modified version for simultaneous measurement of total antioxidant power and ascorbic acid concentration. Methods in enzymology, (299), 15-27.

Cevallos-Casals B. A., Byrne D., Okie W. R., Cisneros-Zevallos L., 2006, Selecting new peach and plum genotypes rich in phenolic compounds and enhanced functional properties. Food chemistry, 96(2), 273-280.

Chun O.K., Kim D.O., Moon H.Y., Kang H. G., Lee C. Y., 2003, Contribution of individual polyphenolics to total antioxidant capacity of plums. Journal of Agricultural and Food Chemistry, 51(25), 7240-7245.

Chun O. K., Kim D. O., 2004, Consideration on equivalent chemicals in total phenolic assay of chlorogenic acid-rich plums. Food Research International, 37(4), 337-342.

Díaz-Mula H. M., Zapata P. J., Guillén F., Martínez-Romero D., Castillo S., Serrano M., Valero D., 2009, Changes in hydrophilic and lipophilic antioxidant activity and related bioactive compounds during postharvest storage of yellow and purple plum cultivars. Postharvest Biology and Technology, 51(3), 354-363.

Duthie S.J., 2007, Berry phytochemicals, genomic stability and cancer: Evidence for chemoprotection at several stages in the carcinogenic process. Molecular Nutrition &, Food Research, 51,665-674.

Franke A. A., Custer L. J., Arakaki C., Murphy S. P., 2004, Vitamin C and flavonoid levels of fruits and vegetables consumed in Hawaii. Journal of Food Composition and Analysis, 17(1), 1-35.

Hui YH, Nip WK., 2006, Food biochemistry and food processing. Wiley-Blackwell, Hoboken, NJ, USA.

Kanner J., Frankel E., Granit R., German B., Kinsella J. E., 1994, Natural antioxidants in grapes and wines. Journal of Agricultural and Food Chemistry, 42(1), 64-69.

Kim D. O., Jeong S. W., Lee C. Y., 2003, Antioxidant capacity of phenolic phytochemicals from various cultivars of plums. Food chemistry, 81(3), 321-326.

Kristl J., Slekovec M., Tojnko S., Unuk T., 2011, Extractable antioxidants and non-extractable phenolics in the total antioxidant activity of selected plum cultivars (Prunus domestica L.): Evolution during on-tree ripening. Food Chemistry, 125,29–34.

Liu M., Li X. Q., Weber C., Lee C. Y., Brown J., Liu R. H., 2002, Antioxidant and antiproliferative activities of raspberries. Journal of agricultural and food chemistry, 50(10), 2926-2930.

Manach C., Scalbert A., Morand C., Rémésy C., Jiménez L., 2004, Polyphenols: food sources and bioavailability. The American journal of clinical nutrition, 79(5), 727-747.

Miletic N., Popovic B., Mitrovic O., Kandic M., 2012, Phenolic content and antioxidant capacity of fruits of plum cv.'Stanley'('Prunus domestica'L.) as influenced by maturity stage and on-tree ripening. Australian Journal of Crop Science, 6(4), 681.

Page A.L, Miller R.H., Keeney D.R., 1982, Methods of Soil Analysis. Part 2, Chemical & Microbiological properties. Agronomy (9), ASSSA, Mad. Wisc. USA.

Ryan B.F., Joiner B.L., Cryer J.D., 2005, MINITAB Handbook: Updated for release 14, 5th edition.

Sies H., 2015, Oxidative stress: a concept in redox biology and medicine. Redox biology, 4, 180-183.

Singleton V.L., Rossi S.A., 1965, Colorimetry of Total Phenolics with Phosphomolibdic-phosphotungstic Acid Reagents. J Enol Viticult, 16, 144-158.

Valko M., Rhodes C., Moncol J., Izakovic M. M., Mazur M., 2006, Free radicals, metals and antioxidants in oxidative stress-induced cancer. Chemico-biological interactions, 160(1), 1-40.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE INFLUENCE OF GROWTH REGULATORS ON INCREASING THE DEGREE OF SETTING AND FRUIT PRODUCTION IN THE IDARED APPLE PLANTATION

Pesteanu Ananie[1]*

[1]Faculty of Horticulture, State Agrarian University of Moldova
Mircesti str. 48, Chisinau, Republic of Moldova;
*Correspondence author e-mail: a.pesteanu@uasm.md

Keywords: *Apple, degree of binding, productivity, quality.*

ABSTRACT

The experimental plot is placed in the orchard "Codru-ST" Ltd. founded in 2012 year. The study subject of the experience was Idared apple variety grafted on M9 rootstock. The distance of plantation is 3.5x 0.8 m. The research was conducted during the period of 2016 year. The tested agents was Wuxal Bio Ascofol, 3.0 l/ha; Stimolante 66 f, 0.2 l/ha; Stimolante 66 f, 0.3 l/ha, which was sprayed in different period. During the research, it was studied the chlorophyll content in leaves, the quantity of flowers, the quantity of fruits, the fruit setting, the production at a tree and at a surface unit, the quality of the fruits. It was established that the higher results were obtained by treating apple trees with Stimolante 66 f at a dose of 0.3 l/ha, applied twice by foliar spraying. The first treatment should be done at the beginning of the flowering period, and the second after the fall of the petals.

INTRODUCTION

At present, apple cultivation imposes new tasks for fruit growers, which allow higher yields to be obtained from a surface area unit, with a lower capital investment (Babuc et al., 2013; Cimpoieş, 2012).

To solve these tasks, in modern fruit growing, the growth regulators are widely used (Curry and Greene, 1993). These products enhance metabolism in plants, increase the amount of amino acids, proteins, carbohydrates, vitamins and minerals that are actively involved in protecting trees from the influence of various biotic and abiotic stresses (Greene, 2007; Neamţu and Irimie, 1991; Watanabe M. et al.,2008).

In research conducted with the Antifriz product before flowering, the proportion of related reproductive organs increased by 2.1 % compared to the control, and in the variant where a treatment was performed during the fall of the petals, the increase was 10, 6 % (Алфёров, 2012).

Another stimulant growth regulator is Stimolante 66 f. Stimolante 66 f is a plant stimulator made up of various vegetal extracts, acid alpha naphthylacetic and a range of balanced microelements that influence metabolic functions, which cause plant growth, the binding of reproductive organs and improving the qualitative and quantitative characteristics of production. It helps overcome phases of stress and physiological stagnation due to frost, excess or lack of water, and prevent the loss of nutritional value of the fruit.

MATERIALS AND METHODS

The researches were carried out during the year 2016, in the apple orchard, founded in the autumn of 2012 at the company "Codru ST", with „knip boom" trees.

The object of study of the experience was Idared apple variety grafted on the M9 rootstock. The crown was conducting after the slender spindle system. Planting distance was 3.5x0.8 m.

Treatments on the experimental sector were performed according to the experience scheme (tab. 1).

Table 1

The scheme of experiments to determine the effectiveness of growth regulators on the degree of setting of reproductive organs to apple trees

Variants	Application method
Control, without treatment	-
Wuxal Bio Ascofol, 3.0 l/ha	By sprinkling three foliar treatments: I - at the end of flowering; II - 30 days prior to harvest; III - 15 days before harvest
Stimolante 66 f, 0.2 l/ha	By sprinkling two foliar treatments: I - at the beginning of flowering; II - after the fall of the petals
Stimolante 66 f, 0.3 l/ha	

Location of plots was made in blocks, each variant having 4 rehearsals. Each rehearsal consisted of 7 trees. At the border between parcels and experimental rehearsals, one untreated tree was left to avoid overlapping variants or rehearsals during the treatments.

Trees treatments were handled with the portable sprinkler in the hours without wind, in the morning. The amount of solution per tree was 0.3 liters, based on the number of trees per unit area and the recommended water quantity of 1000 l/ha.

Researches were conducted in the field and the laboratory conditions according to accepted methods of experiencing crop growth with growth regulators.

Statistical data processing was performed by the dispersion analysis method.

RESULTS AND DISCUSSIONS

Auxins, cytokines and microelement solutions are actively involved in the synthesis of chlorophyll, photosynthesis and plant vegetation.

The investigations show that treatments with growth regulators positively affect the content of chlorophyll "a" and "b" and their sum, as well as the content of carotenoids, determined at the end of the intensive growth phase of the shoots.

In the case of the control variant the content of chlorophyll "a" constituted 2.60 mg/dm^2 and the chlorophyll "b" - 0.82 mg/dm^2. The value of the chlorophyll "a" and "b" content was 3.42 mg/dm^2, and carotenoids 1.22 mg/dm^2 (tab. 2).

The application of the growth regulator Wuxal Bio Ascofol recorded an increase the content of chlorophyll and carotenoids in the leaves. The content of chlorophyll "a" and "b" in this variant constituted 2.94 and 0.93 mg/dm^2 respectively, or an increase of 0.34 and 0.11 mg/dm^2 as compared to the control variant. The amount of chlorophyll "a" and "b" and the amount of carotenoids in this variant constituted 3.87 and 1.33 mg/dm^2, respectively.

In the variant treated with growth regulator Stimolante 66 f at the dose of 0.2 l/ha, the content of chlorophyll "a" in leaf constituted 2.90 mg/dm^2, being practically at the level of Wuxal Bio Ascofol, but increased by 11.5 % compared to the control variant.

In this variant, the content of chlorophyll "b" and the sum of chlorophyll "a" + "b" recorded an increase of 10.9 % and 13.4 %, respectively, compared to the control variant. The amount of carotenoids in this variant was 1.30 mg/dm^2.

In the variant treated with growth regulator Stimolante 66 f at a dose of 0.3 l/ha, the content of chlorophyll "a" increased by 4.4 % compared to the Wuxal Bio Ascofol variant and by 18.1 % compared to the control variant. On treatment with growth regulator Stimolante 66 f at a dose of 0.3 l/ha, the content of chlorophyll "b" in the leaves increased and constituted 1.01 mg/dm^2, and the amount of chlorophyll "a" + "b" – 4.08 mg/dm^2. Basically chlorophyll "b" increased by 23.1 % and the amount of chlorophyll "a" + "b" by 19.3 % compared to the control variant.

Table 2

Growth regulators' action on chlorophyll and carotenoid content in the leaves of Idared apple variety

Variants	Content of chlorophyll pigments, mg/dm^2			Content of carotenoids, mg/dm^2
	"a"	"b"	"a" + "b"	
Control, without treatment	2,60	0,82	3,42	1,22
Wuxal Bio Ascofol, 3.0 l/ha	2,94	0,93	3,87	1,33
Stimolante 66 f, 0.2 l/ha	2,90	0,91	3,81	1,30
Stimolante 66 f, 0.3 l/ha	3,07	1,01	4,08	1,43

Increasing treatment dose with the growth regulator Stimolante 66 f from the dose 0.2 l/ha to 0.3 l/ha has insignificantly influenced chlorophyll content "a", "b", "a" + "b" and carotenoids from the leaves.

The investigations carried out during the vegetation period show that the Idared variety differentiated a sufficient quantity of fruit buds and blossomed from 760 to 780 flowers in the tree crown (tab. 3). The amount of flowering flowers shows us that the trees studied have constant values and experiences can be put into testing the growth regulators.

If, in the control variant, where the treatment was not performed, the quantity of flowers was 770 pcs/tree, then in the variants treated with growth regulators the values ranged from 760 to 780 pcs/tree.

In the variant treated with the Wuxal Bio Ascofol at the rate of 3.0 l/ha, the percentage of fruit setting was 9.3 %, or an increase of 0.6 %, compared to the control variant.

When treating with growth regulator Stimolante 66 f at the dose of 0.2 l/ha, the fruit setting was 9.2 %, or an increase of 0.5 % compared to the control variant and a decrease of 0.1 % versus the variant treated with Wuxal Bio Ascofol at the dose of 3.0 l/ha. Thus, the degree of fruit setting in the treatment with the growth regulator Stimolante 66 f at the dose of 0.2 l/ha is approximately identical to the values recorded in the version treated with Wuxal Bio Ascofol at the dose of 3.0 l/ha.

The highest values of the degree of fruit binding were recorded in the variant treated with growth regulator Stimolante 66 f at the dose of 0.3 l/ha, where the studied index constituted 9.9 %, or an increase of 0.6 % as compared with the variant treated with Wuxal Bio Ascofol at the dose of 3.0 l/ha and by 1.2 % compared to the control variant.

The smallest fruit quantity, of 67 pieces per tree, was recorded in the control variant, and the largest, in the variant treated with growth regulator Stimolante 66 f in the dose of 0.3 l/ha - 76 pieces per tree, or an increase compared to the variant treated with

Wuxal Bio Ascofol at the dose of 3.0 l/ha by 7.0 % and in the control variant by 13.4 %. This increase in the quantity of fruits in the tree crown was recorded as a result of the increase in the setting of the reproductive organs.

Table 3

Growth regulators influence on the quantity of flowers, fruits and their setting after the physiological June fall to Idared apple trees

Variants	The quantity of flowers, pcs/tree	The degree of fruits set, %	The quantity of fruits, pcs/tree
Control, without treatment	770	8,7	67
Wuxal Bio Ascofol, 3.0 l/ha	760	9,3	71
Stimolante 66 f, 0.2 l/ha	780	9,2	72
Stimolante 66 f, 0.3 l/ha	765	9,9	76
LDS 0.05	32	-	3,2

In the variant treated with Stimolante 66 f growth regulator in the dose of 0.2 l/ha, we record that the number of fruits formed was at the same level as in the variant treated with Wuxal Bio Ascofol at a dose of 3.0 l/ha but with 7.5 % higher than the control variant.

The results obtained have shown that treatment with Stimolante 66f growth regulator at a dose of 0.3 l/ha has positively influenced the degree of setting of the reproductive organs and the amount of fruits in the tree crown.

The use of growth regulators Wuxal Bio Ascofol and Stimolante 66 f have a positive influence on the average weight of fruits and the fruit production at a tree and a surface unit.

The lowest number of fruits was obtained in the control variant, where the treatment was not performed being 67 pcs/tree, but the average weight of fruits recorded maximum values being 163.4 g (tab. 4). When using growth regulators with stimulating action, we recorded that the amount of fruits increased and the average weight of fruits ranged from 159.7 to 162.7 g.

The lowest fruit weight on variants treated with growth regulators was recorded in Stimolante 66 f at a dose of 0.3 l/ha being 159.7 g and the highest values were recorded when using Wuxal Bio Ascofol in dose 3.0 kg/ha - 162.7 g.

This decrease happened due to the higher degree of ovulation binding and the increase in the number of fruits. The average weight of a fruit obtained in the variants treated with growth regulators decreased by 0.5 - 2.3 % compared to the control variant, but most of the fruits were of high quality.

The smallest fruit production per tree and per unit area was obtained in the control variant, where it was 10.94 kg and 39.05 t / ha respectively.

In the variant treated with the growth regulator Wuxal Bio Ascofol at a rate of 3.0 l/ha, the fruit production on the tree increased to 11.55 kg and to one hectare to 41.23 tones.

The treatment with growth regulator Stimolante 66f in dose of 0.2 l/ha increased fruit production to 11.68, or 41.70 t/ha.

In the variant treated with Growth Stimulant 66 f in the dose 0.3 l/ha, we record that the fruit production increased compared to the control variant with 4.29 t/ha, or 11.0 %.

Table 4

The influence of growth regulators on average weight of fruits and fruit production in Idared apple tree variety

Variants	Average weight, g	Fruit production		Difference compared to witness, t/ha	In % compared to witness
		kg/tree	t/ha		
Witness, without treatment	163,4	10,94	39,05	-	100,0
Wuxal Bio Ascofol, 3.0 l/ha	162,7	11,55	41,23	+2,18	105,6
Stimolante 66 f, 0.2 l/ha	162,3	11,68	41,70	+2,65	106,7
Stimolante 66 f, 0.3 l/ha	159,7	12,14	43,34	+4,29	111,0
LDS 0.05	7,8	0,44	1,61	-	-

The smallest fruit production per tree and per unit area was obtained in the control variant, where it was 10.94 kg and 39.05 t/ha respectively.

In the variant treated with the growth regulator Wuxal Bio Ascofol at a rate of 3.0 l/ha, the fruit production on the tree increased to 11.55 kg and to one hectare to 41.23 tones.

The treatment with growth regulator Stimolante 66f in dose of 0.2 l/ha increased fruit production to 11.68, or 41.70 t/ha. In the variant treated with growth regulator Stimolante 66 f in the dose 0.3 l/ha, we record that the fruit production increased compared to the control variant with 4.29 t/ha, or 11.0 %.

Studying the influence of the treatment dose on the fruit production, we record that with the increase of the quantity of product administered from 0.2 l/ha to 0.3 l/ha, the study index increases by 1.64 t/ha, or 4.3 %.

The study focused not only on the knowledge of the average fruit diameter, but also on the distribution of the fruits in diameter from 5 to 5 mm in relation to variants of the experience. The data obtained in the control variant (tab. 5) shows that the fruits obtained are of high quality due to the optimal quantity of fruits in the tree crowns. Basically, in the control variant, the II category of fruits quality represented 5.7 %, the I category of quality constituted 24.3 %, and the highest weight of fruits (70.0 %) is attributed to the extra category of quality.

In the variant treated with the growth regulator Wuxal Bio Ascofol at the dose of 3.0 l/ha and in the variant treated with the growth regulator Stimolante 66 f at the dose of 0.2 l/ha, we recorded the same quality of fruits obtained in the tree crown. Thus, in these variants, the fruits of II category of quality was 6.4 and 6.7 % respectively, the fruits of I category of quality being 25.1 % and 25.7 % and the fruits of extra category of quality - 68.5 % and 67.6 %. The respective distribution of the fruits in the given variants is quite reasonable, taking into account the quantity to quality ratio.

In the variant treated with growth regulator Stimolante 66 f at the dose of 0.3 l/ha, the fruits have the smallest diameter compared to the other variants. Thus, 66.5 % of the harvested fruits are attributed to the extra category, and 33.5 % was et the I and II categories of quality. The insignificant diminution of the weight of the fruits of the extra category in favor of the fruits of I and II category of quality is explained by their higher quantity in the crown of the trees compared to the other variants.

Table 5

The influence of growth regulators on fruit redistribution according to their diameter in Idared apple trees

Variants	The share of fruits (%) according to their diameter (mm)					Average diameter, mm
	61-65	66-70	71-75	76-80	81-85	
Witness, without treatment	5,7	24,3	30,9	30,7	8,4	72,2
Wuxal Bio Ascofol, 3.0 l/ha	6,4	25,1	31,1	30,3	7,4	72,0
Stimolante 66 f, 0.2 l/ha	6,7	25,7	30,4	30,1	7,1	71,9
Stimolante 66 f, 0.3 l/ha	7,3	26,2	29,4	30,0	7,1	71,8
LDS 0.05	-	-	-	-	-	3,1

Studying the average diameter of a fruit, we note that the highest values were obtained in the control variant - 72.2 mm followed by the variant treated with the growth regulator Wuxal Bio Ascofol at the dose of 3.0 l/ha where the studied index was 72.0 mm and the variant treated with the growth stimulator Stimolante 66 f in a dose of 0.2 l/ha where the average diameter of a fruit was 71.9 mm.

Insignificantly lower values of the average fruit diameter were recorded in the variant treated with the growth regulator Stimolante 66 f at a dose of 0.3 l/ha in which the studied index was 71.8 mm. This small decrease between the variants treated with growth regulators shows us that the influence of the study factor is not significant.

CONCLUSION

The growth regulator Stimolante 66 f can be included in the technological system for improving the physiological processes in the plant, increasing the setting of the ovaries and the amount of fruits in the crown of the apple trees applied twice by foliar spraying at a dose of 0.3 l/ha. The first treatment must to be done at the beginning of the flowering period, and the second after the fall of the petals.

REFERENCES

Babuc, V., Peşteanu, A., Gudumac, E., Cumpanici, A., 2013, Producerea merelor. Chişinău, 240 pag.

Cimpoieş, Gh., 2012, Cultura mărului. Chişinău, 380 pag.

Curry, E.A., Greene, D.W., 1993, CPPU influences fruit quality, fruit set, return bloom, and pre harvest drop of apples. HortScience. 28(2):115-119.

Greene D.W., 2007, The Effect of Prohexadione-calcium on Fruit Set and Chemical Thinning of Apple Trees. Hortscience. 42(6):1361–1365.

Neamţu G., Irimie Fl., 1991, Fitoregulatori de creştere. Bucureşti, p. 143-180.

Watanabe M., Segawa H., Murakami M., Sagawa S., Komori S., 2008, Effects of Plant Growth Regulators on Fruit Set and Fruit Shape of Parthenocarpic Apple Fruits. J. Japan. Soc. Hort. Sci. 77 (4): 350–357.

Алфёров, В.А., 2012, Влияние обрезки на нормирование урожая и качество плодов в интенсивных насаждениях яблони. Плодоводство и ягодоводство России. 32: 56-65.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓Biology
✓Horticulture
✓Food produce processing technology
✓Environmental engineering

STUDY OF PEDOCLIMATIC FACTORS WHICH CHARACTERIZE THE VINEYARD AREAL FROM SEGARCEA

Popa Ion[1*], Radu Valeriu[1], Firica Marcela Alina[1]

[1]University of Craiova, Faculty of Horticulture, PhD student
*Correspondence author e-mail: ionpopa050667@gmail.com

Keywords: horizon, soil, vine

ABSTRACT

In the present paper there are presented geological aspects regarding the territory of the commune Segarcea, which has a lithological substratum which is totally constituted from piedmont quarters and terraces, which rest on sedimentary marno-argil-sandy pliocene sediments, intersected only locally on the base of the slopes on the right of river Jiu.

INTRODUCTION

Soil exerts a major influence on the growth, birth and quality of production in vines. Unlike other cultivated species, the vine is less pretentious than the soil, easily adapting to difficult edaphic conditions (sands, stony soils) (Toti M. et al., 2017).

The territory of Segarcea commune belongs to the middle and upper Pleistocene represented by alluvial and loessoid deposits except the meadow belonging to holocene represented by alluvial deposits.

Holocene deposits are located in the river meadows and terraces, such as gravel, sands, loessoid tiles, or as wind sands on the terraces on the left of river Jiu downstream from the confluence with Amaradia, or as deluvio-coluvio-retreats on hill slopes.

MATERIAL AND METHOD

Sampling the soil profile, in the field:

~ in this phase measurements and observations made on the relief, the morphology of the soil, the parent material, the water table level, texture horizons, the presence of occurrence of alkaline-earth carbonates by direct determination with 1/3 HCl and so on and it was made a preliminary diagnosis and classification of soils in accordance with the Study Methodology ,,Soil "(Florea N., Canarache A., 1986) and the official classification.

~ harvesting soil samples on genetic horizons.

~ packaging and labeling of each sample,

~ determination of the hygroscopicity coefficient - Micherlich method;

~ apparent density measurements (Da) have been performed;

~ specific density (D).

RESULTS AND DISCUSSIONS

County Dolj holds 3.9 % of the total agricultural area of the country with 585 515 ha, the situation of its distribution by modes of use being (Table 1):

Table 1

Agricultural land repartition on modes of use

Arable	489096 ha
Pastures	68414ha
Hay areas	295 ha
Vine	17178 h
Orchards	7875 ha

The influence of the soil on the vine is due to its physical and chemical properties (Oşlobeanu M. et al., 1991)

Soil structure is a result obtained by associating soil granulometric fractions into complex aggregates with a high water and nutrient retention surface (3 to 30 million m^2 retention area / m^3 of soil). The most favorable for plant growth, including for vines, is the granular structure, represented by friable spherical glomeruli with a diameter of 2-4 mm (Popa A. , et al., 2015).

The Middle and Upper Pleistocene is developed west of river Jiu in the Craiova-Segarcea-Devesel region and in the East of Jiu in the Craiova-Piatra Olt- Craiova-Studina region, being represented by the deluvial, proluvial deposits of loessoid materials and alluvial deposits with accentuated variations texture. The deposits of the old terraces, the upper terraces, and the gravel, boulder, and sand of the lower terrace are attributed to the upper pleistocene. The holcen is represented by the loessoid deposits of the lower terrace, the low terraced deposits and the river beds.

Typical cernoziom (Photo no. 1), damp, low-leveled (mesocalcary), moderately deep, with loose texture, formed on conveyed materials and redeposited from wind deposits made up of medium materials, eubase, arable underlying rocks.

Morphological features:

Ap orph 0-25 cm, gradual passage, gray-brown color (10 YR - 2.5 / 2), gluteous texture, low glomerular structure, poorly developed, plasticity, adhesiveness, porosity, frequent roots, fine cracks to the base.

Amount 25-50 cm, gradual passage, dark brown, glossy texture, medium glomerular gloss and subangular polyhedral structure, developed medium, plasticity, adhesion, fine pores, biogenic neoformations in the form of coprolite, frequent thin roots, low compact .

Photo no. 1 - Soil profile Cernoziom

A / C horizon = 50-80 cm, dark yellowish brown color (10 YR - 4/3), soft texture, medium subangular polyhedron structure, weakly developed, plastic, adhesive, fine pores, low compact, .

Horizon C = 80-135 cm, dark yellowish color (10YR - 5/4), smooth texture, poorly structured, plastic, weak adhesive, fine pores, low effervescence at the bottom.

Physical features:

On the Ap horizon, apparent density is small, the total porosity is moderate, poorly settled soil, medium desiccation, medium permeability.

On the Am horizon, apparent density is high, low porosity, poorly settled soil, high wicking rate, low permeability.

On the A / C horizon, apparent density is high, low porosity, moderate compaction, high wicking rate, low permeability.

Chemical characteristics:

For the A2 horizon, the soil's reaction is poorly acidic, the total nitrogen content is very low, the mobile phosphorus content is moderate, the mobile potassium content is medium, the low nitrogen index, the low humus content.

For horizon I, the reaction of the soil is weak ACTA very low total nitrogen content, phosphorus content is moderate, the mobile potassium content is medium index, low nitrogen, content of humus very small.

For horizon A / C, the reaction is slightly acidic soil, total nitrogen content is very low, phosphorus content is very small, mobile potassium content is moderate, the index of nitrogen is small, very low humus content.

From a climate perspective, Segarcea, falling in a climate temperate (with little impact on the Mediterranean, with mild winters, springs short and hot summers, long autumns drier with sufficient rainfall but unevenly distributed during the year, with moisture deficit and droughts in June, July, August, September and October). For the characterization of climatic conditions, meteorological data were used for the period 1961-2004.

Table no. 2

Monthly and annual average temperature during 1961-2004

Weather station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	**XII**	Annual average
Băilești	1,6	0,7	5,7	12	17,6	21,2	22,8	22,2	17,5	11,3	5,2	0,1	11,2

The average multiannual average temperature is 11.2 ^{o}C (Table no. 2). The warmest month in July (22.8 ^{o}C) and the coldest month in December (0.1 ^{o}C).

Average monthly and annual rainfall over the period 1961-2004

Table no. 3

The sum of the average annual precipitation in the period 1961-2004

Weather station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual amount
Băilești	37,9	35,8	39,4	52,1	59,5	58,9	52,8	36,1	39,3	37,7	50,4	49,1	549

The average annual rainfall (Table no. 3) is 549.0 mm, the richest month in rainfall is 59.5, and the poorest month in precipitation is February with 35.8 mm.

CONCLUSIONS

The soils from the vineyard, starting from the northern area of the country and reaching the Plain of Otenia, are of a great variety.

The diversity of geological conditions found in the basement creates the possibility of significant underground water reserves, highlighted by both drilling and natural manifestations.

The development of the steps relief from the south to the north (meadow, terrace, high piedmont plain and piedmont plain) as well as the great variety of the rocks, plus the changes that take place in the county climate in the same direction, explains the variety of soils and their geographical distribution.

REFERENCES

Florea N., Canarache A., 1986 - Metodologia de elaborare a Studiilor Pedologice editată de Institutul de Cercetare pentru Pedologie și Agrochimie - București

Oşlobeanu M., Macici M., Georgescu Magdalena, Stoian V., 1991 – Zonarea soiurilor de viţă de vie în România. Ed. Ceres, Bucureşti.

Popa A., Giugea N., Genoiu T. C., 2015 – Oltenia mica Românie viticolă, Edit. Aius, Craiova.

Toti M., Dumitru M., Vlad Virgil, Calciu Irina, 2017 – Solul, element de bază al conceptului de „Terroir”, Ed. Terra Nostra, Iași.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✔ *Biology*
✔ *Horticulture*
✔ *Food produce processing technology*
✔ *Environmental engineering*

STUDY OF PEDOCLIMATIC FACTORS WHICH CHARACTERIZE THE VINEYARD AREAL FROM DĂBULENI

Popa Ion[1*], Radu Valeriu[1], Firica Marcela Alina[1]

[1]University of Craiova, Faculty of Horticulture, PhD student
**Correspondence author e-mail:* ionpopa050667@gmail.com

Keywords*: soil, texture, vine*

ABSTRACT

Through the open soil profile in the studied area was identified an epicaric, epicalcaric, transported and redeposited psamosol (wind deposits) made of coarse, sandy-loamy / sandy texture with poor wind erosion.

INTRODUCTION

The perimeter studied is represented by a low-winded flat terrain, with a series of microdepressions.

From a geomorphologic point of view, the land is part of the Danube terrace. It generally has a slightly curved planar relief (waves due to the presence of generally dilated dunes and windstorms) but also microdepression dispersed throughout the surface (Irimia L., 2012).

In geological terms, the area, which includes the land under study, is Holocene age, and the parental rock is represented by wind deposits made of coarse or medium-sized materials (Toti M., 2017).

The climatic zone is part of the temperate continental climate province with Mediterranean influence, with warm summers, moderate winters, with precipitation throughout the year but unevenly distributed over the months. According to the data recorded by the Bechet weather station, the average multiannual temperature is 11.2 ^{o}C (Fig. 1), the multiannual average rainfall is 570 mm (Fig. 2).

The dominant winds are the Crivăţ, who is beating the eastern-north-eastern sector and Austrul, western winds.

The pedoclimatic conditions, presented succinctly, have oriented the process towards the formation of dominant soils usually grouped in the class of protisoils generally represented by psamosoils.

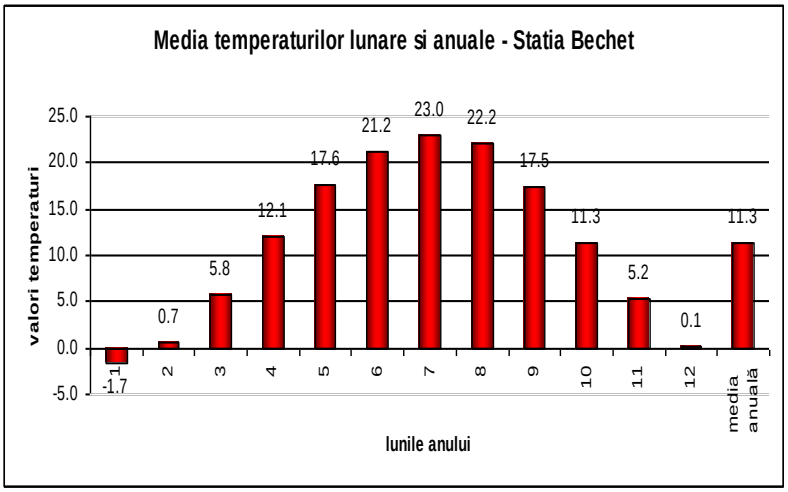


Fig. 1 - Monthly and annual average - Bechet Station

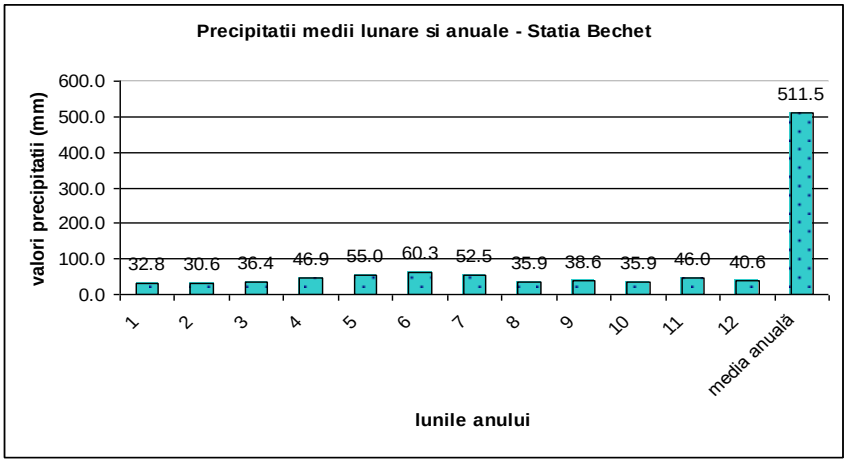


Fig. 2 - Monthly and annual average precipitation - Bechet Station

MATERIAL AND METHOD

• Soil sampling: soil samples were collected on pedogenetic horizons in modified structure and in natural structure;

• The harvesting of the soil samples in the modified settlement, for the physico-chemical-biological characterization, was done in bags, on the thickness of 10-15 cm of each horizon or subsoil of soil.

• The collection of unmodified samples for the characterization of physical and hydrophysical features was done in known volume cylinders (100 cm^3) at the momentum soil moisture (Răuţă C. 1986).

RESULTS AND DISCUSSIONS

Eutric psamosol (Photo no. 1), with sandy-clayey / sandy texture, formed on redeposited materials represented by wind deposits made of coarse materials (sand), having parental material underlying unsealed silicate rocks or poorly consolidated pre-holocene mesobasic (Florea N. 2012).

Characterization of morphological features:

0-39 cm = Ao horizon, light gray brown, 10YR4 / 4 sandy-loamy texture, structured, brittle, reavan, rare thin roots, gradual passage;

36-62 cm = open-angle brown A / C horizon, 10YR4 / 5 sandy-loamy texture, poorly structured, brittle, hardwood, rare thin roots, gradual passage;

62 - 100 cm = C1 horizon, dark yellowish color, sandy texture, structured, rare thin roots, creep, gradual passage;

100 - 120 cm = C2 horizon, light yellowish color, 10YR4 / 5 sandy texture, very brittle structure, upper weakly cemented.

Photo no.1 - Psamosol

The soil is characterized by low acid pH, very low humus content, very low nitrogen content, high mobile phosphorus content, low mobile potassium content, sandy-clayey / sandy texture, rapid global drainage (Table 1).

Sandy soils (clay content of less than 13 %) have high porosity, strong aeration, heat slightly and speed up the ripening of the grapes and are indicated for the early maturation of varieties. These soils have low nutrient retention and low fertility. They are less suitable for wine grape crops, as grapes accumulate small amounts of sugars and anthocyanins and wort acidity is deficient

Table 1

Results of chemical analyzes obtained on samples taken

Depth (cm)	pH in distilled water ratio 1 / 2,5	Humus (%)	Total Azote (%)	P mobile (p.p.m.)	K mobile (p.p.m.)
0-39	5,95	0,92	0,053	52	62
39-62	5,76	0,72	0,048	40	48
62-100	6,29	0,48		12	40
100-120	6,53				

Characterization of physical characteristics Table 2):

On the Ao horizon, the apparent density is small, the porosity is high, untamping, the low wicking rate, the high permeability.

On the A / C horizon, the apparent density is small, the porosity is high, untamping, the coefficient of wilting is high, the high permeability.

On the horizon C1, the apparent density is small, the porosity is high, untamping the wicking coefficient.

Table 2

Results of physical analyzes obtained from samples taken

Depth of harvest cm	Corse sand %	Fine sand %	Dust I %	Dust II %	Clay <0,002 mm	Texture
0-39	23,2	66,4	1,8	2,4	6,2	NL
39-62	24,8	65,3	2,0	2,2	5,7	NL
62-100	27,3	63,5	1,7	1,9	5,6	NL
10-120	31,6	61,0	1,4	1,6	4,4	NN

The requirements for the thickness of the soil layer vary according to the vigor and the production directions of the varieties.

CONCLUSIONS

Against the background of natural factors (lithology, relief, ground water, climate), the metabolism of different varieties and root stocks and the various levels of technology, the soil's action on the development and production of vine and its quality materializes due to its physical and chemical.

Seasons are pleasing: early and relatively short spring, hot summers, sometimes droughts, rainy autumns with the second highest peak (November-December) of rainfalls, and winters are gentle with sleet and snow and sometimes with floods during the cold season (Popa A. , et al., 2015).

The vine, as a mesophyte species, has moderate demands on soil moisture (Irimia L., 2012). It adapts to both poorly wet and well-supplied soil, but the requirements vary according to the phenophase and the biological nature of the varieties. The highest water consumption is recorded in shoots and grain growth phases, when IUA values have to be between 60-80 %.

Moderate soil moisture requirements are recorded during grape maturation, when IUA values must be 50-60 %. Deficiency or excess water, at any point in the growing season, exerts an unfavorable influence on the growth potential of the vine.

REFERENCES

Florea N., Munteanu I., 2012 – ”Sistemul Roman de Taxonomie a Solurilor„ editat de Institutul de Cercetare pentru Pedologie şi Agrochimie - Bucureşti

Irimia L., 2012 - Biology, ecology and physiology of the grapevine. Chapter III.

Popa A., Giugea N., Genoiu T.C., 2015 – Oltenia mica Românie viticolă, Ed. Aius, Craiova.

Răuţă C., Canarache A., 1986 - Metodologia de elaborare a Studiilor Pedologice editată de Institutul de Cercetare pentru Pedologie şi Agrochimie – Bucureşti.

Toti M., Dumitru M., Vlad Virgil, Calciu Irina, 2017 – Solul, element de bază al conceptului de ”Terroir”, Ed. Terra Nostra, Iaşi.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE EFFECT OF THE LOAD OF FRUITS AT BLACK GRAPES AND THE TIME OF MACERATION-FERMENTATION ON PHENOLIC COMPOUNDS FROM THE WINES.

Postolache Elena[1], Ciubucă Aurel[1], Bora Florin Dumitru[1], Donici Iulian[1*], Donici Alina[1]

[1]Research Station for Viticulture and Oenology Bujoru, GALATI
* *Correspondence author. E-mail*: donicialina79@gmail.com
Research Station for Viticulture and Oenology Bujoru, GALATI

Keywords**:** *phenolic compounds, wine, acidity, antocyanins*

ABSTRACT

In the technology of obtaining the red wines, maceration-fermentation is done in order to extract colored phenolic compounds. During maceration, the coloring substances from the skin, the grains, diffuse in the gravy, the amount of anthocyanins extracted being dependent on the technology used. This process is based on the extraction of the colorants from the grapes, as a result of the accumulation of ethyl alcohol and the acidity that stabilizes the phenolic compounds. Phenolic compounds influence the organoleptic qualities of wines, making it worthwhile the astringency, the flavor, the hardness, the color, and so on. The color compounds expressed by total anthocyanins and highlighted by color intensity have the maximum at variants with 28 - 20 eye / hatch with the period of 8 days for maceration - fermentation versus 16 days of maceration - fermentation, which implies an optimal extraction period of 8 days.

INTRODUCTION

The research has been done on wines from the 2017 production at SCDVV for Bujoru for the black grapes (Black normal feteasca and ecological Merlot). The colour compounds from the black grapes have been determined and the phenolic potential both in terms of quality and quantity has been determined from the wine.(Postolache 2016, et al.)

The phenolic compounds help define organoleptic traits of wine and they reveal the most important qualities of wine givind its flavor, colour,softness, basically, defining the wine.(Artem 2016, et al.). From a chemical point of view, the wine is a compound made of water, ethanol, sugar, aminoacids, poliphenolic coumpounds, anthocyanins, organic and unorganic substances (Dalipi, 2015 et al., Karataş, 2015 et al.)

MATERIAL AND METHODS

The research followed the phisico-chemical evaluation of wines obtained in both conventional and ecological systems (anthocyanins, total poliphenols, the intensity of colour, the shade of colour, the study of phenolic profiles meaning the phenolic acids, flavonols, flavonols Stilbenes, anthocyanins etc). The reserach has been made on wines from the experimental varieties Black Feteasca and Merlot from the Dealu Bujorului vineyard.

RESULTS AND DISCUSSIONS

The evolution of the phenolic coumpounds during the maceration-fermentation of the wine of the varieties Black Feteasca and Merlot is presented in charts 1-6.

The alcoholic concentration of the analised wines has recorded values between 14,9-15,3 % vol. For the Back Feteasca variety and 14.0-14,6 vol. for the Merlot. The highest alcoholic concentration was obtained for sample 20 after 8 days of maceration-fermentation for the both varieties of wines. (15,3;14,6) % vol.

The total amount of poliphenols disply the same chart similarity with the quantity of anthocyanins from the both blends showing higher values after 16 days of maceration-fermentarion compared to the 8 days values, regardless of the cutting method of the vines: at 28, 20, 36 eyes (chart 1 and 2). The higher content of total phenols and anthocyanins at 16 days of maceration-fermentation is due to prelonged extraction from the seads.

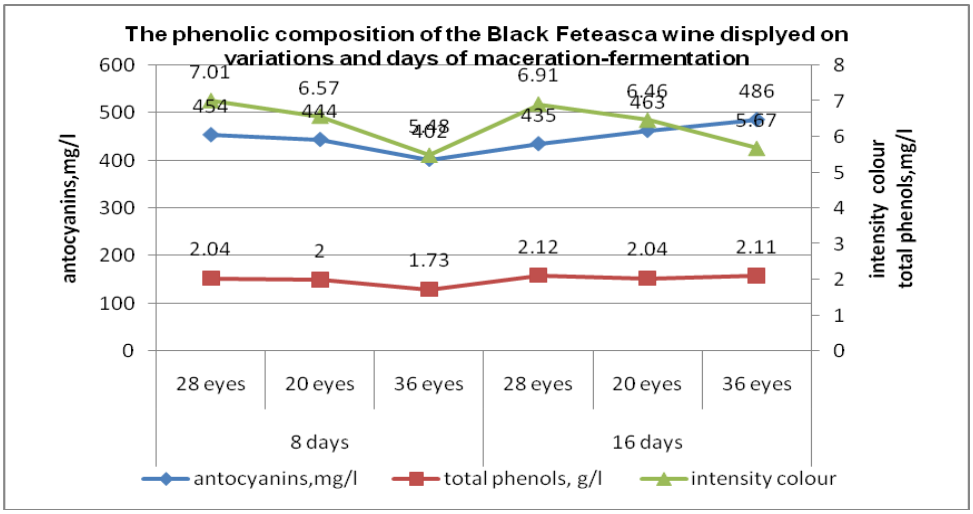


Figure 1. The phenolic composition of the Black Feteasca wine

The intensity od colour of all the variations considered for the study show close values therefore, the maximum intensity of colour (7,01) of the Black Feteasca wine, 28 eyes variation and 8 days of maceration-fermentation compared to 16 days of maceration-fermentation (6,91) and for the Merlot (8,48), was obtained after 8 days of maceration-fermentation for the variation 20 eyes and after 16 days of maceration fermentation is considered lower or slightely higher in value (8,26)

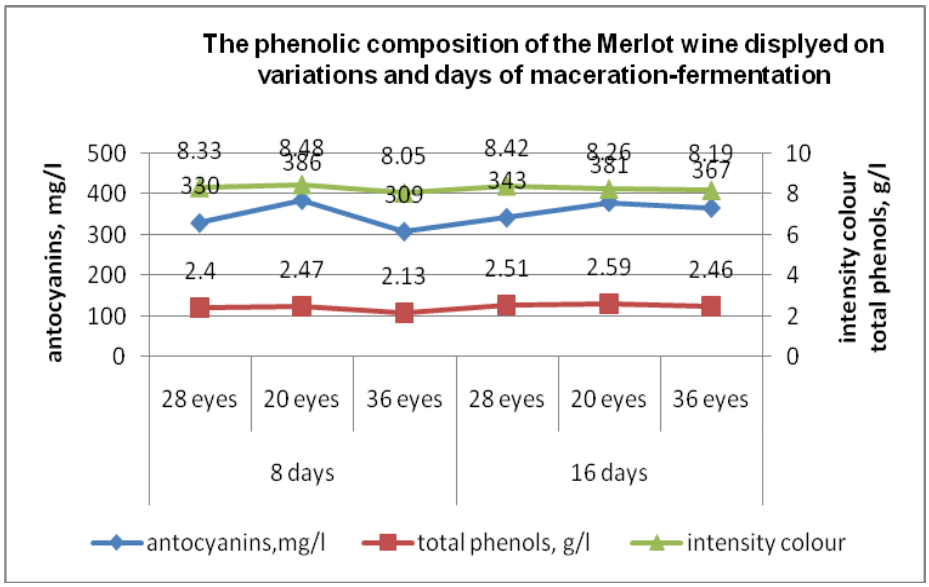


Figure 2. The phenolic composition of Merlot wine

On charts 3 and 4 are presented the phenolic fractions for the wines Black Feteasca and Merlot. The galic acid or 3,4,5-trihidrobenzoic acid, the most common of the hidroxibenzoics acids can found freely in the skin and more in the seads of the grapes. In a tied state, esterified with flavans is more present in the seads and bunch of the grapes from which is then released through hydrolyses.

The gallic acid can be found in the wine in ignificant quantity having the role of fixing the oxigen which gets into the wine and protects it from oxidation. The galic acid from the wine Black Feteasca has recorded higher values at variation 28, 20, 36 eyes at 16 days of maceration-fermentation ((58,48; 54,21; 54,33) mg/l) compared to 8 days fo maceration-fermentation (53,39; 51,3; 39,46) mg/l. The ame chart disply can be found for the Merlot wine for the variation 28,20,36 eyes at 16 days of maceration-fermentation (31,39; 32,71; 31,16) mg/l compared to 8 days of maceration-fermentation (27,40; 25,55; 22,49) mg/l.

The non-hydrolyzable tanins or condensed are called cathechins because through their dry distilation the pirocathechin sublimates. The cathechins having in thier molecule two asymetrical Carbon atoms (C^2 şi C^3), they can be met as cathechins when the substituents from these atoms are in trans position, epicathechins respectfully, when they have cis conviguration.

The cathechins have a redused degree of polimelization and when heated in an acid environment they polimeryze in big molecules, insoluble in water but soluble in alcohol, bownish-red in colour, called flobafens a reaction which also takes place under normal conditions but is slow. The cathechins from the wine come mainly from the grapes where they are in a monomer state and less in a polimerized state a the cathechin tanins are. They are present mainly in the seads and skin especially in the superficial outer layers. Inside they are only found as a trace of momomers and dimers. Freely, being polimerized in the grapes we can find (+) catechin and (-) epicathechin which contribute to the acid and slightely bitter taste.

The quantity of (+) cathechin from the Black Feteasca wine displays lower values at 16 days of maceration-fermentation at 28 and 20 eys (3,39;4,39) mg/l

compared to 8 days of maceration-fermentation (4,1;4,54) mg/l and for 36 eyes and 16 days of maceration-fermentation has higher values of (5,81mg/l) compared to 8 days of maceration-fermentation (4,39 mg/l)

For the Merlot wine all the variations considered for the study have high value of (+) cathechin at 16 days of maceration-fermentation (7.11;8;11;8,27) mg/l compared to 8 days of maceration-fermentation (6,25;6,53;6,25) mg/l.

The cathechins are hodroxiderivates of 3-flavonol also called non-hydrolizable tanins, condensed with no sugar and no possibility to be trensformed into simpler substances except through alcaline melting. When heated pirocathechin is obtained.

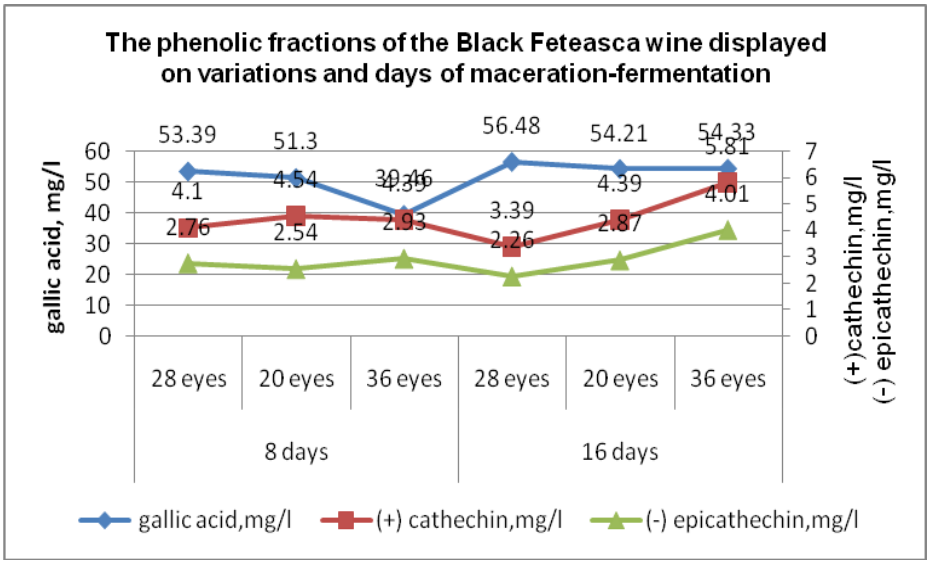


Figure 3.Phenolic fractions for the Black Feteasca wine

The content of (-) epicathechin for the Black Feteasca wine for variation 20 and 36 eyes and 16 days of maceration-fermentation is higher (2,87;4,01)mg/l compared to 8 days of maceration-fermentation (2,54;2,93)mg/l and for the variation 28 eyes the content of (-) epicathechin at the 16 days of maceration-fermentation is lower (2,26mg/l) compared to 8 days of maceration-fermentation (2,76 mg/l). For the Merlot wine all the variations at 16 days of maceration-fermentation the quantity of (-) epicathechin is higher (6,66;8.51;8.05)mg/l compared to 8 days of macration-fermentation (5,51;5,65;4,51) mg/l.

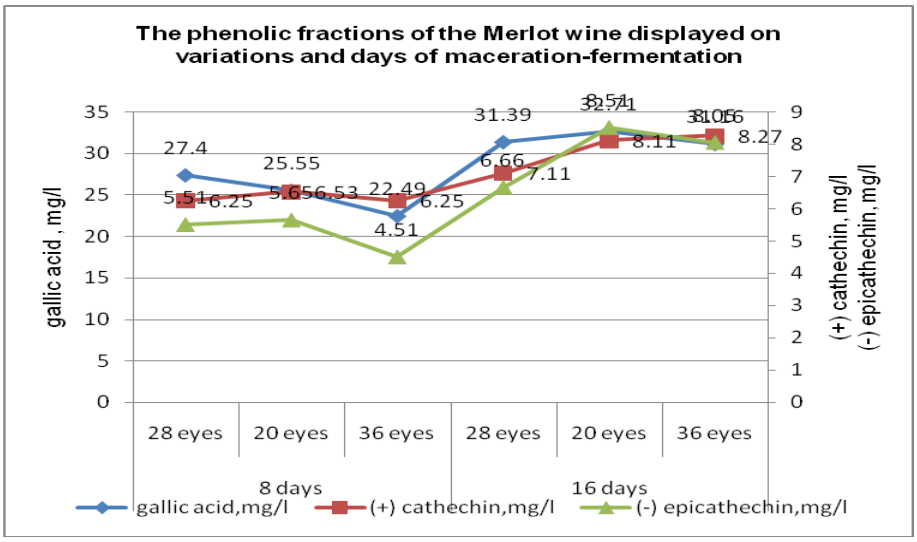


Figure 4.Phenolic fractions for the Merlot wine

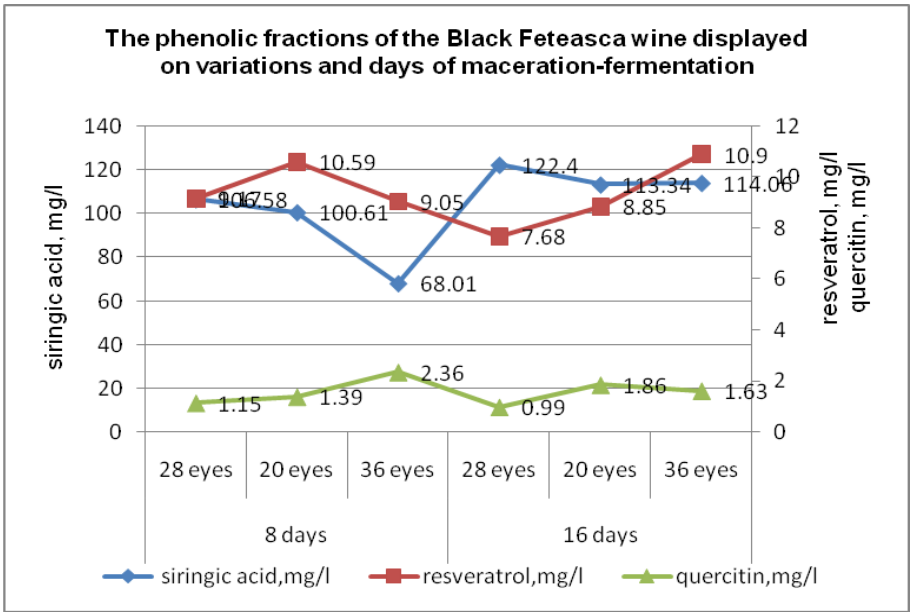


Figure 5. Phenolic fractions for the Black Feteasca wine

The content of syringic acid (chart 5) for the black Feteasca wine has registered high quantities for all variations (28,20,36) eyes especially at 16 days of maceration-fermentation (122,4; 113,34; 114,06) mg/l compared to 8 days of maceration-fermentation (105,58; 100,61; 68,01) mg/l. for the Merlot the quantity of syringic acid has the same chart display with higher values at 16 days of maceration-fermentation (46,5; 49,1; 47,16)mg/l compared to 8 days of maceration-fermentation (36,94; 33,7; 29,49) mg/l.

The syringic acid has a structured formula of a p-hydroxybenzoic acid, the same as the gallic acid. The syringic acid is formed through the degradation of anthocyanins (malvidin, oenidin), which makes the red wines have the highest quantity of phenolic acid.

On charts 5 and 6 there is displayed the content of resveratrol for the wines Black Feteasca and Merlot (mg/l). apart from the phenolic acids we can find within the

grapes a group of substances called stilbenes, similar to cinnamic acids but their acid character is given not by the carboxyl unit but for a phenol function. Representative for this group of substances is resveratrol whose chemical structure reminds us of stilbene.

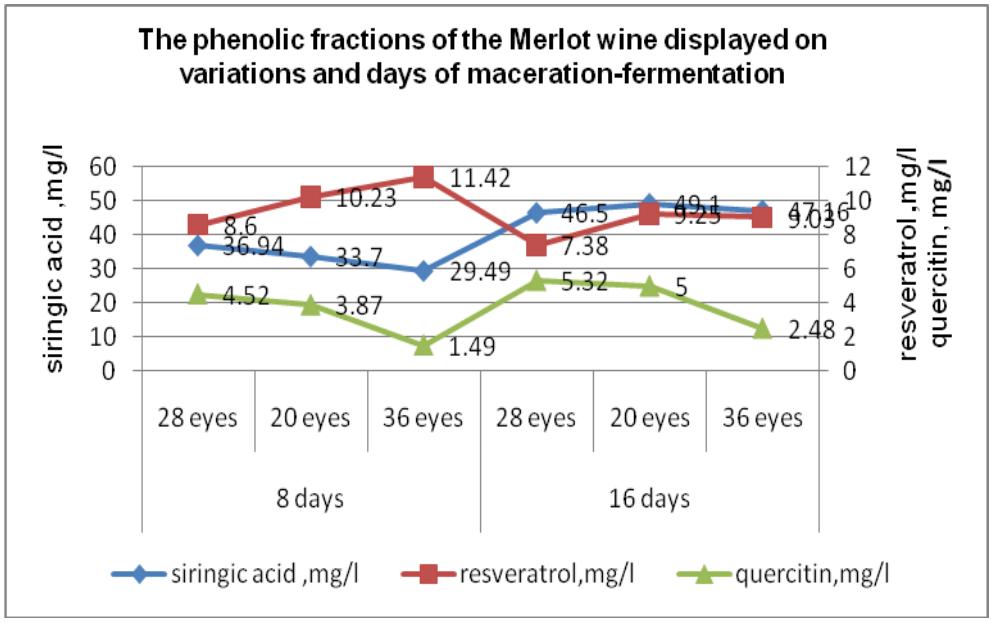


Figure 6. The phenolic fractions for the Merlot wine

The resveratrol (4,5,4-trihidroxistilbene) is a compound with an antioxidant effect (it reduces viability of tumor cells) necessary to the human body which helps prevent cardiovascular diseases it reduces the level of lipids from the blood). The resveratrol in a trans form can be found in grapes and in cis form can be found in wine.

In the Black Feteasca wine the quantity of resveratrol is higher in variation 28, 20) eyes at 8 days of maceration-fermentation (9.17;10,59) mg/l and for the 36 eyes variation at 8 days of maceration-fermentation a lower quantity of resveratrol (9,05) mg/l compared to 16 days of maceration-fermentation (10,9 g/l). For the Merlot wine the content of resveratrol is higher on all variations considered for the study at 8 days of maceration-fermentation (8,6;10.23;11,42)mg/l compared to 16 days of maceration-fermentation (7,38;9,25,9,03) mg/l.

The content of quercetin for the Black Feteasca wine (chart 6) shows higher values for the variations (28; 36) eyes at 8 days of maceration-fermentation (1,15; 2,36) mg/l compared to 16 days of maceration-fermentation (0,99; 1,630 mg/l compared to varistion20 eyes at 8 days of maceration-fermentation (1,3) mg/l compared to 16 days of maceration-fermentation (1,86) mg/l. For the Merlot wine the quantity of quercetin for all variations (28; 20; 36) eyes is higher at 16 days of maceration-fermentation (5,32; 5;2,48) mg/l compared to 8 days of maceration-fermentation (5,52; 3,87; 1,49) mg/l.

CONCLUSIONS

1. From the physical-chemical analysis of the wines from the study we can see that the total poliphenols are more intensly extracted during the maceration-fermentation process from the seads of the grapes for all the variations at 16 days of maceration which

does not justify the extention of the maceration period from 8 to 16 days because they become very astringent.

2. The colour componds expressed through total anthocyanins and revealed through the intensity of colour are at maximum of representation at 8 days of maceration-fermentation. This means that the optimum period of extraction is at 8 days of maceration-fermentation.

3. From the organoleptic caractéristiques point of view of the wines, we obtained extremely dry wines, harmonios, typical at 8 days of maceration-fermentation and by extending the period to 16 days we obtained hard, tannions and astringent wines.

4. By analysing the tannin fractions of the phenolic acids we notice o good display of galic acid, 3-4 hidroxibenzoic acid, (+) catéchine, (-) epicatechine and syringic acid which show an increase through extraction from 8 to 16 days of maceration-fermentation.

5. The tannin fraction represented by quercitrin and resveratrol show high quantities at 8 days of maceration-fermentation compared to 16 days of maceration-fermentation, therefore the best results are at 8 days of maceration-fermentation.

ACKNOWLEDGMENT

This study was financed by the Ministry of Agriculture and Rural Development Bucharest Sectorial Plan, under ADER 3.3.10.Project.

REFERENCES

R. Dalipi, L. Borgese, A. Zacco, K. Tsuji, E. Sangiorgi, R. Piro, E. Bontempi, Le Depero, 2015- *Determination of trace elements in Italian wines by means of total reflection X-ray fluorescence spectroscopy*. Intern J Environ Anal Chem 95(1):1-11.

D. Değirmenci Karataş, F. Aydin, I. Aydin, H. Karataş, 2015- *Elemental composition of red wines in Southeast Turkey*. Czech J. Food Sci 33:228-236.

Elena Postolache, A. Ciubucă, F. D. Bora, Viorica Enache, 2016 - *Evaluarea potentialului fenolic al strugurilor roşii din podgoria ,,Dealu Bujorului*'' *în contextul schimbărilor climatice.* Dezvoltarea Economico Socială Durabilă a Euroregiunilor şi a Zonelor Transfrontaliere". Ediţa a XII-a. Vol. XXVIII. Editura PERFORMATICA Iaşi. ISBN 978-606-685-476-4. pag.100-108 .

Victoria Artem, Arina Oana Antoce, Aurora Ranca, Ancuţa Nechita, Laura Enache, Elena Postolache, 2016- *The Influence of Terroir on Phenolic Composition of Red Grapes.* Bulletin UASVM Horticulture 73(2).Print ISSN 1843-5254, Electronic ISSN 1843-5394.DOI:10.15835/buasvmcn-hort:12173, pag.109-115.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓*Biology*
✓*Horticulture*
✓*Food produce processing technology*
✓*Environmental engineering*

STUDY OF PEDOLOGICAL FACTORS WHICH CHARACTERIZE THE WINE SURROUND OF ŞIMNIC

Radu Valeriu[1]*, Popa Ion[1], Firica Marcela Alina[1]

University of Craiova, Faculty of Horticulture, PhD student
** Correspondence author. E-mail scda_simnic@yahoo.com*

Key words*: vines, soil, profile*

ABSTRACT

The paper presents the determinations and observations made in this phase regarding relief, morphological characters of the soil, parental material, groundwater level and horizon texture. The description of the soil profile is also presented.

INTRODUCTION

Soil exerts a major influence on the growth, birth and quality of production in vines. Unlike other cultivated species, the vine is less pretentious than the soil, adapting easily to difficult edaphic conditions (sands, stony soil; L.Irimia, 2012).

According to Romania, the vine is cultivated on the following types of soil (Oşlobeanu et al., 1991): psamosoils (Sadova-Corabia, Iveşti, Valea lui Mihai), balan soils / kastanozomes, rendzine (Murfatlar, Istria Babadag), regosoils, vertisoils, pseudorendzines, argiloiluvres (Târnave, Alba, Sebeş-Apold), cambic chernozems, chernozems, gray soils / grey faeisomes (Cotnari, Iasi, Huşi, Odobeşti, Panciu, Nicoreşti), argilo-illuvial chernozems / argirus, preluvisoils, brown luvic soils, and planosoils (Dealul Mare, Sîmbureşti, Drăgăşani, Craiova Hills), alluvial soils and alluvial protosoils (Panciu, Odobeşti, Coteşti).

The influence of soil on vines is due to its physical and chemical properties.

The seasons are pleasing: early and relatively short spring, hot summers, sometimes drought, rainy autumns with the second highest peak (November - December) of rainfall, and winters are gentle with sleet and snow, and sometimes with cold floods in the cold season (Popa A., et al., 2015).

MATERIAL AND METHODS

Sampling of soil samples in the field:

• At this stage, determinations and observations were made regarding the relief, the morphological characteristics of the soils, the parental material, the phreatic level, the texture on the horizons, the presence of the alkaline-earth carbonates by direct determinations with HCl 1/3 and so on and a preliminary diagnosis and classification of soils was carried out according to the official classification (S.R.T.S. 2003).

• Harvesting soil samples on genetic horizons.

• Packaging and labeling of each sample.

In the laboratory or physicochemical analyzes, as follows:

• humus (%) - the Walkle-Blak method in the Donut;

• determining the size SB - Kappen method;

• granulometric analysis (5 fractions) - Kacinski method;
• determination of the hygroscopicity coefficient - Micherlich method (Florea N., Canarache A., 1987).

RESULTS AND DISCUSSIONS

Description of soil profile, morphological characterization.

Relief:

- major unit: the southern extremity of the Getic piedmont;
- subunit unit: the fourth terrace of Jiu (Şimnic);
- elements of the main relief form: quasi-horizontal;
- microrelief: quasi-horizontal surface with inclination below 2 % (with bumps between 10-20 cm);
- slope exhibition: < 2 %.

Parental material: River Pleistocene river basin deposits (red clays).

Rocky underwater: pebbles, sands, clays.

Depth of groundwater: >9.

Global natural drainage: good.

Bioclimatic area: *Quercus frainetto* and *Quercus cerris*.

Current vegetation: agricultural crops with *Convolvulus arvensis, Echinochloa crus galli, Setaria glauca, Cirsium arvense, Chenopodium album*.

Land Use:

Current: viticulture;

Anterior: arable.

Surface appearance:

- soil: with cracks in dry periods;
- land: slighty uneven.

Description of the soil profile

The soil was formed in a stacked loamy clay parental material, characteristically inherited from the soil and experimented on a granulometric level and accentuated, in time, by the pedogenetic processes.

With regard to climatic data, characterized by summers as long hot periods, drought has become more common in the last 30 years. Long and warm autumn, mild winters, early spring.

The average annual temperature is 10.9 ^{o}C.

Annual average rainfall is 531.7 mm.

Morphological characterization

Ap 0-29 cm: medium clay in wet and brown - pale brown in dry condition; structure disturbed by agricultural works, unfolds in poorly developed polyhedrals; moderately compact; firmly in a wet state; very rough in dry condition; small pores - medium frequent; many vegetal remains uncompleted or undergoing decomposition.

Apt 29-43 cm: medium clay; brown - dark brown, dark brown and yellowish brown - light yellowish brown in dry condition; firmly wet, very rough in dry condition.

AB 43-61 cm: medium loamy clay; dark yellowish brown with brown spots, wet and brown brownish - light yellowish brown with brown spots in dry condition; wet; semi-angular and angular medium-high friable in wet condition; rough in dry condition.

Bt1 61-120 cm: medium loamy clay; dark yellowish brown with dark brown spots in wet and brown with brown spots in dry condition; wet;

Moderately compact; firmly in a wet state; very rough in dry condition.

Bt2 120-161 cm: medium loamy clay, dark brown aggregate pearls and brown inside wet aggregates, brown on aggregate sides and brown inside dry aggregates. wet; firmly in a wet state; very rough in dry condition.

BC 161-215 cm: loamy clay medium on the sides of the aggregates and brown inside the aggregates both wet and dry; moderately compact; firmly in a wet and very rough condition in a dry state.

Table 1

Physical attributes

Skyline	Depth		Coarse sand	Fine sand (international system)	Dust (international system)	Clay		Texture class	Carbonates
	skyline	sample	2-0,2 mm	0,2-0,02 mm	0,02-0,002 mm	< 0,002 mm	< 0,01 mm		
	cm		% g/g						%
Ap	0-29	5-20	7,2	39,5	25,3	31,6	43,8	LL	-
Apt	29-43	29-43	6,5	39,6	21,5	31,6	43,1	LL	-
AB	43-61	45-60	6,1	35,9	20,6	36,3	43,7	TT	-
Bt_1	61-90	65-80	5,4	33,1	18,9	42,0	51,5	TT	-
	90-120	95-110	5,1	33,0	20,3	41,3	52,1	TT	-
Bt_2	120-161	130-145	5,0	34,5	20,5	38,5	49,6	TT	-
BC	161-215	185-200	7,0	36,7	18,3	37,3	50,1	TT	-
Cn	215-235	215-230	6,6	40,1	19,1	33,6	43,5	TT	-
CK	235-250	235-250	7,6	40,2	19,1	32,1	42,4	LL	1,5

Cn 215-235 cm: Medium loamy clay, intense brown with brown spots in wet and yellow reddish brown spots in dry condition; friable in a wet condition; rough in dry condition.

Ck 235-250 cm: medium clay; gray oliv with brownish reddish brown spots and gray olives with reddish brown spots in dry condition; wet; massive; friable in a wet condition; rough in dry condition; moderately plastic; moderate adhesive; massive effervescence in the mass.

The physical attributes that make up the vocation vocation are: texture, structure, soil skeleton, thickness, porosity, aeration.

The texture or granulometric composition of the soil represents the quantitative weight of the granulometric fractions in the soil composition.

CONCLUSIONS

The studied fields are in the second-order class for vineyard culture and group small soils when used as vineyards.

In order to ameliorate the reactions, these soils can be improved by fertilization with organic or chemical fertilizers at established dosages based on expected (programmed) production and plant variety requirements.

When used as vineyards, the reduced limitations are given by the following pedological factors:

Ground limitations imposed:

• a moderately acidic reaction (pH with values of 5.5-5.8);
• a medium-fine texture (lute-clayey);
• a large edafic volume.

Land limitations:

- a moderately acidic reaction (pH 5.5-5.8);
- a medium-fine texture (lute-clayey);
- a large edafic volume;

Limitations imposed by the land:
- low slope slope (5-10 %).
- slightly uneven lands (requiring soil mobilizations below 500 m.c./ha).
- poorly eroded land.

REFERENCES

Florea N., Canarache A., 1987 - Metodologia de elaborare a Studiilor Pedologice" editată de Institutul de Cercetare pentru Pedologie şi A grochimie - Bucureşti în anul;

Irimia L., 2012 - Biology, ecology and physiology of the grapevine. Chapter III.

Oşlobeanu M., Macici M., Georgescu Magdalena, Stoian V., 1991 – Zonarea soiurilor de viţă de vie în România. Ed. Ceres, Bucureşti.

Popa A., Giugea N., Genoiu T. C., 2015 – Oltenia mica Românie viticolă, Ed. Aius, Craiova.

"Sistemul Roman de Taxonomie a Solurilor " S.R.T.S. editat de Institutul de Cercetare pentru Pedologie şi Agrochimie - Bucureşti în anul 2003.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

OBTAINING BIOLOGICAL MATERIAL BY *IN VITRO* MULTIPLICATION AT *PHYSALIS PERUVIANA* SPECIES, AN IMPORTANT MEDICINAL PLANT

Radomir Ana-Maria[1]*, Stan Ramona[1], Vizitiu Diana Elena[1]

[1]National Research and Development Institute for Biotechnology in Horticulture Stefanesti
*e-mail: radomir.anamaria@yahoo.com

Key words: *Physalis peruviana, "in vitro" culture, explants, microshoots, growth regulators*

ABSTRACT

In this study it was aimed elaboration an "in vitro" propagation protocol for the Physalis peruviana species using seeds as a source of explants. Following the research performed, a germination rate of 90 % was obtained. Regarding the "in vitro" multiplication rate of Physalis peruviana microshoots, the results obtained have been differentiated according to the hormonal balance used. The highest number of shoots/explant (5.25 microshoots/explant) and the highest average length of the shoots (7.23 cm) were obtained on the variant in which the nutrient medium was supplemented with 0.4 mg/l ANA. The shoots were multiplied by subcultivation on the same medium. The highest rate of rooting (95 %) was registered in the case of supplementing the nutrient medium with IBA in a concentration of 1 mg/l. The rooted vitroplants have successfully accommodated to "ex vitro" conditions, achieving an acclimatized rate of 92 %. The results obtained throughout the "in vitro" regeneration phases confirm that the micropropagation technique is an efficient method of multiplication for the Physalis peruviana species.

INTRODUCTION

Physalis peruviana (golden berry) is a herbaceous annual plants belongs to the family *Solanaceae* (Ramirez et al. 2013). According to the previous reports, this plant has a tremendous medicinal value for curing out different diseases: cancer, leukemia, diabetes, ulcers, malaria, asthma, hepatitis, dermatitis, rheumatism and several other diseases (Mayorga et al., 2002; Arun and Asha, 2007; Soares et al., 2003; Wu et al., 2004). The golden berry fruit tastes like a sweet tomato and includes high levels of vitamin C, vitamin A and the vitamin B-complex. The fruit was demonstrated to have both anti-inflammatory and antioxidant properties (Wu et al. 2006, Pardo et al. 2008). Golden berries are usually propagated by seeds, but the germination rate is small. Therefore, it is important to develop an efficient method for multiplication of *P. peruviana* species. Till now the highest regeneration from leaf and nodal explants in golden berry tissue culture was observed at the highest concentration of BAP and Kinetin (Otroshy et al. 2013). To our knowledege, there is very limited previously published paper on *in vitro* propogation of *P. peruviana*. The present paper deals with the development of a protocol for *in vitro* multiplication of *P. peruviana* species using seeds as explant source.

MATERIALS AND METHODS

The biological material used for the initiation of *in vitro* cultures consisted of seeds sampled from *Physalis peruviana* fruits. The seeds were first washed with tap water and were sterilized in 6 % calcium hypochlorite for 10 minutes, after which were performed three rinses with sterile distilled water to remove traces of sterilizing agent.

After sterilization, the seeds were inoculated on the MS culture medium (Murashige-Skoog, 1962) without growth regulators. The inoculation of seed was carried out under aseptic conditions at the hood with sterile laminar air flow.

In order to culture proliferation, the explants by a node taken from microshoots obtained in the initiation cultures phase were inoculated on MS culture medium supplemented with various concentrations and combinations of benzylaminopurine (BAP) and naphthylacetic acid (ANA): growth hormone-free medium (V1), 0.4 mg / l ANA (V2), 1.2 mg / l BAP (V3), 0.4 mg / l ANA / 1.2 mg / l BAP (V4). Subcultivation on fresh medium was performed at an interval of four weeks.

The microshoots regenerated on the multiplication nutrient media were detached from the culture, individualized and cultivated on rooting medium, represented by a variation of the MS basal medium with mineral salts reduced to half in which the auxin concentration varied (1 mg / l IBA-V1 , 2 mg / l IBA - V2, 3 mg / l IBA - V3).

As a carbon source was used dextrose (40 g/l) and as a source of iron was used NaFeEDTA (32 g/l). For solidification of the culture medium was used agar (7 g/l).

The culture media were sterilized by autoclaving at 120°C temperature for 20 minutes. Before autoclaving, the pH registered in a culture medium was adjusted to 5.6-5.8.

For growth, multiplication and rooting of explants have ensured in the growing room controlled conditions of temperature (22-24^{o}C), photoperiod (16 hours) and light intensity (2 500 lx).

The *in vitro* rooted plants were transferred *ex vitro* in order to be acclimatization at their natural environment.

For the initiation phase of the cultures, the monitored parameter was the seed germination rate. The evolution of the regeneration processes at the *Physalis peruviana* explants was evaluated by calculating the multiplication rate (number of shoots / explant) and the length of the shoots. The *in vitro* rooting rate of the shoots was calculated as the ratio of the number of shoots to which the rhizogenesis process occurred and the total number of shoots transferred on the rooting nutrient medium. The percentage of acclimatized plants was calculated as the ratio of the number of viable acclimatized plants and the total number of plants transferred *ex vitro*.

RESULTS AND DISCUTIONS

The observations made during the initiation phase of *in vitro* culture revealed that the inclusion of *Physalis peruviana* species in this culture system does not pose particular problems, the use of calcium hypochlorite (6 % solution for 10 minutes) for the sterilization of the seeds proved to be efficient. The use of basal medium MS without growth hormones favored seed germination and the production of neoplantlets which were then used to test the morphogenetic reaction of *Physalis peruviana* explants on different hormonal formulations of the MS medium (Fig. 1).

Fig. 1. Plantlets regenerated from seed germination on MS medium without growth regulators, after 4 weeks from initiation of *in vitro* culture

In order to proliferate the culture, the explants of a node taken from the microshoots obtained in the initiation phase of the cultures were inoculated on the MS culture medium supplemented with different concentrations and combinations of phytohormones.

The results obtained reflected the important role that it has hormonal balance in overall of the factors that determine the expression of regenerative potential in the *in vitro* culture of the explants, a conclusive evidence in this regard being different effect of the same basal medium supplemented with various combinations and concentrations of growth hormones. All the four variants of the nutrient media tested allowed induction of regenerative processes, but of these, two (V1 and V2) led to a better morphogenetic response, and two (V3 and V4) allowed induction of the regenerative processes, but to a lesser extent (Table 1).

Table 1

The influence of growth hormone combination and concentration on the number and length of the microshoots to the *Physalis peruviana* species

Variant	Growth regulators (mg/l)	No. of shoots	Length of shoots (cm)
V1	-	4,66	6,90
V2	0,4 mg/l ANA	5,25	7,23
V3	1,2 mg/l BAP	3,33	4,22
V4	0,4 mg/l ANA + 1,2 mg/l BAP	2,73	3,64

The results obtained showed that among the four culture media used, the most effective in the shoot regeneration was proved to be the medium supplemented with 0.4 mg/l ANA (V2), in which case the value of the multiplication rate was 5.25 microshoots/explant, and the average length of the shoots was 7.23 cm (Fig. 2). Similar results (4.66 microshoots/explant and the average length of the shoots by 6.90 cm) were obtained on MS medium without growth regulators (V1) (Fig. 3).

Fig. 2. Biological material multiplied *in vitro* on MS medium supplemented with 0.4 mg/l ANA (V2)

Fig. 3. Biological material multiplied *in vitro* on MS without growth hormone (V1)

Replacement of naphthylacetic acid with benzylaminopurine (V3) stimulated shoot regeneration, but the value of multiplication rate was lower (3.33 microshoots/explant). The average length of the shoots was 4.22 cm (Fig. 4). The lowest value of the multiplication rate (2.73 microshoots/explant) and the smallest length of the shoots (3.64 cm) were obtained on MS medium supplemented with 0.4 mg/l ANA and 1.2 mg/l BAP (V4) (Fig. 5).

Fig. 4. Biological material multiplied *in vitro* on MS medium supplemented with 1.2 mg/l BAP (V3)

Fig. 5. Biological material multiplied *in vitro* on MS medium supplemented with 0.4 mg/l ANA and 1.2 mg/l BAP (V4)

After approximately 30 days, the shoots obtained were transferred to fresh medium that supported the regenerative processes. From the qualitative point of view, the biological material resulting from the regeneration of explants had a normal morphology, without vitrification aspects, necrosis or callus differentiation.

The microshoots regenerated on the multiplication medium were detached from the culture, individualized and cultured on rooting medium. Knowing the beneficial effect of auxins on the efficiency of the rhizogenesis process, were tested three variants of the rooting medium in which the auxin concentration varied (1-3 mg / l IBA). The highest value of the rooting rate (92 %) was registered in the V1 variant which is characterized by the presence of auxin IBA at a concentration of 1 mg / l. Although the rooting rate decreased with the increase of auxin concentration, and in the case of V2 and V3 variants the rooting of shoots was achieved in a fairly high percentage (88 %, respectively 70 %) (Table 2 and Figure 6).

Table 2

Effect of IBA concentration on the *in vitro* rooting capacity of *Physalis peruviana* microshoots

Variant	Basic medium	Growth regulators	Concentration (mg/l)	Rooting rate (%)
V1	Macroelemente MS½, microelemente MS½, vitamine MS	IBA	1	92
V2			2	88
V3			3	70

In vitro rooted plants were transferred *ex vitro* in order to accommodate to septic life conditions. The nutrient substrate has an important role on the success of *Physalis peruviana* plants acclimatization, the best results being obtained when were used pills of peat type Jiffy (V2) (95 % acclimated plants). When using the mixture of peat, perlite and manure in proportion of 2: 1: 1, the percentage of acclimatized plants was lower (77 %), this substrate however ensures a good fortification of acclimated plants (Table 3 and Fig. 7).

Table 3

Influence of the nutrient substrate on acclimatization to *ex vitro* conditions of *Physalis peruviana* regenerants

Variant	The nutrient substrate	Rate of acclimatization (%)
V1	peat, perlite and manure (2:1:1)	77
V2	pills of peat	95

We conclude that the results obtained throughout the *in vitro* regeneration phases, certify that for the *Physalis peruviana* species, the micropropagation technique represents an advantageous alternative to the classic methods of propagation, which allows the rapid obtaining of high quality seedlings.

Figure 6. Rooting of *Physalis peruviana* microshoots on ½ MS medium supplemented with 1 mg/l IBA

Figure 7. *Physalis peruviana* plant fortified at pot

CONCLUSIONS

• *In vitro* germination capacity of the *Physalis peruviana* seeds was good, the germination rate being 90 %.

• The most effective culture medium for the shoot regeneration was proved to be the medium supplemented with 0.4 mg/l ANA, in which case the value of the multiplication rate was 5.25 microshoots/explant and the average length of the shoots was 7.23 cm.

• The highest percentage of rooted shoots (92 %) was obtained on the variant in which the nutrient medium was supplemented with 1 mg/l IBA.

• The highest acclimatization rate (95 %) was obtained using peat pills as nutritive substrate.

• The results obtained throughout the *in vitro* regeneration phases certify that the micropropagation technique constitutes an effective multiplication method for the species studied.

REFERENCES

Arun M., Asha V. V., 2007, Preliminary studies on anti-hepatotoxic effect of *Physalis peruviana* L. (Solanaceae) against carbon tetrachloride induced acute lever injury in rats. J Ethnopharmacol 111: 110–114.1.

Mayorga H., Duque C., Knapp H., Winterhalter P., 2002, Hydroxyester disaccharides from fruit of Cape gooseberry (*Physalis peruviana* L.). Phytochemisty 59: 439–445.

Murashige T., Skoog F., 1962, A revised medium for rapid growth and bioassays with Tabacco tissue culture. Physiol. Plant. 15, 473-49.

Otroshy M., Arash M., Sayyed M.M.K., Amir-Hossein B., 2013, Direct regeneration from leaves and nodes explants of *Physalis peruviana* L. Int. J. Farm All. Sci., 2(9), 214–218.

Pardo J.M., Fontanilla M.R., Ospina L.F., Espinosa L., 2008, Determining the pharmacological activity of *Physalis peruviana* fruit juice on rabbit eyes and fibroblast primary cultures. Invest Ophthalmol. Vis. Sci., 49(7), 3074–3079.

Ramirez F., Fischer G., Davenport T.L., Augusto Pinzon J.C., Ulrichs C., 2013, Cape gooseberry (*Physalis peruviana* L.) phenology according to the BBCH phonological scale. Sci. Hortic., 162, 39–42.

Soares M.B.P., Bellintani M.C., Ribeiro I.M., Tomassini T.C.B., Santos R.R., 2003, Inhibition of macrophage activation and lipopolysaccarideinduced death by seco-steroids purified from *Physalis angulate* L. Eur J Pharmacol, 459(1): 107-12.

Wu S.J., Ng L.T., Chen C.H., Lin D.L., Wang S.S., Lin C.C., 2004, Antihepatoma activity of *Physalis peruviana* and *P. peruviana* extract and their effects on apoptosis in human Hep G2 cells. Life Sci 74: 2061–2073.

Wu S.J., Tsai J.Y., Chang S.P., Lin D.L., Wang S.S., Huang S.N., 2006, Supercritical carbon dioxide extract exhibits enhanced antioxidant and anti-inflammatory activities of *Physalis peruviana*. J. Ethnopharmacol., 108(3), 407–413.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

INDIVIDUAL ANALYSIS OF THE DENDROMETRIC MEASUREMENTS OF MATURE *PLATANUS X ACERIFOLIA WILLD.*TREES

Sima Sanda (Petredeanu)[1*], Baciu Aurelian Adrian [1]

[1]Faculty of Horticulture, University of Craiova, 13 A.I. Cuza Street, 200585, Craiova, Romania
*corresponding author, e-mail: sanda.petredeanu@bnro.ro

Keywords*: expertise, London Plan Tree, dendrometric features,*

ABSTRACT

Urban green spaces are defined as city areas where complex interaction of environmental, human, socio-economic and cultural factors take place, that offer a dynamic perspective, but with some stability, given by the customs and values of a society under transformation. Valuable urban landscape, both culturally and in terms of urban life quality is a subject that can be reviewed based on climate, social and territorial changes, undergone by the city in its evolution, focusing on elements that serve as memorial landmarks, heritage landscape that can define and characterize the evolution of a society. The secular trees, or those with aesthetic, historical, memorial and social value, represent such cultural elements that require focus due to their importance, doubled by a lack of protection and preservation prospect from the view point of historical and landscape significance. The current study aims to analyze the evolution of the site, its history and creation, to identify the tree vegetation with historical, ecologic, social and memorial significance, verifying and updating the information within "The list of protected trees", regarding the Platanus X acerifolia Willd trees found in The Plane Park of Bucharest.

INTRODUCTION

Urban green spaces are considered to offer various benefits for cities and their inhabitants. Besides offering recreational areas, they significantly influence the quality of the urban environment (Pickett and McDonnell 1993; Tyrväinen 2001, Rodenburg et al. 2002).

For cities, the energy and quality of urban life is determined and supported by the dynamic component of vegetation, especially the tree vegetation, with a role in regulating the urban ecosystem. The world becomes more enriched due to the memorable places where humans project their lives and buildings. (Simonds, 1967). The ecologic and cultural-historical principles of building and the analysis of urban landscape lead to conservation and protective measures in the case of valuable urban areas.

In the heart of Bucharest, on the right side of Dambovita river, there is a valuable landscape, dominated by the presence of special historical plane trees, of *Platanus x acerifolia Willd*. species, which actually gave the name of the land – The Plane Tree Park. The piece of land suffered progressive changes, currently belonging to the National Bank of Romania.

The management based on urban landscaping analysis and developmental control, allows a planned evolution of vegetation and vegetal assembly, taking into

account globalization principles and continuous analysis, evaluation and intervention activities (McIntyre et Al. 2000). Through the value of their landscaping properties, green areas offer identity to human settlements, creating “accessible art, easy to understand and relatable to all, because it uses natural elements which exert spontaneous attraction” (Iliescu A.F. 2006).

The current study aims to investigate the evolution of the site, analyze the history and its creation, identify trees with historical, ecologic, social and memorial value, verifying and updating the information within “The list of protected trees, regarding the *Platanus x acerifolia Willd* trees found in The Plane Park of Bucharest. Following the identification of the heritage trees, the study aims to further continue the research, so as to achieve a complex analysis of the dendrometric characteristics of each tree, determining the functional, aesthetic and memorial value in order to preserve and protect the heritage of the site. This is why it is necessary in busy urban areas, such as Bucharest, for appropriate management of green spaces.

Specialized technical expertise reports must be created in order to determine the state of health, aesthetic, historic and functional values of the plane trees studied and to provide the correct maintenance measures.

MATERIALS AND METHODS

A study of 43 *Platanus x acerifolia Willd*. trees has been conducted, species which also gives the name of the land – The Plane Tree Park, some of which are secular, is represented by 31 monumental specimens in different health stages. These 31 specimens are included in the list of protected trees, managed by the Romanian Academy.

Each individual tree has been analyzed following a scheme drawn according to the principles of Sustainable Management and issued an Individual analysis sheet, containing morphological aspects (basic anatomical elements: crown, bark.), internal structure of the stem (considered following a tomography analysis), the health condition and aesthetic appearance. The time frame in which the study has been conducted refers to a period of 9 years (2008-2017).

To create the Individual analysis sheet the following dendrometric, phytopathological and aesthetic characteristics of the trees have been considered:

- Total height of the tree;
- The tree’s crown diameter ;
- Crown insertion height;
- Diameter and width of the stalk;
- Aesthetic, historic and functional value.

The stalk of a removed tree has been found on the land and it had been analyzed to determine the annual growth rate. It is 3.478mm radial, which is 6.96 diametric, allowing tree-age determination. Knowing the diameter of the analyzed trees their age was determined (Ø:0.696mm=year). The eldest plane tree (H-Pa-45) is 185 years old, which means it dates back to Tudor Vladimirescu’s time.

These have been considered to be the most important characteristics leading to objective determinations of the general well-being of the tree (health state, pathology, age), but also to establishing the global value of the analyzed specimen (historic importance, aesthetic and functional value).

Aesthetic value has been categorized on a scale of 1 to 4 with appropriate grades according to the overall visual offered, in which 1 stands for outstanding aesthetic value, while 4 stand for insignificant aesthetic value. The aesthetic value of the specimens refers to the individual value of the tree and not to that of the landscape it is part of.

The criteria for the interpretation of these appreciations have been:

- The harmony in the shape of the habitus, given by a balanced report between the stalk and the crown;
- Compact and regular crown;
- The verticality of the stalk or the plastic beauty of its inclination (keeping the balance of shapes);
- The integrity of the stark and crown (no lesions or visible flaws);
- The balance and harmony of the perceived visuals (stalk, crown, bark, foliage, sprouts);
- The special architecture of the crowns (the insertion angles of the ridges, the shape of the branches).

The historical value has been determined according to the width of the stalk and their record, found in the List of Protected Trees, comprised by the Romanian Academy.

In order to be considered a piece of heritage, these tree specimens must fulfill the following criteria:

- The age criteria: older than 100 years for long-lasting trees or older than 50 years for trees with a short life expectancy;
- The criteria referring to artistic value, urban (landscaping): value given by the way in which it is part of an urban setting – trees with an outstanding aesthetic and functional values, setting a pleasant atmosphere, with homogenous traits within the landscape;
- The frequency criteria (rarity and uniqueness): high value for species rarely seen in the common landscaping of an area, species with uniqueness value, protected species, endangered in a certain area;
- The criteria referring to the memorial-symbolic value: species which have been silent witnesses of memorable historic, literary, artistic events that have marked a certain stage in the development of a society etc.

These classification criteria, which apply to architectural historical monuments, in accordance to 422/2001 Law, further modified and added (GO 10/2016 to modify and add 422/2001 Law), could be easily adapted for landscaping historical monuments and protected trees.

Law protected trees, being natural monuments; have been marked in the Inventory records under the YES/NO mention.

The functional value of the analyzed tree vegetation has been ranked on a scale of 1 to 3, in which 1 represents high functional value, while 3 represents low functional value.

The basic criteria through which this functional value has been analyzed are:

- The presence of the analyzed specimen in areas with a well-defined role and landscaping function (casting shadow over parking areas, benches, path walks, roads and terraces);
- Supporting architectural elements, through the special volumetrics of the habitus (marking and signaling the entrance of a building, flanking a façade, marking the inflection of roads, creating surprise elements through screening and progressive revealing etc.);
- Taking part in defining the functional character of a specific area (visual screening, dominant wind protective screen etc.).

The vegetation state of the analyzed specimens has been ranked alphabetically from A to E, in which A represents an excellent state, while E represents dry pieces of vegetation.

The basic criteria through which this vegetative value has been analyzed are:

- Overall health, from a visual view point (the presence of visual marks of infestation or pests);
- The wearing of the stalk or crown (visible marks, hollows, destructive effects of previous cuttings);
- The number of open cavities found on the stalk or crown;
- The state of the ridges, under-ridges, general skeletal branches;
- Foliage level or crown density (physiological causes for various de-foliage).

RESULTS AND DISCUSSIONS

In order to keep and perpetuate the special value of the landscape, to preserve and regenerate the health of all the monumental specimens, which will lead to a further presence of mature trees in the urban landscaping for as long as possible, the main focus was on the *Platanus acerifolia* trees.

The research has had as objective the study of the site's evolution, the historic analysis and the development of the site, to identify the tree specimens with historic, ecologic, social and memorial value of all the categories of vegetation present in the analyzed site. Following the identification of trees with a heritage value, the aim was to extend the research, with the purpose of a complex analysis of the dendrometric characteristics of each specimen, establishing its functional, aesthetic and memorial value, in order to preserve and protect the heritage value of the site.

For the specimens of these mature trees the complex analysis of all data, which can further influence their development, has been conducted integrating the analysis and measurements of the specimens' phenotypic structure (data recorded in the Inventory Sheets), with analysis and measurements of the internal structure of the stalk, in order to detect hidden cavities (data recorded in the Tomography Sheets). Also specific focus has been attributed to the secular population of *Platanus x acerifolia*, which represents a nominative value of this site.

Table 1

The values of biometric determinations of the analyzed trees in The Plane Tree Park, Bucharest 2008.

Plant Code	Total height (m)	Crown diameter (m)	Crown insertion height (m)	Stalk circumference (m)	Diameter (cm)	Tree age (years)
A-Pa-01	17.45	23.00	4.09	3.30	105	151
A-Pa-02	23.44	22.60	3.01	3.16	101	145
A-Pa-03	20.98	21.00	4.79	3.12	99	150
B-Pa-04	13.00	14.00	3.00	3.20	102	147
B-Pa-05	17.24	18.00	6.15	3.12	101	145
B-Pa-06	12.18	16.00	3.89	2.86	91	131
B-Pa-07	16.11	16.80	4.38	2.76	88	126
B-Pa-08	14.96	18.00	3.17	2.70	86	124
B-Pa-09	19.87	18.00	3.77	2.93	93	134
B-Pa-10	11.80	9.60	5.20	1.82	58	83
B-Pa-11	11.18	11.20	5.13	2.43	77	110
B-Pa-12	18.07	12.80	3.74	2.64	84	121
B-Pa-13	21.90	16.00	3.25	2.67	85	122
B-Pa-15	26.10	22.60	2.74	3.50	111	159
B-Pa-16	28.99	31.00	4.67	2.64	84	121

Plant Code	Total height (m)	Crown diameter (m)	Crown insertion height (m)	Stalk circumference (m)	Diameter (cm)	Tree age (years)
B-Pa-17	25.18	30.00	3.53	3.99	127	182
B-Pa-21	10.28	13.60	3.26	2.40	76	109
B-Pa-22	14.80	8.00	6.33	3.41	82	118
C-Pa-23	19.32	10.00	3.56	3.32	106	152
C-Pa-24	19.50	9.40	4.29	3.72	118	170
C-Pa-25	12.06	8.00	5.35	2.55	81	116
C-Pa-26	10.28	10.60	3.26	Nu	109	157
C-Pa-27	23.18	8.80	12.11	3.10	99	142
C-Pa-28	23.86	14.20	12.70	Nu	125	180
E-Pa-30	19.32	8.80	3.56	2.48	79	114
F-Pa-31	28.00	9.40	3.40	3.41	109	157
F-Pa-32	27.00	12.40	3.60	3.63	116	167
F-Pa-33	25.00	8.20	7.29	2.48	93	134
F-Pa-34	24.00	12.00	3.87	3.11	99	142
F-Pa-35	25.00	13.60	4.61	3.45	113	162
F-Pa-36	16.00	9.20	2.20	2.10	67	96
G-Pa-37	22.56	18.00	5.42	3.05	97	139
G-Pa-38	22.14	18.00	3.75	2.45	78	112
G-Pa-39	21.09	16.00	4.53	2.78	88	126
G-Pa-40	21.31	11.60	4.17	2.18	69	99
G-Pa-41	18.86	13.40	8.43	2.53	81	131
G-Pa-42	23.51	23.00	4.10	2.88	92	132
G-Pa-43	14.74	10.80	3.05	2.67	85	122
G-Pa-44	16.25	12.40	3.57	3.12	99	142
H-Pa-45	24.10	14.00	4.29	4.04	129	185
H-Pa-46	22.12	20.00	3.19	4.24	126	181
I-Pa-47	20.10	18.60	3.04	3.35	107	154
I-Pa-48	20.94	15.00	2.60	3.78	120	172

Table 2

Aesthetic value of the analyzed trees in The Plane Tree Park, Bucharest 2008.

Plant Code	Aesthetic value (1/2/3/4)	Historic value Yes/No	Functional value (1/2/3)	Vegetation state (A,B,C,D,E)	Tree age (years)
A-Pa-01	1	No	1	C	151
A-Pa-02	1	Yes	1	C	145
A-Pa-03	1	Yes	1	C	150
B-Pa-04	2	Yes	1	C	147
B-Pa-05	2	Yes	1	B	145
B-Pa-06	2	Yes	1	C	131
B-Pa-07	2	Yes	1	C	126
B-Pa-08	2	No	1	B	124
B-Pa-09	2	No	1	B	134
B-Pa-10	4	Yes	2	D	83
B-Pa-11	4	No	2	D	110
B-Pa-12	1	No	1	C	121
B-Pa-13	1	Yes	1	C	122

Plant Code	Aesthetic value (1/2/3/4)	Historic value Yes/No	Functional value (1/2/3)	Vegetation state (A,B,C,D,E)	Tree age (years)
B-Pa-15	1	Yes	1	C	159
B-Pa-16	1	Yes	1	C	121
B-Pa-17	1	Yes	1	C	182
B-Pa-21	3	Yes	1	D	109
B-Pa-22	3	Yes	1	D	118
C-Pa-23	1	No	1	C	152
C-Pa-24	2	Yes	1	C	170
C-Pa-25	2	No	1	D	116
C-Pa-26	3	No	1	C	157
C-Pa-27	2	No	3	D	142
C-Pa-28	2	No	3	C	180
E-Pa-30	2	Yes	2	C	114
F-Pa-31	1	Yes	1	C	157
F-Pa-32	1	Yes	1	C	167
F-Pa-33	1	Yes	1	C	134
F-Pa-34	1	Yes	1	C	142
F-Pa-35	1	Yes	1	C	162
F-Pa-36	2	Yes	1	C	96
G-Pa-37	1	Yes	1	C	139
G-Pa-38	1	Yes	1	C	112
G-Pa-39	1	Yes	1	C	126
G-Pa-40	1	No	1	C	99
G-Pa-41	2	Yes	2	C	131
G-Pa-42	2	Yes	2	C	132
G-Pa-43	1	No	1	C	122
G-Pa-44	1	Yes	1	C	142
H-Pa-45	1	Yes	1	C	185
H-Pa-46	1	Yes	1	C	181
I-Pa-47	1	Yes	1	C	154
I-Pa-48	1	Yes	3	C	172

The dendrometic measurements in table 1 show the impressive dimensions from a value view point of these trees, which have heights of over 28 meters (B-Pa-15, B-Pa-16, B-Pa-17, F-Pa-31, F-Pa-32) and with a stalk diameter of over 125 cm (B-Pa-17, B-Pa-24, B-Pa-28, H-Pa-45, H-Pa-46).

From the view point of aesthetic value out of the 43 analyzed trees, 55.8 % have outstanding aesthetic value, 32.5 % have a suitable aesthetic value, 6.9 % have a reduced aesthetic value, while 4.6 % have no aesthetic value.

From the view point of vegetation value, the trees have been classified as follows: 7 % in very good state, 79 % in a good state, while 14 % are in an average state.

A number of 31 plane trees (72,1 %) out of the 43 specimens studied, represent declared natural monuments, aspect which imposes that the technical operations needed to preserve the aesthetic-functional value will be executed more carefully and with consideration of current norms and laws.

The correlation between the determined age (years) and the diameter of the stalk (cm) shows a close dependence of the two aspects, the correlation coefficient being significantly positive(R^2= 0, 9879) fig 1.

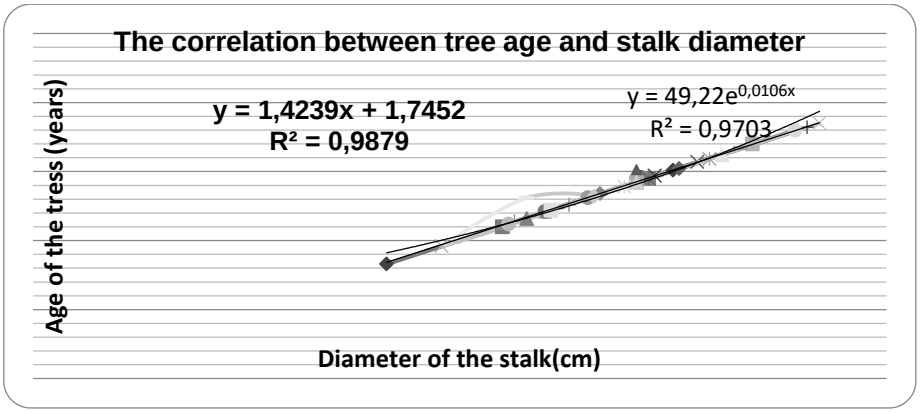


Figure 1. The correlation between the tree age and stalk diameter of the plane trees in The Plane Tree Park – RNB.

This aspect proves that fact that the older the trees become, the higher the quantity of stored biomass is, including the one stored in the stalk.

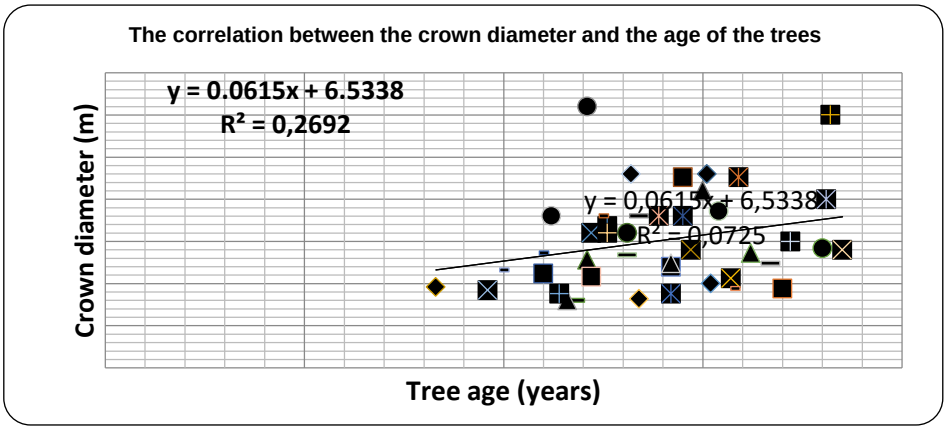


Figure 2. The correlation between the crown diameter and the age of the trees in The Plane Tree Park – RNB.

Out of figure 2, it is noticeable a value of $R^2 = 0,2692$ between the correlation of the crown diameter of the plane trees and the age, which shows a weak interdependence between the two sets of values. The conclusion can be drawn that, in addition to the age of the trees, there are other elements that influence the health state of the trees (wounds – hollows, crown cutting in periodic interventions, placement, density etc.).

CONCLUSION

All the research and field and archive analysis have led to the following conclusions in relation to the differential and integrated management of the historic landscaping of The Plane Tree Park, as described:

1. The analysis of the vegetation has been conducted through a complex landscaping method, focused on dendrometric measurements, functional, aesthetic, historic and landscaping value-identification analysis, and according to the health stare of the specimens. All of the data have been recorded in the *Inventory Sheets.* In addition to all of these measurements, there have been conducted analysis that refer to indirect factors, such as pedological and phytopathological analysis.

2. There is a need for a complex analysis of all data that can further influence the development of the trees, integrating the analysis and measurements of the phenotypic structure of the specimens (recorded in the Inventory Sheets), with the analysis and measurements of the internal structure of the stalk, to track hidden cavities (tomography sheets).

3. All the dendrometric measurements and estimates to the value of the vegetation are necessary in order to comprise The Plan for the landscaping management and prioritized intervention.

4. There is a close connection between the determined age (years) of the trees and the diameter of the stalk (cm) the correlation coefficient is significantly positive.

5. There is a need for a tomographic analysis of the internal structure in all the 43 plane specimens considering the age of the trees (67 % are over 130 years old).

6. This analysis attributes the permanent monitoring of the specimens, conducting regenerative interventions and programming their replacement, before the trees become an imminent threat.

REFERENCES

Iliescu A.F., 2003 – A*rhitectura peisajeră. Editura Ceres, Bucureşti, pag. 103.*

McIntyre N.E., Knowles-Yánez K. & Hope D., 2000 – Urban ecology as an interdisciplinary field: differences in the use of “urban” between the social and natural sciences. Urban Ecosystems 4: 5–24.

Simonds J.O., 1967 – Arhitectura peisajului (traducere din limba engleză: Moisescu A., Stoenescu Ş.), Editura tehnică Bucureşti.

Pickett S.T.A. & McDonnell M.J., 1993 - Humans as components of ecosystems: A synthesis. In: McDonnell M.J. & Pickett S.T.A. (eds.), Humans as components of ecosystems: The ecology of subtle human effects and populated areas, Springer-Verlag, New York, USA, pp. 310–316.

Rodenburg C., Baycan-Levent T., van Leeuwen E. & Nijkamp P. 2002. Urban economic indicators for green development in cities. In: Martinuzzi A. (ed.), Greener management international; evaluating sustainable development policy, Issue 36, Winter 2002, Greenleaf Publishing, Sheffield, UK, pp. 105–119.

Tyrväinen L. 2001 - Economic valuation of urban forest benefits in Finland. Journal of Environmental Management 62: 75–92.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓*Biology*
✓*Horticulture*
✓*Food produce processing technology*
✓*Environmental engineering*

PRELIMINARY RESULTS ON THE CULTURE OF ZUCCHINI PATTISON (CUCURBITA PEPO PATISSONIANA) ON SANDY SOILS IN SOUTHERN OLTENIA

Sfîrloagă Loredana Mirela[1], Diaconu Aurelia[1], Dima Milica[1], Novac Mihaela Gabriela[1], Croitoru Mihaela[1]

[1]Research and Development Station for Plant Culture on Sands Dabuleni
e-mail:ditaloredanamirela @yahoo.com

Keywords*: zucchini, sandy soils, yield*

ABSTRACT

In the pedoclimatic conditions of the sandy soils in southern Oltenia it was found that zucchini Patison behaves very well. The zucchini Patison (Ovari feher) produces large fruit production on sandy soils (53t / ha). The best period of establishment of the zucchini Patison crop is at the end of April, using seedlings obtained in alveolar trays.

The zucchini Patison culture is profitable on sandy soils. At a production of 53 t / ha and at an average price of 2.5 lei / kg a profit of 35500 lei / kg is obtained.

INTRODUCTION

The Cucurbitaceae family is the second largest horticultural family in terms of economic importance after Solanaceae. Includes several important crops such as Cucumis melo, Watermelon Citrullus lanatus, Cucumis sativus and many Cucurbita fruits with edible fruits (Jeffrey, 1980). The genus Cucurbita originates from the two Americas, comprises three species of important crops such as Cucurbita pepo, Cucurbita moschata and Cucurbita maxima grown in temperate, subtropical and tropical regions (Wang et al., 2011).

It is supposed to originate in Africa, from where it has spread to Europe and America. The area of culture is more limited, with large areas being cultivated in the US and Russia, but also with some expansion in the warmer countries of Western Europe. In our country it is cultivated on small areas in the household system. It has been known in Banat since 1960 and is a vegetable that is increasingly appreciated by consumers. Patison is cultivated for its fruits, consumed in different stages of technical maturity. Fruits are rich in carbohydrates, mineral salts, vitamins, as the nutritional value is higher and the range of products more diversified. Fruit that has passed the time of harvesting and those at physiological maturity are used in animal feed (Ciofu R., et al., 2003).

The use of Patison pulp in the range of plants cultivated at SCDCPN Dăbuleni ensures good anti-deflationary protection due to the high degree of land coverage over a large period of the year, as well as a source of income for small farmers.

MATERIAL AND METHOD

Research has aimed behavior Patison zucchini, on sandy soils. Using zucchini Patison in the range of cultivated plants to SCDCPN Dăbuleni provides good protection

antideflaţională given the high land cover over a long period of the year, and a source of income for small farmers. The experience was located in the experimental field at SCDCPN Dăbuleni and was festablished by seedling aged 17 days. The seedling was obtained in alveolar trays by sowing (on 28.03.2018 in peat). Zucchini plants Patison variety Ovari feher sprang on 10.04.2018 and were transplanted in experimental field on 27.04.2018. During the vegetation period observations were made on the main plant phenophases (plant growth, the appearance of floral buttons, mass flowering, physiological maturity of fruit). Biometric observations and determinations were made on the fruits: fruit weight, fruit height , fruit diameter, shape index, pulp thickness, total production.

RESULTS AND DISCUSSIONS

Consumption of fresh vegetables is increasingly high, being one of the clues demonstratingto the degree of development and the evolution of the concept of rational nutrition and its diversification. In most countries, consumption of vegetables per capita exceeds 120-140 kg.

Increased emphasis is placed on the diversification of the assortment, allowing for a staggered period as long as possible (Gherman N., et al., 1980).

The variable character of the climate in southwestern Romania, where the summers are dry and warm, offers favorable conditions for the cultivation of zucchini Patison.

In order to achieve the earliest crops, seedling will be used and the sowing, scheme is 70 cm between the rows, 35-40 cm between the plants at rows 36000-41000 plants per hectare (Vâlceanu Gh., 1982).

Two phase fertilizations were applied in the culture technology with complex fertilizer 16: 16.16, and in the case of water deficiency were carried out sprinkling irrigation. Thus, three treatments have been carried out against diseases and pests attacks: with Novadim, Dithane, Topsin, Calypso, Curzate.

The main phenophases of Patison zucchini plants are shown in Table 1.

From the point of view of the phenophases of vegetation, the Patison courgette culture was evidenced by the appearance of floral buttons (May 10), mass flowering (May 16), technical maturity of fruits (5 June - 10 July) and physiological maturity starting with 1 August.

The harvesting was done manually as the fruit reached the tehnical maturity. The first harvest occurred 38 days from transplantation in the experimental field and 55 days after appear. The main biometric features of the fruits are shown in Table 2.

Table 1

The main phenophases at zucchini Patison culture

The main phenophases	Date
The emergence of floral buttons	10 May
Flowering in the mass	16 May
Technical maturity of fruits	5 June-10 July
Physiological maturity of fruits	1 August

Fruits intended for fresh consumption presented at harvest at a diameter of 9.42-13.20cm, a fruit height of 5.22-7.10cm and the weight can reach up to 537.4g.

Table 2

Biometric measurements of Patison fruit,Ovari feher variety

Specification	Fruit height (cm)	Fruit diameter (cm)	Fruit weight (g)
Harvest I (6.06.2018)	6.28	13.2	537.4
Harvest II(11.06.2018)	5.64	11.38	457.5
Harvest III(19.06.2018)	5.90	10.7	342.0
Harvest IV(20.06.2018)	5.22	9.42	236.4
Harvest V(4.07.2018)	6.08	10.36	345.4
Harvest VI(10.07.2018)	7.10	10.48	520.0
Average	6.03	10.92	406.4

A number of 6 harvests have been carried out since 5.06. 2018 and was recorded a total production of 53 t / ha was recorded (Table 3).

During the harvest, the yields were differentiated, in the first decade there were yields of 25 t / ha, and towards the end of the vegetation period, the quantity of zucchini Patison fell significantly, with a production of 1 t / ha.

It can be seen from the data presented (Table 4) that the at zucchini Patison culture shows profitability on sandy soils. Thus, at a production of 53 t / ha, at an average price of 2.5 lei / kg, a profit of 35500 lei / kg is obtained.

Table 3

The staging of production the zucchini Patison Ovari feher variety

Date of harvest	Production
Harvest I (6.06.2018)	16
Harvest II(11.06.2018)	6
Harvest III(19.06.2018)	25
Harvest IV(20.06.2018)	3
Harvest V(4.07.2018)	2
Harvest VI(10.07.2018)	1
Total	53

Table 4

The economic efficiency the zucchini Patison culture

Species	Production (t/ha)	Total expenses (lei/ha)	Revenue (lei/ha)	Profit (lei/ha)
The zucchini Patison (*Ovari feher* variety)	53	9700	132500	35500

CONCLUSIONS

From the obtained results on the behavior of Patison zucchini in culture, in the pedoclimatic conditions of the sandy soils in southern Oltenia, the following were found:

-the zucchini Patison (Ovari feher) produces great productions of fruits on sandy soils (53t/h);

- the best period of foundation of the zucchini Patison culture is at the end of April, using seedlings obtained in alveolar trays.

- the zucchini Patison culture is profitable on sandy soils

At a production of 53 t / ha and at an average price of 2.5 lei / kg a profit of 35500 lei / kg is obtained.

REFERENCES

Ciofu Ruxandra, Stan N., Popescu V., Chilom Pelaghia, Apahidean S., Horgoş A., Berar V., Lauer F.K., Atanasiu N., 2003, Tratat de Legumicultură, Editura Ceres. Bucureşti, pag.855.

Gherman N., Huluţă M., Iancu I., 1980, Studiul agrobiologic, elemente de tehnologie si problemele extinderii în cultură a unor specii de ceapă, Simpozionul Naţional Cultura Legumelor Verdeţuri şi a Speciilor Mai Puţin Răspândite în Cultură.Tiparul I Institutul Agronomic ,,N. Bălcescu", Bucureşti, Bacău, pag. 49.

Jeffrey C., 1980, A review of the *Cucurbitaceae*, Bot. J. Linn. Soc. 81, 233–247.

Vâlceanu Gh., 1982, Cultura legumelor mai puţin răspândite. Editura Ceres. Bucureşti, pag. 205-208.

Wang Y. H., Behera T. K., Kole C., 2011, Genetics, Genomics and Breeding of Cucurbits. CRC Press.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

EVALUATION OF POLYPHENOLS CONTENT AND ANTIOXIDANT ACTIVITY IN FRESH ORANGE JUICES OF DIFFERENT VARIETIES, AT THE MATURING STAGE OF THE FRUITS

Stavropoulos Georgios-Christos[1], Gougoulias Nikolaos[1*], Papachatzis Alexandros[1], Koutinas Nikolaos[2], Zakynthinos Georgios[3], Ntalla Maria-Nektaria[4]

[1]Department of Agronomy Technology, Technological Educational Institute of Thessaly, Larissa, Greece.
[2]Department of Agronomy Technology, Technological Educational Institute of Thessaloniki, Greece.
[3]Department of Food Technology, Technological Educational Institute of Peloponnese, Kalamata, Greece.
[4]Department of Computer Science and Engineering, Technological Educational Institute of Thessaly, Larissa, Greece.
*Correspondence author: email: ngougoulias@teilar.gr

Keywords: *Orange juices; total phenols; phenolic fractions; DPPH activity; FRAP activity*

ABSTRACT

Orange juices from eight varieties of orange fruits (Navelina, Newhall, Merlin, Tarocco, Moro, Valencia, Lane late and Salustiana) grown in Peloponnese region, have been studied for evaluating and comparing their polyphenols content and antioxidant properties. It has been established that total phenols (TP) of the orange juices move in broad ranges depending on the variety type, chemical soil properties, and the ecological conditions of fruits cultivation. The content of TP in the orange juices ranged from 344.7 to 522.9 mg GAE L^{-1} juice, non-flavonoid phenols (NFP) ranged from 47.7 to 98.4 mg GAE L^{-1} juice and flavonoid phenols (FP) from 253.1 to 439.5 mg GAE L^{-1} juice. The lower IC_{50} values (22.7 and 23.8 μL orange juices), which indicated higher antioxidant potential, were observed for the orange juices from the Newhall and Salustiana varieties respectively, while the antioxidant activity FRAP ranged from 7.3 to 12.5 mM FRAP.

INTRODUCTION

The creation of free radicals in human cells causes the oxidation of the biological macromolecules. These changes of the biological macromolecules induce the occurrence of many diseases (Sies, 2015). Epidemiological investigations demonstrate that the oxidative destruction of biomolecules can be reduced by using endogen and exogenous antioxidants such as vitamins C, E, carotenoids, polyphenols, etc. which mainly are contained in fruits and vegetables (Valko et al. 2006). Fruit and vegetable rich food reduces the risk of degenerative diseases such as cardiovascular and cancer (Zhang et al. 2016).

Oranges and orange juices, is an important source of vitamin C and polyphenolic compounds such as are hydroxycinnamic acids and flavonoids. Citrus flavonoids have shown therapeutical properties such as antiinflammatory, antihypertensive, diuretic and analgesic (Monforte et al. 1995). According to some authors (Kanitsar et al. 2001, Belajova´ and Suhaj 2004), the content on hydroxycinnamic acids and flavanone in orange juices, depends on the variety of oranges, their ripeness and the technological processes of juices production.

The purpose of the present research is to evaluate the antioxidant activity and the contents of total phenols on the fresh orange juices from some orange varieties, at the maturing stage of the fruits, under environmental conditions of Peloponnese region, Greece.

MATERIAL AND METHODS

This study, was conducted in eight orange orchards which are they in the Argos of Peloponnese region, Greece. The distance of the orange orchards from the sea is 5km, and the altitude 5m. The region of Argos (latitude $37^0$36'N, longitude $22^0$47'E) is characterized by a Mediterranean climate with mild dry winters and hot dry summers. Average winter temperature 10.2 ^{0}C, average summer temperature 26.3 ^{0}C and average annual precipitation 480 mm.

Orange fruit from eight varieties (*Citrus sinensis*) were the subject, as of study (Navelina, Newhall, Merlin, Tarocco, Moro, Valencia, Lane Late and Salustiana). Each variety is grown in different orange orchards. From all orange varieties, the orange fruit were collected at the stage of maturing fruit. Five fruit of each variety were squeezed by a domestic juicer and the juice obtained, is filtered and used immediately for physicochemical analyses and antioxidant activity determination. For soil depth 0-30 cm, the pH all orange orchards ranged from 7.79 to 8.46, electrical conductivity from 0.09 to 0.35 dS m^{-1} and inorganic nitrogen from 14 to 31.5 mg/kg soil. For soil depth 30-60 cm, the pH all orange orchards ranged from 7.76 to 8.55, electrical conductivity from 0.09 to 0.34 dS m^{-1} and inorganic nitrogen from 9 to 21.0 mg/kg soil. Moreover, other soil chemical properties of orange orchards are presented in Table 1 and Table 2.

Methods of analyses: Soil was analyzed using the following methods which are referred by (Page et al. 1982). Organic matter was analyzed by chemical oxidation with 1 mol L^{-1} $K_2Cr_2O_7$ and titration of the remaining reagent with 0.5 mol L^{-1} FeSO4. Soil pH and Electrical conductivity, (EC), measured in the extract (1 part soil : 5 parts H_2O). The Texture of soils was determined by the method Bouyoucos. The calcium carbonate was determined by the method Bernard. Inorganic nitrogen was extracted with 0.5 mol L^{-1} $CaCl_2$ and estimated by distillation in the presence of MgO and Devarda's alloy, respectively. Available P forms (Olsen P) was extracted with 0.5 mol L^{-1} $NaHCO_3$ and measured by spectroscopy. Exchangeable form of potassium was extracted with 1 mol L^{-1} CH_3COONH_4 and measured by flame Photometer (Essex, UK).

The pH, the Brix degrees and the total acidity were measured in the orange juice. The Brix degrees by a Zeiss refract meter, while the total acidity by titration with 0.1N NaOH solution and expressed in g of citric acid per 100ml orange juice.

The amount of total polyphenols (TP) in the orange juice was determined with the Folin-Ciocalteu (F.C.) reagent according to the method of (Singleton and Rossi, 1965) using the microvariant proposed by (Baderschneider et al. 1999), and were expressed as gallic acid equivalent (GAE) in mg L^{-1} juice.

The content of nonflavonoid phenols (NFP) in the orange juice was determined with the F.C. reagent after removing the flavonoid phenols (FP) with formaldehyde according to the method of (Kramling and Singleton, 1969) and was expressed as gallic acid equivalent (GAE) in mg L^{-1} juice. Flavanoid phenols (FP) in the orange juice were determined as a difference between the content of total phenols (TP) and nonflavonoid phenols (NFP). Their amount was evaluated as gallic acid equivalent in mg L^{-1} juice.

DPPH• assay in the orange juice: The DPPH-scavenging activity of orange juice were evaluated using the stable free radical 2,2′-diphenyl-1-pycrylhydrazyl radical (DPPH•), as a reagent, according to the method by (Brand-Williams et al. 1995) and the results were expressed as percentage decrease against control. The reaction mixture contained 4mL 10^{-4}M DPPH methanolic solution and different amounts of orange juice. The inhibition percentage for each sample was calculated using the following equation:

% inhibition = [(E0 – Ex)/E0] × 100

where E0, is the extinction of the radical solution before the reaction and Ex, after polyphenols addition of juice solution (Yen and Duh, 1994).

The inhibition coefficient (IC_{50}), represents 50 % reduction in the colour intensity of the DPPH radical by the total phenols in the studied orange juices. Percent inhibition curves versus of sample volume were used to determine of the inhibition coefficient (IC_{50}).

Table 1

Soil chemical properties of orange orchards for each cultivated variety

Orange varieties	Soil depth 0-30 cm of orange orchards					
	Chemical properties					
	Texture	P-Olsen	Exchangeable		$CaCO_3$	Organic matter
			K	Na		
		mg/kg	mg/kg	mg/kg	%	%
Navelina	CL	53.36±2.96	389.6±21.1	63.71±3.27	17.08±0.90	2.48±0.15
Newhall	SCL	136.5±7.15	143.52±7.47	267.9±12.5	17.08±0.89	1.24±0.07
Merlin	SCL	55.01±2.93	133.38±6.35	140.30±6.5	23.75±1.32	1.91±0.10
Tarocco	SCL	46.21±2.45	430.56±20.4	31.97±1.67	17.50±0.88	1.24±0.06
Moro	SCL	42.31±2.18	287.04±13.5	31.97±1.46	14.17±0.83	1.41±0.07
Valencia	SL	15.40±0.80	81.90±4.07	31.97±1.57	59.17±3.13	1.04±0.06
Lane Late	SCL	15.95±0.88	164.19±8.33	63.71±3.30	26.25±1.19	1.47±0.07
Salustiana	CL	36.85±1.99	256.23±11.97	51.06±2.57	24.58±1.26	1.47±0.07

CL, Clay loam; SCL, Sandy clay loam; SL, Sandy loam; Data represent average means and standard deviation (SD), n=4.

Ferric reducing antioxidant power assay (FRAP) in the orange juice: The ferric reducing antioxidant power of the orange juice was evaluated according to the method by (Benzie and Strain, 1999) and the results were expressed as mM FRAP.

Data analysis was made using the MINITAB (Ryan et al. 2005) statistical package. The results are means of five parallel samples. Analysis of variance was used to assess treatment effects. Mean separation was made using Tukey's test when significant differences (P=0.05) between treatments were found.

Table 2

Soil chemical properties of orange orchards for each cultivated variety

Orange varieties	Soil depth 30-60 cm of orange orchards					
	Chemical properties					
	Texture	P-Olsen	Exchangeable		$CaCO_3$	Organic matter
			K	Na		
		mg/kg	mg/kg	mg/kg	%	%
Navelina	CL	23.36±1.31	207.09±9.86	21.85±1.10	18.05±1.03	2.02±0.10
Newhall	SCL	20.52±1.17	112.71±5.37	23.69±1/08	18.33±0.94	1.14±0.06
Merlin	SCL	24.75±1.33	153.66±7.05	139.2±6.38	23.33±1.26	1.84±0.09
Tarocco	SCL	16.06±0.85	254.28±11.2	15.41±0.76	19.17±0.91	1.19±0.07
Moro	SCL	11.33±0.66	114.27±5.44	13.80±0.74	13.75±0.71	1.34±0.06
Valencia	SL	9.20±0.53	79.56±4.02	11.96±0.63	60.12±2.86	0.96±0.05
Lane Late	SCL	9.50±0.59	107.64±5.25	24.38±1.23	25.83±1.34	1.37±0.08
Salustiana	CL	14.78±0.89	138.45±7.21	25.53±1.34	25.42±1.27	1.41±0.07

CL, Clay loam; SCL, Sandy clay loam; SL, Sandy loam; Data represent average means and standard deviation (SD), n=4.

RESULTS AND DISCUSSION

Table 3 shows the physicochemical characteristics of orange juice, on the maturity stage of the orange fruits.

Table 3

Physicochemical characteristics of orange juice on the maturity stage of the fruits

Orange juices (varieties)	pH	Brix degrees	Total acidity (g citric acid / 100ml orange juice)
Navelina	3.78±0.19	14.3±0.66	1.22±0.06
Newhall	3.58±0.17	16.2±0.79	2.12±0.10
Merlin	3.76±0.17	12.0±0.56	1.01±0.05
Tarocco	3.68±0.19	10.0±0.52	1.27±0.07
Moro	3.42±0.16	11.2±0.53	1.55±0.07
Valencia	3.29±0.15	11.1±0.51	1.60±0.09
Lane Late	3.62±0.18	11.9±0.60	1.27±0.07
Salustiana	3.82±0.17	12.8±0.59	0.98±0.05

Data represent average and SE deviation. (n) = 5.

The content of total phenols (TP) in the fresh orange juices from the varieties studied ranges from 344.7 to 522.9 mg (GAE) L^{-1} juice (Table 4). The highest content was found in the juice of Newhall variety, and the lowest in the juice of Valencia variety. These values are different than those which obtained from other authors for the same varieties orange fruits in other regions (Rapisarda et al. 2008). It has been established that the concentration of the total phenols and of phenol fractions in the fresh orange juice different, varies and depends on the cultivar, colection season of fruits,soil chemical properties, climatic conditions, agricultural techniques of orange trees, technological processes of the production of juices, juice color, time and temperature of storage (Kanitsar et al. 2001, Belajova´ and Suhaj 2004, Klimczak et al. 2007, Rapisarda et al. 2008).

The content of flavonoid phenols (FP) in the fresh orange juices from the varieties studied ranges from 253.1 to 439.5 mg (GAE) L^{-1} juice. The highest content was found in the juice of Salustiana variety, and the lowest in the juice of Lane Late orange variety (Table 4). The FP content in the juice of Salustiana, Moro and Tarocco varieties constitute 89.7 %, 89.2 % and 88.1 % respectively of TP amount, whereas in the juices of Navelina, Newhall, Merlin, Valencia and Lane Late varieties reached 82.8 %, 81.5 %, 77.6 %, 76 % and 72 %, respectively. The content of non-flavonoid phenols (NFP) in the juices of Lane Late, Valencia and Merlin varieties constitute 28 %, 24 % and 22.4 % respectively of TP amount, whereas for juices Newhall, Navelina, Tarocco, Moro and Salustiana reached 18.5 %, 17.2 %, 11.9%, 10.8 % and 10.3 %, respectively (Table 4).

The results expressed as inhibition coefficient (IC_{50}) are demonstrated in Table 4. The lower IC_{50} values (22.7 and 23.8 µL orange juices), which indicated higher antioxidant potential, were observed for the orange juices from the Newhall and Salustiana varieties respectively. The antioxidant activity of the orange juices is not only due to the monomeric polyphenols contained in the juices but also in a synergistic action of the polyphenols with other compounds. The antioxidant activity FRAP of the orange juices from the varieties studied varies within the limits of 7.3 to 11.9 mM FRAP (Table 4).

Table 4

Content of TP, FP, NFP, DPPH-scavenging activity and Antioxidant activity FRAP in the fresh orange juices studied

Orange juices (varieties)	TP	FP	NFP	Inhibition coefficient (IC_{50})	FRAP
	mg (GAE) L^{-1} juice			*μL juices	mM
Navelina	396.6cd	328.4 c	68.2c	53.8c	8.1d
Newhall	522.9a	426.2 a	96.7a	22.7a	12.5a
Merlin	355.2d	275.6 d	79.6b	82.6d	7.3e
Tarocco	442.5c	389.8 b	52.7d	48.9c	8.5d
Moro	441.8c	394.1 ab	47.7d	28.6b	10.3c
Valencia	344.7d	262.0 de	82.7b	48.3c	8.2d
Lane Late	351.5d	253.1 e	98.4a	94.2e	7.3e
Salustiana	490.0b	439.5a	50.5d	23.8a	11.9b

*Volumes of orange juice yielding 50 % inhibition of the radical absorbance (IC_{50}). Columns with the same letter do not differ significantly according to the Tukey's test (P=0.05).

CONCLUSIONS

Fresh orange juices studied from the region of Peloponnese are characterised by different and specific quantities and ratio of total phenols, nonflavonoid and flavonoid phenols. The orange juices are characterised by comparatively high antiradical and antioxidant activities. The differences in the phenols content and in the separate fractions as well as their antioxidant activity depend on the chemical composition of the orange fruit from the typical for the region varieties as well as on the ecological conditions of fruits cultivation.

REFERENCES

Baderschneider B., Luthria D., Waterhouse A.L., Winterhalter P., 1999, Antioxidants in white wine (cv. Riesling): I. Comparison of different testing methods for antioxidant activity. Vitis, 38(3): 127-131.

Belajova E., Suhaj M., 2004, Determination of phenolic constituents in citrus juices: method of high performance liquid chromatography. Food Chemistry 86, 339–343.

Benzie I.F., Strain J.J., 1999, Ferric reducing/antioxidant power assay: direct measure of total antioxidant activity of biological fluids and modified version for simultaneous measurement of total antioxidant power and ascorbic acid concentration. Methods in enzymology, (299),15-27.

Brand-Williams W., Cuvelier M.E., Berset C.L.W.T., 1995, Use of a free radical method to evaluate antioxidant activity. LWT-Food science and Technology, 28(1), 25-30.

Kanitsar K., Arce L., Rios A., Valcarcel M., 2001, Determination of phenolic constituents in citrus samples by on-line coupling of a flow system with capillary electrophoresis. Electrophoresis 22, 1553–1565.

Klimczak, I., Małecka, M., Szlachta, M., & Gliszczyńska-Świgło, A. (2007). Effect of storage on the content of polyphenols, vitamin C and the antioxidant activity of orange juices. Journal of Food Composition and Analysis, 20(3-4), 313-322.

Kramling T.E., Singleton V.L., 1969, An estimate of the nonflavonoid phenols in wines. American Journal of Enology and Viticulture, 20(2): 86-92.

Monforte M. T., Trovato A., Kirjavainen S., Forestieri A. M., Galati E. M., Lo R. C., 1995, Biological effects of hesperidin, a Citrus flavonoid.(note II): hypolipidemic activity on experimental hypercholesterolemia in rat. Farmaco (SocietÃ chimica italiana: 1989), 50(9), 595-599.

Page A.L, Miller R.H., Keeney D.R., 1982, Methods of Soil Analysis. Part 2, Chemical & Microbiological properties. Agronomy (9), ASSSA, Mad. Wisc. USA.

Rapisarda, P., Bianco, M. L., Pannuzzo, P., & Timpanaro, N. (2008). Effect of cold storage on vitamin C, phenolics and antioxidant activity of five orange genotypes [Citrus sinensis (L.) Osbeck]. Postharvest biology and technology, 49(3), 348-354.

Ryan B.F., Joiner B.L., Cryer J.D., 2005, MINITAB Handbook: Updated for release 14, 5th edition. Brooks/Cole-Thomson Learning Inc., Kentaky, KY.

Sies H., 2015, Oxidative stress: a concept in redox biology and medicine. Redox biology, 4, 180-183.

Singleton V.L., Rossi S.A., 1965, Colorimetry of Total Phenolics with Phosphomolibdic-phosphotungstic Acid Reagents. J Enol Viticult, 16: 144-158.

Valko M., Rhodes C., Moncol J., Izakovic M. M., Mazur M., 2006, Free radicals, metals and antioxidants in oxidative stress-induced cancer. Chemico-biological interactions, 160(1), 1-40.

Yen G.C., Duh P.D., 1994, Scavenging effect of methanolic extracts of peanut hulls on free-radical and active-oxygen species. Journal of Agricultural and Food Chemistry, 42(3), 629-632.

Zhang L., Yue P., Jiang J., Fan J., Gao X., 2016, Effect of phenolic compounds on antioxidant activity in 8 blueberry (Vaccinum spp.) juices. Carpathian Journal of Food Science and Technology, 8(2), 178-186.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

CONTROL THE MAIN PARAMETERS OF QUALITY AND AUTHENTICITY OF WINES FROM OPRIŞOR

Stoica Felicia, Balaban Alin Constantin, Popescu Raluca Iulia

[*]University of Craiova, Faculty of Horticulture
** Correspondence author. E-mail*: feliciastoica@yahoo.com

Keywords*:* red wine, *quality parameters, authenticity*

ABSTRACT

Lately, it lays emphasis on achieving wine quality, natural and authentic. Besides the analyzes modern, last generation HPLC, GC MS, GC FTIR, IRMS, NIR, quality and naturalness of the wines can be determined by analyzing the main parameters (alcohol, total acidity, extract, ash) and calculating the most important quality indicators (ratio alcohol / glycerol, alcohol / extract, extract / ash Halphen and Gautier). For this purpose were analyzed neutral red wines (Cabernet sauvignon, Feteasca neagra si Merlot) from two different range, Caloian and La Cetate, from Oprisor wine center.

INTRODUCTION

An important percent of wines sold around the world are fake (Loubry, 2015, Stoica 2015), and may presenting business risk for companies and to consumer health. The authenticity of wine is a basic element in its certification both nationally and internationally. Basing on the fact that the term 'origin' is of considerable importance directly correlated with the quality of wines, ranking them in terms of geographical origin and variety became an issue of significant interest to the producers and consumers (Banu et al, 2013). The chemical composition of wine is affected by multiple factors, including production area, grape variety, soil type, climate (terroir) and viticole and oenological practices (Muntean et al., 2018). Moreover, these products must be offered to consumers in a state of perfect clarity and lasting stability over time (Băducă Cîmpeanu et al, 2007).

These factors play an important role in differentiating the wines according to their geographical origin and year of harvest (Cichi et al., 2009, Schlesier K et al., 2009).

MATERIAL AND METHODS

For this study had the following objectives:

1. Analysis of the main quality parameters attesting the naturalness of some red wines from the Oltenia Profunda - CALOIAN range and LA CETATE range

2. Analysis of the main indicators of quality and authenticity of some red wines from Oltenia Profunda range CALOIAN and LA CETATE range.

For this study we have analyzed the following red wines from Cabernet Sauvignon, Merlot and Feteasca neagra. The first two wines are obtained from grape varieties of French origin and the last Romanian.

All the wines analyzed are obtained in the wine-growing center Oprişor, wine production 2016 and 2017.

To calculate ratios alcohol - glycerol extract - ash, alcohol - extract, Halphen, Gautier and the main parameters that define the flavor of wines were determined in the laboratory of oenology at the Faculty of Horticulture alcoholic contents in wines, glycerol contents, ash and dry extract using OIV methods (Muntean et al., 2001). With these data were calculated ratios weight dosed alcohol and extract relationships, the relationship between the weight of non-reducing dry extract and ashes.

For determining the ratio extract - ash extract is considered 100 % and ash is as a percentage of extract. Between extract reduced and there is no linear relationship ash.

For determining the R_R ratio alcohol – extract,, alcohol degree is multiplied by 10 to obtain the alcohol by volume. The amount of alcohol by volume are then multiplied by 0.79 (the molecular weight) to obtain the alcohol by weight. The limits of variation of R_R ratio is 4.3 to 5.5 for white wines and 3.6 to 4.5 for red wines.

The Halphen ratio is Total acidity (g / L) / Alcohol (% vol.) Values of this report are between 0.2-0.8 for natural wines.

Gautier index representing the amount of alcohol % vol. total acidity g / L presents legal limits range from 13-17 (Banu et al, 2013).

*These ratiosand quality indicators are taken into particular consider in determining the degree of naturalness of wine products and compositional balance (*Stoica*, 2015).*

RESULTS AND DISCUSSIONS

The results on the main parameters of the CALOIAN range are shown in Table 1. and 2.

Table 1

The main quality parameters of Oprişor wines from the CALOIAN range 2016

Wine sample	Alcohol % vol.	Total acid., g/L H_2SO_4	Volat Acid.g/L	Free SO_2 mg/L	Tot. SO_2 mg/L	Non-reduc.extract g/L	Extr. total, g/L	Reduc. sugar, g/L	Ash, g/L
Cabernet Sauvignon	13.0	5.2	0.54	45.0	110.0	27.0	30.85	3.85	2.50
Feteasc㠠neagră	13.5	4.95	0.59	45.1	98.2	24.0	27.8	3.8	2.59
Merlot	13.0	5.1	0.52	44.1	85.3	25.1	28.4	3.4	2.53

Alcohol content in all Caloian wines in the year 2016 exceeds 13 % vol., and in the wine year 2017, there are two wines, Cabernet Sauvignon and Feteasca Neagra, reaching and exceeding 14 % vol.

Total acidity is between 4.95-5.6 g/L H_2SO_4 in 2016 and 4.9 and 6.1 g/L H_2SO_4 in 2017. The parameter attesting to the state of health of wines, volatile acidity in no year and any wine analyzed does not reach the threshold of 0.9 g/L, ranging between 0.48-0.59 gLl in 2016 and 0,51 - 0,56 in 2017.

It can be appreciated that during this period the accumulations of sugars were remarkable in the conditions of a very good total acidity.

Obtained under equal biotechnological conditions, the nature of the variety and the basic composition of the grapes at the time of harvest imprint their differentiated contents in non-reducing extract and ash.

With an extraction of less than 25 g/L, only Feteasca neagra wine was presented in 2016, which is relatively good in relation to the sustained yields of this variety. For wines of other varieties, extractivity exceeded 27 g/L, reaching exceptional levels for Cabernet Sauvignon wines (27.0 g/L in 2016). In contrast, in 2017, Feteasca neagra

variety has a total dry extract of 28.69 g/L), Merlot 28.8 g/L and Cabernet Sauvignon of 28.0 g/L at low residual sugar contents around of 3 g/L.

Table 2

The main quality parameters of Oprişor wines from the CALOIAN range 2017

Wine sample	Alcohol % vol.	Total acid., g/L H_2SO_4	Volat Acid.g/L	Free SO_2 mg/L	Tot. SO_2 mg/L	Non-reduc.extract g/L	Extr. total, g/L	Reduc. sugar, g/L	Ash, g/L
Cabernet Sauvignon	14.0	5.3	0.51	44.1	70.0	25.0	28.0	3.0	2.53
Fetească neagră	14.5	4.9	0.52	45.2	75.5	25.0	28.69	3.69	2.62
Merlot	13.5	5.4	0.56	42.5	73.8	25.1	28.8	3.7	2.56

Ash in contents between 2.53 g/L (Cabernet Sauvignon) and 2.56 - 2.62 g/L (Feteasca neagra and Merlot respectively) signifies an important richness of wines in mineral substances of considerable importance hygienic food.

Table 3

Quality indices of wine Oprişor – CALOIAN, 2016-2017

Wine sample	S.Gautier	R.Halphen	R. Ross	R. Blarez	Ash/Extract x100
2016					
Cabernet Sauvignon	17.66	0.41	3.80	2.91	9.25
Fetească neagră	17.86	0.37	4.44	3.09	10.79
Merlot	17.58	0.40	4.09	2.83	10.07
2017					
Cabernet Sauvignon	18.79	0.37	4.42	2.92	10.12
Fetească neagră	18.88	0.33	5.8	3.31	10.48
Merlot	18.34	0.40	5.37	2.78	10.19

Natural character and high quality of red wines 2016-2017 CALOIAN emerges from indicatorilr values of quality and value ash×100/extract non-reducing.

The values of this report reach and even exceed the ideal threshold (10 %) in 7 of the 8 wines, with the highest levels being recorded by the products obtained from the grape varieties Fetească neagră and Merlot (10.48 and 10.19, respectively).

The sum of Gauthier (% vol. + Total acidity g/L H_2SO_4) in the wines analyzed ranges from 17.58 to 18.88. It is estimated that the value of this index is 17-18 when the wines have a high alcoholic strength, which corresponds to a minimal acidity. If the value of the Gautier index is less than 13 there is suspicion that the wines were diluted with water.

Halphen ratio, the ratio between total acidity and alcohol for wines analyzed ranges between 0.37 and 0.42 in 2016 and 0.33-0.46 in 2017. This index has significant values depending on the geographical area and the alcoholic strength of the wine.

The Ross ratio, alcohol / extract ratio has values between 3.80 and 5.37 in 2016 and 4.42 and 6.04 in 2017, being over the minimum limit and below the maximum limit set for this index. The content of the extract increases with the increase in alcoholic strength. The alcohol / extract ratio varies within narrow limits, with different sizes for white and red wines.

The average R ratio, within an alcoholic strength range of 8.5 to 15 % vol, is 3.6-6.5 for red wines. Exceeding this value indicates the addition of alcohol.

The results of the analysis of LA CETATE wines from the years 2016 and 2017 are listed in Table 4. and 5.

Table 4

The main quality parameters of Oprişor wines from the LA CETATE range 2016

Wine sample	Alcohol % vol.	Total acid., g/L H_2SO_4	Volat Acid. g/L	Free SO_2 mg/L	Tot. SO_2 mg/L	Non-reduc.extract g/L	Extr. total, g/L	Reduc. sugar, g/L	Ash, g/L
Cabernet Sauvignon	14.0	5.55	0.59	44.5	126.0	27.1	30.7	3.7	2.52
Fetească neagră	13.6	5.49	0.66	40.1	72.0	25.0	29.0	4.0	2.40
Merlot	14.1	5.2	0.64	43.5	80.2	27.1	30.8	3.7	2.54

Table 5

The main quality parameters of Oprişor wines from the LA CETATE range 2017

Wine sample	Alcohol % vol.	Total acid., g/L H_2SO_4	Volat Acid. g/L	Free SO_2 mg/L	Tot. SO_2 mg/L	Non-reduc.extract g/L	Extr. total, g/L	Reduc. sugar, g/L	Ash, g/L
Cabernet Sauvignon	13.5	5.5	0.55	45.2	111.2	26,0	29.75	3.75	2.54
Fetească neagră	14.5	5.2	0.49	43.0	90.5	26.0	29.9	3.9	2.60
Merlot	13.9	5.35	0.55	44.4	120.2	24.0	27.87	3.87	2.58

Alcohol content, in both years, is in line with the levels set for this feature for high quality home designation types. The proportion of alcohol in the other 6 wines ranges between 13.5 % vol. (Cabernet Sauvignon 2017) and 14.5 % vol. (Fetaesca neagra 2017) fully confirms what has been said. For the year 2016, the alcohol content was between 13.6 % vol. Fetească neagră and 14.1 % vol. La Merlot. Alcohol content, in fact, justifies those very important carbohydrates accumulated in 2017, even in the first decades of September when technology maturity occurred.

Total acidity contents of 5.20 g/L (in H_2SO_4) to Merlot and 5.55 g/L (in H_2SO_4) to Cabernet Sauvignon accompany the proportions in the alcohol. In 2017 total acidity values ranged from 5.2 g/L to Fetească neagră and 5.55 g/L. Cabernet Sauvignon. On the whole assortment, this feature does not pose any corrective problems. The situation is generally satisfactory, considering that in 2016 and 2017, grapes maturing occurred in excessive heat and lack of precipitation, conditions that, as is well known, greatly enhance the respiration of organic acids.

Volatile acidity, with contents not exceeding 0.55 g/L (in H_2SO_4) in 2017, is entirely appropriate given the technological conditions in which red wines are generally obtained. The extract of more than 25 g/L in 5 of the wines is able to give the attributes wines to be in the high quality categories. A lower extract is recorded for Merlot wine in 2017. Ash, containing between 2.54 g/L (Cabernet Sauvignon) and 2.60 g/L (Fetească neagră), keeping the specific proportions, follows the contents in a non-reducing extract.

Table 6

Quality indices of wine Oprişor – LA CETATE, 2016-2017

Wine sample	S.Gautier	R.Halphen	R. Ross	R. Blarez	Ash/Extract x100
2016					
Cabernet Sauvignon	18.96	0.39	4,08	2.82	9.29
Fetească neagră	18.43	0.40	5,44	2.81	9.6
Merlot	18,66	0.37	5,20	3.09	9.37
2017					
Cabernet Sauvignon	17.95	0.40	4,10	2.72	9.76
Fetească neagră	19.21	0.35	4,40	3.07	10.0
Merlot	18.7	0.38	4,57	2.89	10.75

The nature and authenticity of red wines in the LA CETATE range is highlighted by their quality index values.

Values Halphen ratio is within the quality limits for red wines, 0.65-0.40.

The ROSS report is based on the fact that the alcohol / extract ratio is even lower as the alcoholic strength of the wine is weaker. This is obtained by dividing the sum of alcohol + fixed acidity to the alcohol / extract ratio. For red wines, the value of this ratio is usually equal to or higher than 3.2, even for poor natural wines. It does not fall below 3 in the most exceptional cases. In the case of red wines from the LA CETATE range analyzed, it is noted that the values of this ratio are well above the 3.2 value, standing at 4.08 for Cabernet Sauvignon and 5.08 for Merlot in 2016.

The Blazer ratio between the alcoholic strength of a wine and its fixed acidity is represented by a maximum number, depending on the alcoholic strength but which varies with the origin of the wine. For the application of these rules, the origin of the wine under examination must be known.

The natural and high quality of red wines in the LA CETATE 2016-2017 range is derived from the ash / extract ratio which, with one exception (Cabernet Sauvignon 2016), reaches or even exceeds 10 % which is considered optimal (Fetească neagră 2017 - 10 % and Merlot 2017 - 10.75 %.

CONCLUSIONS

Oprişor vineyard has a high degree of favorability for vine cultivation and wine production, in line with the claims of domestic and foreign consumers.

Red wines, in all years, with regard to the main characteristics of the composition, the attributes fixed for top quality wines with a designation of origin: alcohol content between 13,0 % vol. and 14.5 % vol.,acidity contents between 4,90 g/L and 5,50 g/L (in H_2SO_4); non-reducing extract contents with variable values ranging from 24,0 g/L to 27,0 g/L; ash proportions ranging from 2.40 g/L to 2.62 g/L,are arguments in support of the above.

The physico-chemical components of red wines are accompanied by chromatic features similar to those obtained in the most famous vineyards in the country and abroad.

In the structure of the red wine assortment, the native variety Fetească neagra, a variety with sustained and high quality production, can hold the weight. Besides these can be found the Merlot variety, which proved a special oenological potential for making fine wines, able to reach in relatively short periods of aging and aging qualitative - organoleptic levels of exceptional;

Also the Cabernet Sauvignon variety is desirable for getting "full", expressive and firmly defined wines.

It can be seen that the studied wines, obtained in the reputed Oprişor wine cellar from the long-lasting vineyard, Plaiurile Drîncei, are competitive both on the domestic and the foreign market, due to the special compositional and chromatic qualities and their naturalness and authenticity.

REFERENCES

Banu C., Bulancea M., Ianiţchi D., Bărăscu E., Stoica A (2013). Industria alimentară între adevăr şi fraudă, Editura ASAB, p. 359-392

Băducă Cîmpeanu C, (2007). A Survey of the Influence of Cultivar and Vineyard on Colour and Sensorial Characteristics of Some Romanian Red Wines. *Acta Horticulturae, nr. 754*, p. 463–468. ISSN 0567–7572. ISBN 978 90 6605 620 6.

Cichi Daniela Doloris, Costea D.C., Olteanu I., Camelia Popa, Giugea N., Maracineanu L.C., Cichi M., (2009). Adjustment of the viticultural assortment to the climatic restraints from several viticultural areas of Oltenia, Lucrari ştiinţifice USAMV Iasi seria Horticultură, anul LII*, vol. 52,* 701-706,

Loubry J-M. (2015).Traçabilité et protection contre la contrefaçon des vins. Panorama des solutions existantes et enjeux technologiques, *La Revue des Œnologues*, no. 157, 38-40

Muntean Camelia, Băducă C., Stoica Felicia, 2001 – Operaţii tehnologice şi metode de analiză şi control în industria vinicolă, Ed. Sitech, Craiova.

Muntean Camelia, Stoica Felicia, Băducă C., Cichi Daniela, (2018). Study of the anthocyanic potential of grapes varieties for red wines in Dranic wine center, Annals of U.S.A.M.V. Bucuresti, serie B, vol LXII, pag. 59-64

Schlesier K, Fauhl-Hassek C, Forina M, Cotea V, Kocsi E, Schoula R, van Jaarsveld F, Wittkowski R (2009) Characterisation and determination of the geographical origin of wines. Part I: overview. *Eur Food Res Technol*, 230:1–13.

Stoica Felicia**,** (2015) The main parameters and indicators that define the quality and authenticity of white wines from vineyard Drăgăşani - Romania, Carpathian Journal of Food Science and Technology, *Vol. 7, No 4*,139-144

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

RESEARCH REGARDING PATHOGEN CONTROL ON TOMATOES IN THE FIELD

Sovarel Gabriela, Costache Marcel

Research Development Institute for Vegetable and Flower Growing Vidra
** Correspondence author. E-mail*: gabriela_sovarel@yahoo.com

Keywords*: tomato, pathogen control, field*

ABSTRACT

The main objective of this experience was to develop a program of treatments for the control of tomato pests in the field. The experience was organized at RDIVFG Vidra on field conditions, in 5 variants, with 4 replicates, placed in randomized blocks. Depending on the favorability of climatic factors, there were applied 5 treatments (2 in May and 3 in June). The technological variants of control have been established according to the sequence of the occurrence of the pathogens. The best efficacy in the control of pathogens was 81.9 % for the following treatment (T) sequence: T1. Champ 77 WG 0.25 %, T2. Bravo 500 SC 0.2 %; T3. Copper Max 50 WP 0.25 %; T4. Ortiva Top 0.1 %; T5. Melody Compact 49 WG 0.2 % + Score 250 SC 0.05 %. The efficacy of treatments varied between 79.1 and 81.9 %.

INTRODUCTION

In Romania, the most important pathogens of tomato crops (Costache, 2007) are both soil borne pathogens as *Fusarium oxysporum* f.sp. *lycopersici* (Fusarium wilt) respectively *Verticillium dahliae* (verticillium wilt) and pathogens which attack the aerial part of the plants (leaves, stems, fruits) as *Alternaria porri* f.sp. *solani* (early blight), *Botrytis cinerea* (grey mold), *Fulvia fulva* (leaf mold), *Erysiphe* sp. (powdery mildew), *Phytophthora infestans* (late blight) etc. For the registration of tomato cultivars, disease resistance is evaluated against *Fusarium oxysporum* f. sp. *lycopersici* race 0 and 1 (FOL0 and FOL1), *Verticillium dahliae, Tomato mosaic virus* race 0 and *Meloydogine incognita* (Sigillo and Bravi, 2011). All *Alternaria* diseases are characterized by a short period of susceptibility in seedlings, a long period of resistance in young to intermediate -aged plant and increasing susceptibility in aging plant (Rotem, 1994). Sources of genetic resistance have been identified within tomato related wild species, in particular green-fruited *L. hirsutum* and red-fruited *L. pimpinellifolium* (Foolad, 2005). Resistant cultivars at *Botrytis cinerea* are not present (Heyens *et al.,* 2011) and the solutions are sanitation, cultural measures and chemical control. Varieties with major gene resistance to foliar fungal pathogens such as gray leaf spot and *Cladosporium* leaf mold (two genes usually used) are common, while a few varieties have resistance to some races of late blight (Scott, 2005).

MATERIAL AND METHODS

The experience for controlling tomato pathogens was organized at RDIVFG Vidra, in field conditions, in 5 variants, with 4 replicates, placed in randomized blocks. Tomato planting in the field was done on May 2, 2017, the density of 40000 plants / ha.

Depending on the favorability of climatic factors, there were applied 5 treatments (T): 2 in May (15 and 30) and 3 in June (9, 19 and 30).

The technological variants of the control were determined according to the sequence of the pathogens, as follows:

- variant I: T 1: Copper Max 50 WP 0.25 %, T 2: Cabrio Top 0.2 %; T 3: Champ 77 WG 0.25 %; T 4: Ortiva Top 0.1 %; T 5: Consento 450 SC 0.2 % + Score 250 SC 0.05 %;
- variant II: T 1: Champ 77 WG 0.25 %, T 2: Bravo 500 SC 0.2 %; T 3: Copper Max 50 WP 0.25 %; T 4: Ortiva Top 0.1 %; T 5: Melody Compact 49 WG 0.2 % + Score 250 SC 0.05 %;
- variant III: T 1: Copper Max 50 WP 0.25 %, T 2: Polyram DF 0.2 %; T 3: Champ 77 WG 0.25 %; T 4: Ortiva Top 0.1 %; T 5: Acrobat MZ 69 WG 0,2 % + Score 250 SC 0.05 %;
- variant IV: T 1: Champ 77 WG 0.25 %, T 2: Dithane M 45 WP 0.2 %; T 3: Copper Max 50 WP 0.25 %; T 4: Ortiva Top 0.1 %; T 5: Ridomil Gold MZ 68 WG 0.25 % + Score 250 SC 0.05 %;
- variant V: untreated check.

Tomato crops are frequently attacked by pathogens, *Xanthomonas vesicatoria* (bacterial spot on tomato), *Pseudomonas tomato* (bacterial speck), *Alternaria solani* (early blight), *Fulvia fulva* (leaf mold) and *Phytophthora infestans (late blight)*.

RESULTS AND DISCUSSIONS

On June were favorable conditions for the attack of pathogens *Pseudomonas tomato, Xanthomonas vesicatoria, Alternaria solani*, *Fulvia fulva* and *Phytophthora infestans* at early tomato field crops. In the first decade of June, the two bacteria were manifested: *Pseudomonas tomato* and *Xanthomonas vesicatoria*. Also, in the second decade of June appeared *Alternaria solani, Fulvia fulva* and *Phytophthora infestans*. The attack especially evolved towards the end of the first decade of July as a result of the fall of 84 l / mp at the beginning of this decade (Table 1).

The variants chosen for the treatments provided a good efficacy for the control of pathogens ranging between 79.6 % at variant I and 80.7 % for variants II and III. In the treated variants degree of attacks (DA %) was 1.8 - 2.2 % for *Pseudomonas tomato*, 1.7-2.0 % for *Xanthomonas vesicatoria*, 1.6 - 1.9 % for *Alternaria solani*, 2.0-2.4 % in *Fulvia fulva* and 2.7-3.3 % in *Phytophthora infestans* (Table 2).

The yield of early tomato crops varied between 22.9 t / ha in variant I and 24.1 t / ha in variant II. The untreated control the yield was 18.95 t / ha (Table 3).

Table 1

Influence of climatic factors on the occurrence and evolution of pathogen attack at early tomato crops

Pathogens and climatic factors	Degree of attack /month /decade							
	April	May			June			July
	III	I	II	III	I	II	III	I
Pseudomonas tomato	0	0	0	0.2	0.5	3.3	5.2	12.2
Xanthomonas vesicatoria	0	0	0	0	0.3	2.7	4.6	9.5
Alternaria solani	0	0	0	0	0	0.7	4.9	12.7
Fulvia fulva	0	0	0	0	0	0.2	2.8	8.4
Phytophthora infestans	0	0	0	0	0	0.7	5.8	13.7

Minimum temperature (ºC)	4.7	10.9	10.5	12.4	15.0	14.2	17.4	15.9
Average temperature (ºC)	10.8	14.7	15.3	16.5	20.1	19.4	24.1	21.9
Maximum temperature (ºC)	18.3	19.4	20.9	21.4	26.0	25.9	31.9	21.9
Minimum relative humidity (%)	53.6	60.2	53.7	57.0	47.5	47.6	33.7	46.0
Average relative humidity (%)	65.4	70.3	63.1	66.9	56.9	56.2	52.6	57.9
Maximum relative humidity (%)	83.4	85.2	76.3	76.6	77.8	68.3	71.3	74.7
Rain (mm)	6.3	43.6	19.9	7.5	20.0	22.5	1.0	84.0

Table 2

Efficacy of some variants of fungicide treatments at early tomato crops

Variant	Degree of attack (%) on leaves						
	Pseudomonas tomato	*Xanthomonas vesicatoria*	*Alternaria solani*	*Fulvia fulva*	*Phytophthora infestans*	Total	Efficacy (%)
I.	2.2	2.0	1.8	2.3	3.2	11.5	79.6
II.	1.8	1.7	1.6	2.4	2.7	10.2	81.9
III.	2.0	1.9	1.9	2.1	3.0	10.9	80.7
IV.	2.1	1.8	1.7	2.0	3.3	10.9	80.7
V.	12.2	9.5	12.7	8.4	13.7	56.5	-

Table 3

The influence of treatment variants on early tomato yield

Variant	yield		
	kg/m^2	t/ha	%
I.	2.295	22.950	121.1
II.	2.410	24.100	127.2
III.	2.330	23.300	122.9
IV.	2.310	23.100	121.9
V.	1.895	18.950	100.0

CONCLUSIONS

Any of the treatment options (efficacy ranging from 79.6 % to 81.9 %) can be used in the field of early field tomatoes:

- variant II: T 1: Champ 77 WG 0.25 %, T 2: Bravo 500 SC 0.2 %; T 3: Copper Max 50 WP 0.25 %; T 4: Ortiva Top 0.1 %; T 5: Melody Compact 49 WG 0.2 % + Score 250 SC 0.05 %;
- variant III: T 1: Copper Max 50 WP 0.25 %, T 2: Polyram DF 0.2 %; T 3: Champ 77 WG 0.25 %; T 4: Ortiva Top 0.1 %; T 5: Acrobat MZ 69 WG 0.2 % + Score 250 SC 0.05 %;
- variant IV: T 1: Champ 77 WG 0.25 %, T 2: Dithane M 45 WP 0.2 %; T 3: Copper Max 50 WP 0.25 %; T 4: Ortiva Top 0.1 %; T 5: Ridomil Gold MZ 68 WG 0.25 % + Score 250 SC 0.05 %;
- variant I: T 1: Copper Max 50 WP 0.25 %, T 2: Cabrio Top 0.2 %; T 3: Champ 77 WG 0.25 %; T 4: Ortiva Top 0.1 %; T 5: Consento 450 SC 0.2 % + Score 250 SC 0.05 %;

ACKNOWLEDGMENT

This work was made with the support of the Ministry of Agriculture and Rural Development-Romania, through the Agriculture and Rural Development Programme ADER 2015-2018.

REFERENCES

Costache M, Roman T, Costache C (2007). Diseases and pests of vegetable crops, Editura Agris, Bucuresti. 47-55.

Foolad MR, Sharma A , Ashrafi H, Lin G (2005). Genetics of early blight resistance in tomato. ISHS Acta Horticulturae 914: 397 – 406.

Heyens K, Aerts R, Seels B, Vogels L, Bruno PA (2011). Biological control of *Botrytis cinerea* in tomato. ISHS Acta Horticulturae 914: 361-363.

Rotem J.(1994). The genus *Alternaria*. Biology, epidemiology and pathogenicity. APS Press. 201.

Scott JW (2005). Perspectives on tomato disease resistance breeding: past, present and future. ISHS Acta Horticulturae 695: 217-224.

Sigillo, L, Bravi R (2011). Resistance tests to diseases of tomato cultivars for listing in the common catalogue. ISHS Acta Horticulturae 914: 449-453

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

TRENDS IN THE EVOLUTION OF CRYPTOGAMIC DISEASES IN VINEYARDS IN THE BUJORU VINEYARD ECOSYSTEM, IN THE CONTEXT OF CURRENT CLIMATE CHANGE

Tabaranu Gabriel[1], Viorica Enache[1], Alina Donici[1]

[*] Statiunea de Cercetare-Dezvoltare pentru Viticultura si Vinificatie Bujoru, judetul Galati, România
** Correspondence author. E-mail*: gabitabaranu@yahoo.com

Keywords*: grapevine, pathogens, vineyard.*

ABSTRACT

This paper presents the The researches took place at the Bujoru Vine-Growing Research and Development Stage in 1992-2016 and targeted the spread of the main pathogens and pests in the vineyard plantations, an ecological phenomenon that is influenced by ecological zonal factors and ecological plasticity, each species occurs in nature on a given territory occupying a determined area. After analyzing the dynamics of the vineyard health status of the Bujoru viticulture ecosystem in the last 25 years, it is observed that the occurrence and evolution of the main pathogens were influenced by the climatic conditions area. In the vineyard plantations of the Bujoru vineyard, harmful fauna is relatively varied and numerous, but only a few pathogens (manna, mildew, gray rot) produce year-on-year significant economic damage. Pathogens were monitored by notaries observations and scores to determine the frequency (F), intensity (I) and attack rate (G.A %).

INTRODUCTION

The wine-growing plants in Moldova are increasingly affected by the climate changes that have taken place over the last decades. Changing environmental conditions causes changes in metabolism, growth and development processes, with positive or negative influences on plant quality and vitality.

Research supports the development of the capacity to assess and mitigate the impacts of climate change and other stress factors on the state of viticulture ecosystems and is based on a series of data over a 25-year period so that the tendency / periodicity of the elements climatic and natural resources and their influence on the behavior of the vine. In vine cultivation technology, pathogen control is one of the key technological links for obtaining high grape yields and high quality wine.

The emergence and evolution of the main pathogens of vineyards in the Dealu Bujorului vineyard is influenced by the direct and indirect effects of the technological and ecological zonal factors that affect the quality and quantity of the grapes (Mirica I. et Mirica Afrodita, 1976; Teodorescu Georgeta et al., 2003; Ulea E., 2003; Simion Cristina, 2003; Tabaranu G. et al. 2005).

MATERIAL AND METHODS

The researches took place at the Bujoru Vine-Growing Research and Development Station between 1992 and 2016 and aimed at the emergence and spread of the main pathogens of vines. The vineyards are located on land with a slope of 0-25 %, the lands with slopes above 15 % are equipped with anti-erosion through terraces, the exhibition of the eastern land; altitude about 36 -133 m; orientation of the lines from north to south; planting distance 2.1 m x 1.2 m; Berlandieri x Riparia selection Telecky Openheim SO4-4. To assess the aggressiveness of the main pathogens of the grapevine (manna, oidium, gray rot), the values of intensity (I), frequency (F) and degree of attack (GA %) of the vineyards in representative varieties in the vineyard (Fetească albă, Aligoté, Merlot and Chasselas d'ore).

RESULTS AND DISCUSSIONS

Knowing the dynamics, spread and development of the main pathogens and pests and the way they evolved according to the ecological conditions specific to the Dealu Bujorului vineyard are of particular importance as it is the basis for establishing the prognosis and warning of the occurrence of pathogens and the appropriate system of counter. For the analysis of the climatic factors were used the data recorded at the weather station and AgroExpert system of SCDVV Bujoru (average air temperature, rainfall) Table 1 and 2. In the vineyard culture are first of all interested in the climatic factors values from April 1 - September 30, which overlap most of the times with the length of the vegetation period. From the analysis of the climatic elements it is observed that during the analyzed period the average air temperature recorded values between 18.1 °C in the years 1997, 2014 and 21.6 °C in 2007 (Table 1).

Table 1

Temperature (°C) average air during 1992-2016

The year/ month	Vegetation period						Mediate
	VI	V	VI	VII	VIII	IX	
1992	11.8	16.7	21.0	23.1	26.5	17.1	19.3
1993	10.4	18.6	22.1	23.0	23.3	17.7	19.1
1994	13.7	19.5	22.2	25.2	24.0	21.8	21.0
1995	12.5	16.8	22.9	25.9	23.1	17.0	19.7
1996	10.9	21.0	23.6	24.2	22.1	14.3	19.3
1997	8.3	19.7	22.2	22.9	21.0	14.9	18.1
1998	15.0	17.4	23.2	24.6	23.3	17.1	20.1
1999	12.9	17.0	23.8	25.3	22.9	18.5	20.0
2000	14.5	19.1	22.5	25.1	24.7	16.5	20.4
2001	12.5	18.1	20.5	27.0	25.6	18.2	20.3
2002	11.4	19.9	23.3	26.3	23.1	17.7	20.2
2003	10.5	22.3	24.5	29.0	25.2	16.8	21.3
2004	12.6	17.5	22.2	23.9	22.8	17.9	19.4
2005	11.7	18.2	20.8	24.3	23.3	19.1	19.5
2006	12.3	17.5	22.3	24.2	23.5	18.1	19.6
2007	12.1	21.2	25.5	28.1	25.4	17.4	21.6
2008	13.0	17.9	23.1	24.0	25.8	15.6	19.9
2009	11.1	16.5	21.0	23.8	21.9	17.1	18.5
2010	10.8	16.8	20.4	22.8	24.0	16.1	18.4
2011	9.5	16.1	20.1	24.2	23.3	18.5	18.6
2012	12.9	17.9	20.1	28.0	26.4	20.7	21.0
2013	12.7	18.5	20.9	21.5	22.2	15.0	18.4
2014	11.0	15.6	20.7	22.1	22.3	17.0	18.1
2015	10.4	17.0	20.3	23.7	23.0	19.0	18.9
2016	13.0	15.3	21.3	22.9	22.3	17.6	18.7

Table 2

Precipitation (mm) during period 1992-2016

The year/ month	Vegetation period						Total
	IV	V	VI	VII	VIII	IX	
1992	22.3	40.4	107.7	45.0	23.2	55.1	293.7
1993	52.1	52.0	72.5	29.6	29.2	38.3	273.7
1994	27,6	9.3	49.5	61.7	44.3	1.8	166.6
1995	10,7	65.5	45.0	44.1	24.5	82.7	261.8
1996	67,4	14.2	29.1	27.1	111.2	113.1	294.7
1997	63.7	29.9	92.9	145.0	109.7	25.1	466.3
1998	16.2	48.1	25.4	36.5	85.0	29.4	240.6
1999	43.0	29.0	93.4	37.0	72.3	30.2	304.9
2000	33.4	16.7	18.1	48.7	15.7	56.6	189.2
2001	45.8	29.8	105.5	10.0	0.8	84.2	276.1
2002	43.7	4.2	48.4	98.7	122.0	10.4	327.4
2003	18.3	28.3	47.5	13.6	13.2	47.8	168.7
2004	43.6	41.1	29.1	84.5	44.3	59.5	302.1
2005	18.4	59.2	74.8	98.6	50.8	14.5	316.3
2006	54.2	40.0	77.7	31.8	92.1	34.4	330.2
2007	14.9	31.3	96.4	1.0	57.3	36.5	237.4
2008	37.7	60.6	38.5	55.5	9.8	49.8	251.9
2009	12.8	28.4	86.8	30.9	13.8	56.0	228.7
2010	26.6	103.2	127.6	101.8	40.2	20.2	419.6
2011	53.6	32.2	45.2	93.4	28.0	5.2	257.6
2012	18.6	115.8	13.8	27.1	23.1	24.6	223.0
2013	32.0	89.6	90.6	18.6	81.6	203.6	516.0
2014	72.4	4.1	38.5	84.6	55.0	3.4	258.0
2015	32.0	13.8	53.0	23.0	74.4	22.4	218.6
2016	66.2	63.4	74.4	12.4	38.0	65.0	319.4

The results obtained from the investigations carried out during the period (1992-2016) on the varieties (Feteasca alba, Aligote, Merlot, Chasselas dore) on the appearance and dynamics of the main pathogens of vines (manna, flour and grain rot) the fact that these were influenced by the level of climatic factors existing in the viticultural ecosystem and by the applied crop technology, reflected in the attack (GA %) score on both leaves and grapes.Thus, in order to assess the aggressiveness of the main pathogens of the vine, during the studied period, the values of the degree of attack (G.A %) of the grape varieties for each variety were calculated.

Regarding the pathogen which produces the vine hand, Plasmopara viticola, it can be appreciated that its appearance and evolution was influenced by the values of the fungal-friendly climatic factors (temperature, frequent and abundant rainfall, high atmospheric humidity, persistence of water on the leaves) . From the 25 years of study, the fungus had very favorable conditions for occurrence and evolution in 1992, 1993, 1993, 2004, and 2014, when high levels of leaf attack and clusters. The highest values of G.A % on leaves and grapes were recorded in 1994, 1999, 2010 and 2016 for all varieties analyzed (Table 3).

Table 3

Vine dynamics dynamics (Plasmopara viticola - Bert. Et Curt.) Between 1992 and 2016

Variety, the year	Fetească albă		Aligoté		Merlot		Chasselas d'ore	
	leaf	grapes	leaf	grapes	leaf	grapes	leaf	grapes
	G.A %	G.A %	G.A %	G.A %	G.A %	G.A %	G.A %	G.A %
1992	0.27	0.37	1.07	0.27	0.09	0.48	1.12	0.21
1993	1.46	1.22	1.85	0.21	1.37	1.36	1.84	0.66
1994	1.27	8.91	0.31	8.28	0.84	1.60	8.32	8.4
1995	0.37	0.51	0.24	0.58	0.63	0.41	0.63	1.19
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	16.58	9.51	2.67	3.76	8.77	10.42	26.70	9.50
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.01	0.05	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.17	0.15	0.0	0.0
2003	0.19	0.07	0.0	0.0	0.19	3.99	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.01	0.01	0.0	0.0
2005	0.11	0.57	0.07	0.70	0.91	29.85	0.0	0.0
2006	0.33	0.08	0.28	0.54	0.51	7.40	0.48	0.48
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.40	0.12	0.10	0,60	6.99	0.25	0.34	0.78
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	14.43	4.15	7.47	1.96	3.33	1.40	9.67	2.71
2011	0.06	0.03	0.65	0.18	0.24	0.15	0.0	0.0
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2013	0.20	0.0	0.0	0.0	0.21	0.96	0.0	0.0
2014	2.96	0.96	0.0	0.0	2.76	1.15	0.0	0.0
2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2016	4.22	17.44	0.18	0.06	0.33	3.57	5.62	5.47

The dynamics and virulence of the pathogen that produces the flour, Uncinula necator, was influenced by the climatic factors (the increase of the air temperature during the vegetation period, the lack of precipitation in August), which favored its development. Thus, in 1993, 1994, 1995, 1999, 2002, 2005, 2011, 2015 and 2016, the pathogen recorded the highest levels of attack on both leaves and grapes (Table 4).

Table 4

The dynamics of grape must (Uncinula necator - Schw. Burr.) in 1992 - 2016

Variety, the year	Fetească albă		Aligoté		Merlot		Chasselas d'ore	
	leaf	grapes	leaf	grapes	leaf	grapes	leaf	grapes
	G.A %	G.A %	G.A %	G.A %	G.A %	G.A %	G.A %	G.A %
1992	0.22	0.12	0.62	0.46	0.33	0.41	0.89	1.59
1993	1.32	1.54	3.64	0.77	1.57	1.25	3.06	1.08
1994	0.45	8.99	1.08	8.63	0.79	0.86	0.96	1.08
1995	1.91	3.7	0.24	0.79	1.56	1.38	1.22	2.39
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	8.25	0.0	0.0	4.92	3.24	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.20	0.21	0.0	0.0
2003	0,15	0.02	0.0	0.0	0.05	0.07	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.15	0.01	0.0	0.0
2005	0.04	0.07	0.50	0.0	1.68	0.00	0.0	0.0
2006	0.53	0.09	0.89	0.0	0.12	0.02	0.24	0.15
2007	0.56	0.55	0.38	0.0	0.35	0.00	0.38	0.0
2008	1.06	0.75	0.27	0.07	0.21	0.09	0.35	0.35
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.12	0.09	0.06	0.0	0.18	0.03	0.0	0.0
2011	2.64	1.85	0.06	0.06	0.42	0.24	0.0	0.0
2012	0.05	0.0	0.0	0.0	0.13	0.0	0.0	0.0
2013	0.36	0.09	0.0	0.0	0.27	0.10	0.0	0.0
2014	0.23	0.11	0.0	0.0	0.20	0.09	0.0	0.0
2015	0.19	0.15	0.12	0.35	0.70	1.21	0.12	1.29
2016	4.73	0.56	1.78	0.91	0.46	5.67	0.39	0.15

Following the appearance and evolution of the gray rot of botrytis (Botritys sp) during the period 1992-2016, it is observed that the dynamics of the fungus evolution was influenced by favorable conditions of attack (precipitation, high atmospheric humidity, attack of the grape moth at G-III). Of the 25 years analyzed, in just 5 years the gray rot of grapes caused considerable damage (1994, 1996, 2005, 2006 and 2007). Thus, in 1996 the Merlot variety was 48.76 % and the Aligote variety of 58.27 %. In 2006 the gray rot registered an attack rate of 10.90 % for the Merlot variety and 27.45 % for the Aligoté variety (Table 5).

Tabel 5

Dynamics vine gray mold (Botrytis cinerea - Pers.) during 1992-2016

Variety, the year	Fetească albă	Aligoté	Merlot	Chasselas d'ore
	grapes	grapes	grapes	grapes
	G.A %	G.A %	G.A %	G.A %
1992	0.0	0.48	0.07	0.15
1993	0.70	0.41	0.34	1.24
1994	8.99	1.94	2.39	1.60
1995	0.15	1.78	0.96	0.31
1996	45.72	58.27	48.76	37.82
1997	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.06	0.0
2000	0.0	0.0	0.0	0.0
2001	0.89	1.67	0.52	0.37
2002	0.0	0.0	0.15	0.0
2003	0.10	5.33	4.33	0.02
2004	0.0	0,0	0.14	0.0
2005	3.12	7.51	0.33	6.94
2006	0.0	27.45	10.90	0.0
2007	2.80	3.64	0.0	0.0
2008	0.06	0.18	0.0	0.07
2009	0.0	0.12	0.0	0.09
2010	1.07	4.58	0.0	0.54
2011	0.24	0.10	0.0	0.0
2012	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0

2014	0.20	0.0	0.60	0.0
2015	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0

CONCLUSIONS

- The vine has been damaged in 8 years (1993, 1994, 1999, 2004, 2005, 2010, 2014, 2015), and the highest levels of attack (GA %) on leaves and grapes were registered in 1994, 1999, 2010 and 2016 for all varieties analyzed.

- Grapevine production was virulent in 7 years (1993, 1994, 1999, 2002, 2004, 2015, 2016).

- The gray rot of grapes caused significant damage in 5 years (1994, 1996, 2005, 2006, 2007).

- In 1994 there was a virulent attack of cryptogamic diseases (manna, mildew and gray rot) with high levels of attack (GA %) on both leaves and grapes, being the most difficult year for calf culture vineyard

- From the analysis of climatic elements, it is highlighted that during the last 10 years during the June-July period favorable conditions for the appearance and development of vine manna, and in July-August for the mildew of the vine.

ACKNOWLEDGMENT

This work was carried out under the 3PS / 2017 Project: Research to support the development of the capacity to assess and mitigate the impact of climate change and other stressors on the state of forest ecosystems and wine-growing.

REFERENCES

Mirică I. şi Mirică Afrodita,1976 - Combaterea bolilor şi dăunătorilor la viţa de vie, Editura Ceres, p 25 - 55.

Teodorescu Georgeta, Roman T. şi Mirică Sumedrea Mihaela, 2003 - Entomologie Horticolă, Editura Ceres,Bucureşti p 330 - 343.

Ulea E., 2003 - Fitopatologie, Ed."Ion Ionescu de la Brad", Iaşi, p 205 - 229.

Simion Cristina, 2003 - Tehnologie ecologică de producere a strugurilor pentru obţinerea vinurilor roşii. Ed. Pax Aura Mundi, Galaţi, 27-30.

Tabaranu G., Simion Cristina, 2005 - Întrebări şi răspunsuri privind recunoaşterea şi combaterea dăunătorilor precum şi a celor mai frecvente boli în plantaţiile viticole din S-E Moldovei, Editura Pax Aura Mundi, Galaţi.

*** Ministerul Agriculturii şi Industriei Alimentare, 1980 - Metodici de prognoză şi avertizare a tratamentelor împotriva bolilor şi dăunătorilor plantelor de cultură, Bucureşti

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

FRUIT-TREES POTENTIAL IN SUBCARPATHIAN DEPRESSION AREFU-CORBENI, ARGES COUNTY

Denisa Elena Tudor[1]*, Doru Gabriel Bucur[2]

[1]Agency for Payments and Intervention in Agriculture Argeş
[2]Office for Pedological and Agrochemical Researches Argeş County
* *E-mail:* denisaelenatudor@yahoo.com

Keywords: *suitability, economic value, orchard, restrictions, soil*

ABSTRACT

Economic efficiency in the agricultural field, as expressed by the level of production, depends on a number of natural and anthropogenic factors. The work of evaluation and suitability focused on the quality of land in terms of productive efficiency for different established crops. In this paper we present agricultural land suitability in Arefu-Corbeni basin for the use of the orchard. At the same time highlight, the complex work of evaluation focuses on most suitable fruit trees species for the climatic conditions of the investigated area.

The results were obtained by analyzing the physic and chemical characteristics of the soil and geological substrate, specific lithology, relief, hydrographic elements, climate. For further study, of the plurality of soils characterized Arefu-Corbeni depression, a representative soil was selected and characterized morphological, physical and chemical.

INTRODUCTION

The Arefu-Corbeni Depression is developing in the Getic Subcarpathian area, between the northern peaks of the Frunţi and Ghiţu massifs in the Făgăraş Mountains and Subcarpathian foothills on south: Tămaşu and Chicera. It is crossed by the spectacular road of Transfăgărăsan (DN 7C), whose route crosses the gorge of Argeş and Făgăraş to Vidraru and glacial lake Bâlea.

This depression was first idenfied after large-scale research conducted by French geographer Emm. De Martonne (Tufescu, 1966), through a geological profile made in 1906 (Tufescu 1966, Ielenicz 2003). In literature, depression is known by many names: Arefu (Ielenicz 2003, Tufescu 1966), Arefu-Berindeşti (Tufescu 1966) or Arefu-Căpăţâneni (Pop 2006) or Căpăţânii-Arefu (Velcea & Savu 1982).

Growing fruit trees and shrubs is a very important economic sector for human society, if they have a life cycle of four years from strawberries, to 30-60 years for apple, pear and walnut (Mladin et al. 1996).

In the year 2011, orchards basin of Arefu and Corbeni totaled 353 hectares, of which 144 hectares were planted with apple species and 209 hectares of plum trees. Of these orchards, 11 % were present as young fruit orchards, 30 % and 59 % were recorded as fruit and in decline orchards.

Given the complicated conformation of subcarpathic relief and pronounced degree of fragmentation of land in studied area and as a result of the changes after 1990, the most cultivated fruit trees in the area were selected for study.

MATERIAL AND METHODS

Research of Arefu-Corbeni Subcarpathian basin took place during the years 2011-2017. Reaching assumed depth study of all environmental factors, opening on the field of soil profiles and analysis of samples taken from these in Soil and Agrochemical Studies Office Argeş laboratory, in conjunction with the information from the archive of this institution. Since the basin covers the territories of Arefu and Corbeni communes, to obtain data of this work was necessary to define the investigated perimeter by different topographic base and soil considerations, establishing specific soil types and measuring each soil unit.

Native soils are very special regarding zoning of the evolutionary process, morphological and chemical properties, and can not always be an optimal support for same vegetation cover. Therefore, proper management and efficient production requires a proper assessment of the potential of these soils for this agricultural area.

RESULTS AND DISCUSSIONS

Depression Arefu-Corbeni covers about 64 km^2 (which includes the southern corridor of the Argeş River - 6 km^2). Of this area, 70 % is occupied by farmland, 23 % by forest and 7 % by urban and unproductive areas.

All forms of relief in the region bears the mark of geological composition and movements in which they were trained (Bucur & Buşu 2000). Asymmetry of slopes is evident in that valley where they origins is in the frame of northern massive, results intensive erosion and deposition of materials. taken from the mountain and seated at the foot of hills (aprons accumulation), while on south, less inclined slopes are affected by the landslides of all kinds, large waves and mounds - in most cases *glimee* (Hianu 2000); slides are semi-stabilized and relics, but the risk of reactivation is present in many areas.

The climate is temperate - continental, the annual average temperature is 9 ^0C and the average annual precipitation of 730 mm.

With carpathian origin, Arges River is the main river of the area and pierce depression from north to the south.

On the Argeş valley and other affluents, ground-water tables is located between 1 and 4 meters deep, on terraces 4-10 meters and on the slopes and peaks are more confined to 10-30 meters. There are many areas with coastal springs, an important agent for triggering landslides. Springs are in many places captured and are the main sources of water supply to the villages.

For the hills that dominate the depression, it is representative nemoral forest (*Fagus sylvatica*) and oak (*Quercus petraea*).

Considered a raw, natural and sometimes with anthropogenic influences, soil is created by evolutionary cooperation of many factors: climate, hydrographic network, geomorphological processes, relief, slopes, substrate lythology, all in conjunction with wildlife and vegetation.

Assessments of field and laboratory tests revealed a range of sufficiently diversified soils.

In this context, the lowest depression areas represented by meadows, terraces with recent training, and aprons, they were formed soils with slowed progress, represented by fluvisols (12 % of agricultural land).

Upper third of slopes and long gentle hills from southwestern basin are dominated by districambosols (5 %)**.**

Regosol (15 %) are imposed on the erosion-surfaces, medium-strongly inclined slopes. Some important sections of the heights of secondary peaks are support for preluvisols (10 %). Due to the high clay content, preluvisols have a pronounced compaction and poor overall drainage.

On valleys, terraces, and in some areas of the narrow side have developed eutricambosoils (58 %). Such a sol has been chosen for illustration, of which the physical, chemical and morphological characteristics are described in the *Soil Profile*.

The valuation of the use as orchard land in the studied area was done according to existing methodologies (MESP 1987). Final suitability class was given by the most restrictive factor for land - considered homogeneous in terms of the climatic conditions.

The study showed that the pedoclimatic factors of depression Arefu-Corbeni printing reduced limitations (grade II) and moderate limitations (Class III) for 71 % of the total agricultural evaluated land (Figure 1), because of the low and medium unevenness of the land, the average gradient of the slopes, acidic or alkaline reaction and the presence of calcium carbonate.

The land with severe restrictions (class IV) and very severe restrictions (class V) represents 24 % of fruit growing surface. In general, restrictive factors that have contributed to include areas in these classes were graded by the marked inclination of the slopes, the unevenness of the land, the reaction (strongly acidic) in the soil profile, correlated with the presence of aluminum in small or medium quantities, and semi-active land-slides.

Non-recommended land to be cultivated with fruit species covers 5 % of the studied surface, the limitations are land-slides waves and the small active volume of soil on the bottoms of the valleys (Fluvisols).

***Location**:* Corbeni commune
Coordinates: N latitude 45^{0}19'15", E longitude 24^{0}39'38", absolute altitude 636 metre
Relief and microrelief: slope, southern exposure
Main slope: 10-15 % and 15-20 %

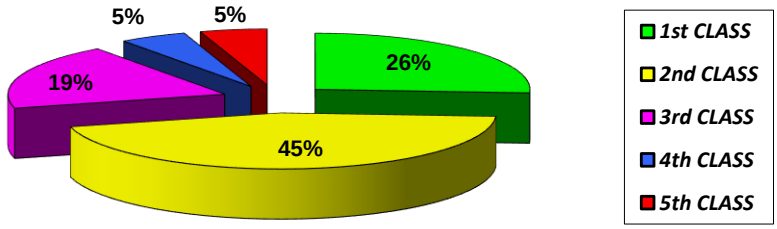


Figure 1. Classes of suitability for the orchard of the Subcarpathian depression Arefu-Corbeni

Soil Profile Record
Type: Typic Eutricambosol, loamy/ loamy

Surface: moderate inclined, weak unhomogenous
Bedrock: loams
Depth of underground/water: more than 10 metre
Land-use: apple tree and plum tree orchard

Morphological characterization

Layer Ao (0-24 cm): 10 YR 4/3, loamy, very frequently thin and medium roots, little poor developed polyhedral agregates, moist, weak densely, softly, graduate pass;
Layer AB (24-40 cm): 10 YR 4/4, loamy, rare thin and medium roots, moderate developed medium polyhedral agregates, damp, weak densely, softly, clear pass;
Layer Bv (40-68 cm): 10 YR 5/4, loamy, very rare medium roots, poor developed medium polyhedral agregates, damp, weak densely, softly, graduate pass;
Layer BC (68-83 cm): 10 YR 5/4 with 10 YR 4/6, loamy, very poor developed medium polyhedral agregates, damp, weak densely, softly, graduate pass;
Layer Cn (sub 83 cm): 10 YR 4/6, loamy, medium polyhedral aggregates, very poor developed, damp, moderate densely, softly.

Analytic data of the soil profile shows a weak acid reaction on the profile. The soil has a large organic matter reserve (189 tones/ hectare), but the humus content is medium in layer A and small-very small in the depth of the profile. Mobile phosphorus insurance is small-very small, and those in mobile potassium is moderate in the first 40 cm and low in depth. The soil is mesobasic/eubasic (saturation in bases). The textural fractions are uniform on the profile, the texture is medium. Hydrolytic acidity is medium in horizon A and small in depth. The sum of the bases is medium-high. The nitrogen index is medium in the surface horizon and small in depth.

Analytical data and physico-chemical properties of the soil profile

Layers	Ao	AB	Bv	BC	Cn
Depth of sampling; cm	5-15	28-38	50-60	70-80	90-100
Bulk sand (2,0-0,2 mm); %	21.0	8.9	11.6	10.4	12.4
Fine sand (0,2-0,02 mm); %	25.2	31.4	28.9	31.9	38.3
Dust I (0,02-0,01 mm); %	10.6	11.3	11.8	13.7	10.8
Dust II (0,01-0,002 mm); %	17.6	20.8	18.7	18.2	11.5
Clay (below 0,002 mm); %	25.6	27.6	29.0	25.8	27.0
Soil skeleton %	-	-	-	-	-
pH in Water	5.9	6.2	6.3	6.4	6.3
Carbonates; %	-	-	-	-	-
Organic matter; %	3.7	1.9	1.1	1.0	0.8
Nitrogen index (IN);	3.1	1.7	1.0	0.9	0.7
Mobile Phosphorus; ppm	12.0	9.0	8.0	5.0	5.0
Mobile Potassium; ppm	145.0	151.0	103.0	73.0	66.0
Change Bases (SB); me/100 g sol	26.4	25.3	24.8	24.6	25.3
Hydrolytic acidity (Ah); me/100g sol	5.0	3.8	3.3	2.8	2.6
Changeable Hydrogen ($SH_{8,3}$);	8.8	7.0	6.1	5.6	5.7
Cationic exchange capacity (T_{Sh});	35.2	32.3	30.9	30.2	31.0
Cationic exchange capacity (T_{Ah});	31.4	29.1	28.1	27.4	27.9
Saturation in bases (V_{Ah}); %	83.8	86.9	88.3	89.8	90.7
Saturation in bases (V_{Sh}); %	75.0	78.3	80.3	81.5	81.6
Mobile aluminum; me/100 g sol	-	-	-	-	-

The assessment was very important in order to establish the economic value of orchards in atudied area.

Whole studied area, by processing indicators that participated in obtaining evaluation notes and calculation notes (weighted average notes), showed that apple (38 points) and plum (36 points), pear (32 points), cherry- sour cherry (29 points) belongs to quality class IV for orchard.

Among the indicators that influenced orchard notes of evaluation are quoted: annual rainfall regime, texture of sandy-loam soil, low edaphic volume, high groundwater depth, stagnogleyzation and landslides.

In terms of soil taken as a case-study, it has a deep substrate, is formed on the slant slopes, weak patchy, with groundwater at more than 10 meters deep, slightly acid pH (5.9 to 6.4). These features include the soil in class II of suitability, restrictive factor being poor land unevenness. Other parameters that participated in determining of suitability for orchard does not affect classification.

The assessment, showed that areas, characterized by this type of soil, meets a score typical for class II of quality - apple (73 points), plum (72 points), pear (65 points), and class III - sweet or sour cherry plantations (58 points).

CONCLUSIONS

Factors with an important role in the inclusion of areas in a certain class of suitability for orchard (figure 2) have been reflected in the pronounced inclination degree of the slopes, the unevenness of the land, the reaction of the soil on the profile to a depth of 100 cm and in some cases by landslides.

Following the work of the evaluation of agricultural land, it results that apple tree and plum tree have obtained slightly higher notes than pear, cherry and sour cherry. In fact, orchards of apple and plum are the most common in the area.

For typical eutricambosoil looked after evaluation, weighted average mark was 67 points of evaluation, which will include it in Class II of quality for orchard. Following the evaluation in terms of suitability, areas characterized by this type of soil have little limitation regarding fruit production.

In view presented in this work and that at the end of year 2017, in Argeş County, yield of fruit production was relatively low because of the approx. 20513 hectares, more than 50 % are physiological depleted, so it should be applied ameliorative works designed to correct some deficiencies and to increase productivity.

These works will be carried out in accordance with European standards laid down in Directive 91/676/EEC for the protection of waters against pollution caused by nitrates from agricultural sources.

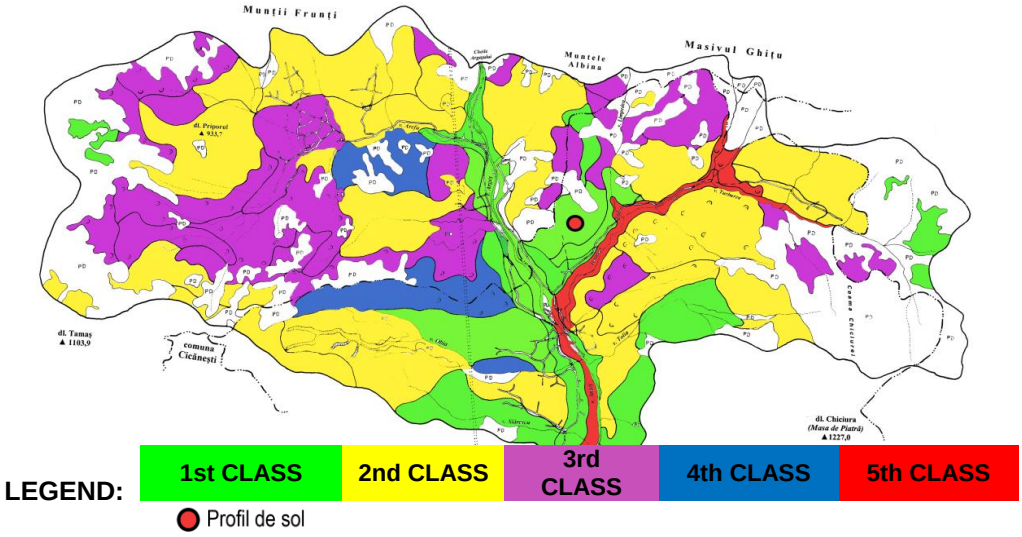


Figure 2. Agricultural land suitability for the orchard in Subcarpathian depression Arefu-Corbeni

REFERENCES

Bucur D., Buşu R., 2000, Studii şi cercetări asupra învelişului de soluri pe teritoriul cadastral Corbeni (studiu pedologic şi agrochimic) - Arhiva Oficiului de Studii Pedologice Şi Agrochimice Argeş.

Hianu C., 2000, Studii şi cercetări asupra învelişului de soluri pe teritoriul cadastral Arefu (studiu pedologic şi agrochimic) - Arhiva Oficiului de Studii Pedologice şi Agrochimice Argeş.

Ielenicz M., Pătru I. G., Ghinea M., 2003, Subcarpaţii României, Edit. Universitară, Bucureşti, pp. 2, 211.

Mladin Gh., Mladin P., Pârlea M., 1996, Cum cultivăm şi îngrijim plantele pomicole, Editura TIPOMUR, Tg. Mureş, pp. 1,19.

Pop P. G., 2006, Carpaţii şi Subcarpaţii României, ediţia a II-a revizuită şi adăugită, Edit. Presa Universitară Clujeană, Cluj-Napoca, pp. 99-100.

Tufescu V., 1966, Subcarpaţii şi depresiunile marginale ale Transilvaniei, Editura Ştiinţifică, Bucureşti, pp. 27, 170.

Velcea V., Savu A., 1982, Geografia Carpaţilor şi a Subcarpaţilor Româneşti, Edit. didactică şi pedagogică, Bucureşti, pp. 148.

*** Directiva Consiliului din data de 12 decembrie 1991 privind protecţia apelor împotriva poluării cu nitraţi proveniţi din surse agricole (91/676/CEE).

*** Metodologia de Elaborare a Studiilor Pedologice (MES.P), 1987, partea I, partea a II-a, partea a III-a, Institutul de Cercetări pentru Pedologie şi Agrochimie Bucureşti.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

ASPECTS OF INTERACTION BETWEEN FOLIAR FERTILISATION AND FRUITS THINNING ON APPLE TREES

Vamăşescu Sergiu[1*]

[1]State Agrarian University of Moldova
**Correspondance author E-mail*:vamasescus@gmail.com

Keywords*: Apple, chemical thinning, foliar fertilization, harvest*

ABSTRACT

The research was carried out between 2013 and 2016 in the apple orchard planted in 2003 with the Idared variety grafted on the M26 rootstock, with a planting distance of 4x2 m. The trees are guided by the shape of a thin crown. In the experience foliar fertilization with Urea 46 % N was performed in concentration from 0.4 % to 1.2 % depending on the period of fruit development and 3 methods of fruit reduction: chemical when the central fruit in the inflorescence is 10 - 12 mm with Bioprzerzedzacz 060 SL at a concentration of 0.075 %, manually and mixed. At the highest concentrations of Urea 46 % N, the Idared variety yielded the largest fruit harvest in 2016 reaching 49.1 t / ha.

INTRODUCTION

The fruit tree alternation is characterized by the presence of a large number of fruit in a year, followed by a low-yielding year. As a result, the large number of fruits inhibits antogen induction and differentiation of fruit buds, leading to low production the following year. In intensive orchards, the correct adjustment of the fruit load is an indispensable measure for obtaining constant and quality produce (V. Babuc, 2012, Gh. Cimpoieș, 2016). This desideratum can also be achieved by chemical and manual norming of the fruit load correlated with maintenance and fructification cutting, fertilization and irrigation (V. Balan, R. Şaganian, 2008).

Chemical normalization is the method to correct the fastest load of fruit and can be used in complex with phytosanitary treatments. As a result, chemical preparations can influence anthogenic induction, differentiation of fruit buds, fruit blooming and fruit binding, productivity level and fruit quality. At the same time, the problem of the chemical scission of apple was treated abundantly and the results obtained were diverse and contradictory, which demonstrates the complexity of this subject in relation to the requirements of plants in different phases of vegetation (I. Gonda, 2003; V. Balan, S. Vamaşescu, 2013, 2014).

MATERIALS AND METHODS

We have studied the interaction between foliar fertilization and fruiting, as the main determinants of the quantity and quality of apple fruit.

The study of the influence of fruit loading on growth norms and fruits in the apple orchard covered the period 2013-2016 in an experiment organized in an apple orchard in SA "Zubreşti" Straseni. I studied the Golden Delicious, Idared and Florina apple varieties grafted on the M 26 rootstock planted in 2003 at a distance of 4 m between the rows and

2 m between the trees in a row. Treatments were applied with 46 % urea N in a concentration of 0.4 % to 1.2 % by a single adjustable growth phase (Tab 1) when the temperature was 16-18^0 C. Each variant consisted of four rehearsals of three trees each, arranged through the randomized block system. Chemical harvesting was performed when the central fruit was 10-12 mm in diameter (Table 2) with Bioprzerzedzacz 060SL in a concentration of 0.075%, 7.5 ml per 10 liters of water and 1000 l of solution per hectare respectively

Table 1

Schedule of experience.

Nr.	The period of effect foliar fertilization	Foliage fertilizer concentration			
		V1	V2	V3	V4
Urea 46 % active substance					
1	After bloom (when the 75% where in bloom)	water	0.4	0.5	0.6
2	When the fruit is size one nuts(fruit have 10-12 mm in diameter)	water	0.7	0.8	0.9
3	When the fruit are in size one walnuts (fruit have 25-30mm in diameter)	water	1.0	1.1	1.2
Polyfeed(N19:P19:K19)					
4	When fruits are in the ripen stages(20-30 July)	water	0.1	0.1	0.1
Calcium chloride(CaCl2)					
5	With 20-30 days before harvest	water	0.5	0,6	0,7

Manual harvesting of fruits is usually done after the physiological fall from June to July 5 to 10, which is no later than 30 days after the fruit is bound. This type of mating has a role in improving fruit quality and fruit size. Manual shredding occurs when fruit from inflorescence is less than 10-15 cm away from each other. Remove small, deformed, attacked diseases and pests then normal ones.

The harvest for each tree was determined by weighing it on 24 representative trees, then the arithmetic mean was performed. The average weight of the fruit is determined by weighing 100 pieces of fruit electronically.

The experiment was mounted on the rotation plane according to the method of organizing the factorial experiences (foliar fertilization, chemical and manual fruit reduction) and included variants with the following scheme for the use of foliar fertilizers and methods of fruit thinning: V1 (V1f + V1R), V2 (V1f + V2R) V3 (V1f + V3r) V4 (V1F + V4R) V9 (V3F + V1R) V5), V10 (V3f + V2R) V11 (V3f + V3r) V12 (V3f + V4R) V13 (V4f + V1R) V14 (V4f + V3R)

Table 2

Schedule of experience.

Variant	The period of effect foliar spray
Variant 1	Control
Variant 2	Management of chemicals when the central fruit diameter is of 10-12 mm blossoms Bioprzerzedzacz 060 SL preparation in a concentration of 0.075 %.

Variant 3	Administration of chemicals when the central fruit diameter of 10-12 mm is blossoms Bioprzerzedzacz 060 SL preparation in a concentration of 0.075 % + manual fruit thinning.
Variant 4	Manual thinning is carried out after the fall of physiological fruit when the fruit reaches 16-18 mm in diameter.

RESULTS AND DISCUSSIONS

In 2013 the smallest number of fruits in V7 variant with 160 pcs and most in V13 variant with 198 pcs.

In fruit-free variants with no foliar fertilization, the number of fruits consisted of 168 pieces to 173 pcs in variant V4. With the increase in Urea 46 % N applied, the number of fruits increases. However, in variants with the application of the Bioprzerzedzacz 060SL growth recipe in the concentration of 0.075 %, on the background of foliar fertilization, the number of fruits is higher, having a higher level in the chemically controlled variants of the fruit: 189 pieces in the variant V6: 181 pcs in the variant V10 and of 187 pcs. in the V14 variant.

In 2014, the number of fruits in the Golden Delicious variety increased in most variants but with a stronger emphasis in variants with the application of fruit scrub and without fertilization V2 with 203 pcs V3 with 207 pcs. In the foliar fertilization variants and without the application of the three methods of norming the fruit load (chemical, manual and mixed fruit thinning) there was an increase in the number of fruits, but compared to the previous year (2013) the increase was the smaller being up to 226 units in the V13 variant.

In 2015 the fewest fruits were in the V1 variant with 151 pieces, and the most fruits in the variant V16 with 188 pcs. Between the variants with but without foliar fertilization and the variants with thinning and fertilization we notice an insignificant increase in the number of fruits depending on the 46 % N applied Urea concentration reaching 2 % compared to the non fertilized variants.

In 2016, the number of fruits is the highest, but in the control version their number is 100 pieces due to an insufficient number of buds made in the year before 2015. In the fertilization and fruit reduction research, we can see that the number of fruits in the only variants with foliar fertilization with Urea 46 % N are slightly higher in V5 variants with 229 units compared to variants V6 - 204 pcs and variant V8 with 199 pcs. where the manual scraping of the fruit was applied.

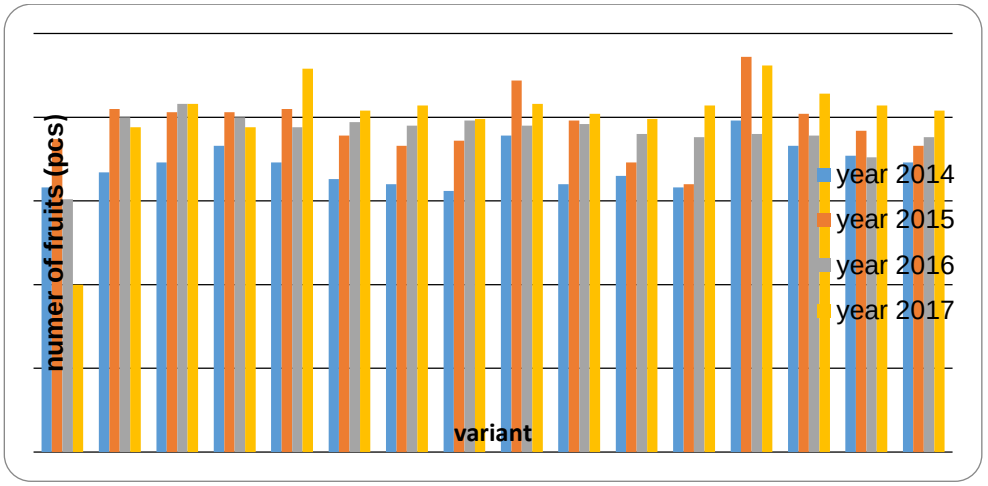


Figure 1 Number of fruit of Idared variety according to fruit thinning and foliar fertilization application.

Fruit weight is a key indicator that ensures a good harvest of fruit. In Idared variety in 2013, the smallest fruit was found in V1 with an average fruit weight of 100 g and the largest fruit in the V16 version with an average weight of 200 g.

In variants with different dilution methods, the average fruit weight varied from 164 g in the chemical reduction, to 180 g in the manual fruit picking variant (V4). With the application of different foliar fertilization levels based on Urea 46 % N, the fruit weight also increases. In variant V5 where the fertilizer concentration was applied by 0.4 %; 0.7 %; 1.0 %, the fruit weight was increased to 130 g, but with the application of Urea 46 % N in a concentration of 0.6 %; 0.9 %; 1.2 %, the fruit weight was 150 grams. But the weight of the fruit grew even more in the variants where, besides the foliar fertilization, the fruit was reduced. Thus, the largest fruits were recorded in the chemical-ripening variants of the fruits.

In 2014 the fruit weight increased in all variants, the highest average fruit weight was registered in V14 with 230 g. Compared to 2013, in 2014 the fruit weight in foliar fertilization variants registered the highest increase. From 31 % in V9 to 40 % in V5.

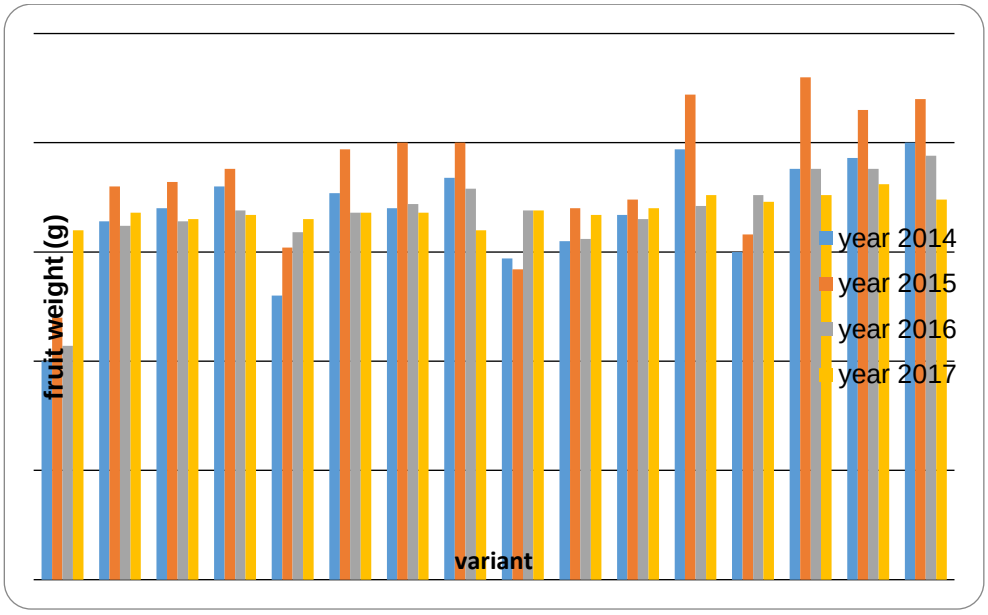


Figure 2 Fruit weight of Idared variety according with fruit thinning and foliar fertilization application.

In 2015 fruit weight registered 14 % lower values in the variants with fertilization and the difference compared to 2014. However, in the foliar fertilization only variants registered the 16 % difference.

In 2016 the smallest fruit weight was recorded in control variant (V1) by 160 g. In variant V5 where the concentration of Urea 46 % N was 0.4 %; 0.7 % and 1.0 % plus fruit picking according to the experience scheme, fruit weight was greater than or equal to 2014 from 160 g (V8) to 168 g (V6).

In variant V9, the average mass of a fruit was higher than in 2015. In the variants with chemical reduction and manual reduction with the weight of 170 g.

CONCLUSIONS

1. In 2016 the number of fruits is the highest, compared to the previous years (2013 - 2015), but in the control version their number is at the level of 2013 by 100 pcs. due to an insufficient number of fruit buds that had to be deposited in the previous year 2015. On the variants of fertilization and fruiting study we can see that the number of fruits in the foliar fertilization only with Urea 46 % N is slightly higher in the variants V2f-1r with 204 units compared to V2f-2r versions 193 pcs. and version V2f-4r with 188 pcs. where the manual scraping of the fruit was applied.

2. In 2016 the lowest fruit weight was recorded in control variant (V1f-1r) by 63 g. In variant V2f where the concentration of Urea 46 % N was 0.4 %; 0,7 % and 1,0 % plus fruit picking according to the experience scheme the fruit weight was less than or equal to 2014 from 140 g. (V2f-1r) to 168 g (V2f-2r).

In the V3f variant the harvest was higher than in 2015. In the variants with chemical shake and manual shredding weighing 170 g.

REFERENCES

Babuc, V. 2012, Pomicultura. Chişinău: Tipografia Centrală 662 p. ISBN 978-9975-53-067-.

Balan, V., Şaganean, R. 2008, Orchard productivity in function of fruit thinning. In: Lucrări ştiinţifice, USAMV „Ion Ionescu de la Brad". Iaşi, anul LI, vol. 51: Horticultură, p. 675-678.

Balan, V., Vămăşescu S. 2014. Increase quantity and quality of apple fruit by normalization of load by different methods of thinning. In: Lucrări ştiinţifice, USAMV Bucureşti, Vol. LV, p. 352-357. ISSN 2069- 6965.

Balan, V., Vămăşescu, S. 2013. Influence of foliar application of fertilization and fruit thinning on fruit production and quality. In: Lucrări ştiinţifice, USAMV „Ion Ionescu de la Brad". Iaşi, Anul LIII, vol. 53(2): Horticultură, p. 219-224.

Cimpoieş, Gh. 2016, Cultura mărului. Chişinău: Bonus Offices, 382 p. ISBN 978-9975-80-547-6.

Gonda, I. 2003. Cultura eficientă a mărului de calitate superioară. Braşov: Gryphon, ISBN 973-604-015-1

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓*Biology*
✓*Horticulture*
✓*Food produce processing technology*
✓*Environmental engineering*

THE INFLUENCE OF THE SOIL MAINTENANCE SYSTEM ON THE FAUNA FROM THE STEFANESTI VITICULTURAL CENTER

Vizitiu Diana Elena[1]*, Nedelea Gina[1], Radomir Ana-Maria[1]

[*]University of Craiova, "Al. Buia" Botanical Garden, Craiova[1] National Research and Development Institute for Biotechnology in Horticulture Stefanesti Arges, Romania
** Correspondence author. E-mail*: vizitiud@yahoo.com

Keywords*: Grapevine, Insect, Shannon, Simpson, Equitability*

ABSTRACT

Soil maintenance system has a direct effect on the diversity of fauna which is constantly changing due to the intensification of anthropogenic activities which exert strong pressures on the environment. The aim of this study was to monitor the fauna from grapevine plantation with the different soil maintenance systems and to determine the Shannon, Simpson and Equitability indices. Thus, in 2016 were identified 18 species of insects (two of which are part of the beneficial insect) and in 2017 were identified 38 species of insects (of which 9 belong to beneficial insect). These belong to the Orthoptera, Coleoptera, Hymenoptera, Mecopera, Hemiptera, Megaloptera, Lepidoptera, Dermaptera, Diptera, and Araneae orders.

INTRODUCTION

The grapevine because it is a perennial plant, occupy the soil for a long time, which leads to the appearance of a large number of pests and diseases.

In generally a vineyard is being managed intensely to obtain large quantities of grapes and wine without taking into account the negative impact on biodiversity (Winter et al. 2018).

The addition of non-crop plants, especially flowering species, can attract and maintain natural enemies, and in some cases, this increase in agrobiodiversity and can lead to increased ecosystem services, including the biological control of pests (Wilson & Daane, 2017).

MATERIAL AND METHODS

The study was conducted on the territory of the National Research and Development Institute for Biotechnology in Horticulture Stefanesti Arges, Romania (INCDBH Stefanesti), which is located in the vineyard of Stefanesti (44°42 and 44°55 north latitude), located in the southern central part of Muntenia sub-Carpathians (Fig. 1).

The microclimate of Stefanesti locality is relatively moist and is due to the neighborhood of forests in the north-east, the platform relief fragmented by the deep valleys disposed almost perpendicularly on the corridor formed by the Arges river on the one hand and the human settlements with woody vegetation on the other which shuts down the air currents to the south.

Assessment of the impact of conservative soil cultivation practices on harmful insects and useful insects was carried out in the following experimental variants:

- V1 **–** Permanent natural grassing of the soil (throughout the study). It was obtained by leaving the band between the rows with spontanous weeds;
- V2 **–** Temporary natural grassing (after a certain number of years the land it plow and it is mantained few year as a black field, after which it is regrassing);
- V3 **–** Artificial grassing in strips (between rows) with *Trifolium repens* var. silvestris (10 kg/ha).
- V4 **–** Artificial grassing in strips (between rows) with *Lotus corniculatus*, Bull variety (18 kg/ha).
- V5 **–** Black field. Conventional non-organic system.

Fig. 1 Location of experimental variants

In order to determine the insect species were mounted the adhesive traps on the rows of grapevine. The insects identification was done with an IPM Scope, then the data have been centralized and were calculated the Shannon, Simpson and Echitability diversity index depending on the soil maintenance system, but also according to order of which they are part.

RESULTS AND DISCUSSIONS

In the present, viticulture, like all agriculture, faces with pollution problems as a result of the application of unreasonable systems for the maintenance of vineyards. Soil maintenance systems it influences, besides the production of grapes, and the evolution of insects in vineyards.

In all five variants of soil maintenance, in 2016 were identified 18 species of insects: *Poecilimon schmidti, Diplolepis rosae, Polistes dominula, Cantharis rustica, Lucanus cervus, Lytya versicatoria, Oryctes nasicornis, Panorpa sp., Sialis* sp., *Empoasca vitis, Eucarta amethystina, Diacrisia sannio, Thymelicus sylvestris, Pieris* sp., *Apatura clytie, Argynnis paphia, Coccinella septempunctata, Harmonia axyridis*. In 2017 were identified 38 species of insects: *Harmonia axyridis, Psyllobora 22-punctata, Coccinulla 14-punctata, Coccinulla 10-punctata, Coccinulla quatuordecimpustulata, Vibidia duodecimguttata, Scymnus frontalis, Cantharis rustica, Centrotus cornutus, Antaxia nitidula signaticollis, Antaxia nitidula, Agrillus* sp., *Dolomedes sp., Panorpa* sp., *Cercopis vulnerata, Apis melifera, Mordella* sp., *Forficula auricularia, Philaenus spumarius, Pirates hybridus, Cortodera diferens, Polistes dominulus, Anthomya procellaris, Paederus fuscipes, Sarcophaga* sp., *Andrena* sp., *Vespula vulgaris, Trichaetipyga juniperina, Tetigonia viridissima, Neomya cornicina, Cicadella viridis,*

eiosimyza sp., *Stenolopus teutonus, Heliophilus* sp., *Graphosoma lineatum, Oulema obscura, Dermestes murinus, Harpalus pubescens*.

According to the Shanon index (Fig. 2 A) the best distribution of harmful insects was in 2016 at V2, V3 and V4 experimental variants and in the case of useful insects it was in 2017 for variants V3 and V4.

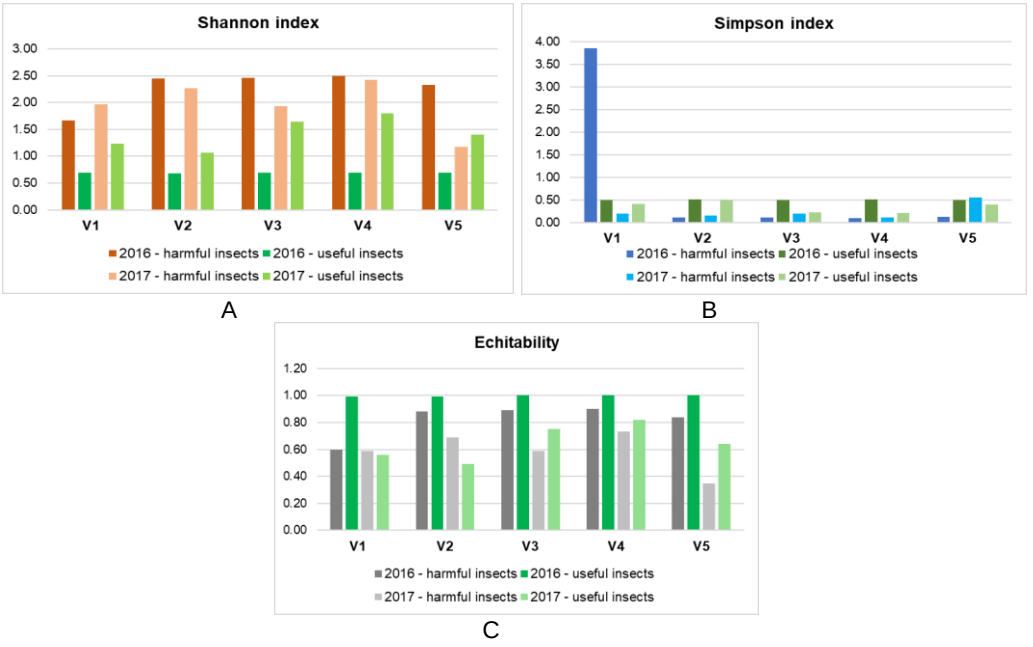
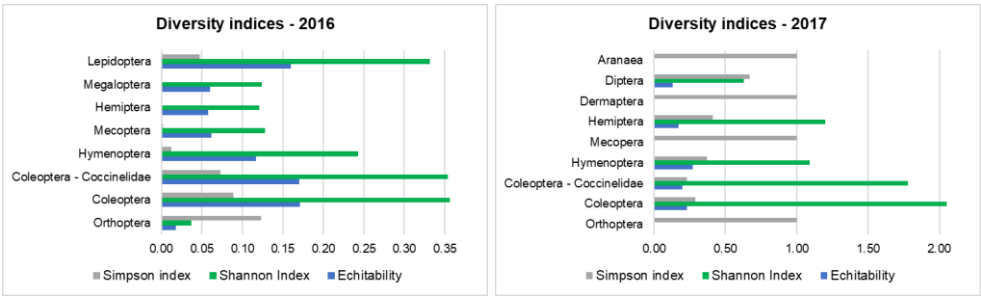


Fig. 2 The Shannon (A), Simpson (B) and Equitability (C) indices from experimental variants

Regarding the Simpson index, the data from Figure 2 B shows that the greatest diversity of harmful species was found both in 2016 and in 2017 for V2, V3 and V4 experimental variants, and in case of beneficial insects at variants 3 and 4 in 2017.

From the comparative analysis of all five variants of soil maintenance, it is noticed that both in 2016 and in 2017 the relative abundance of harmful insects was similar in variant 1. In the case of useful insects, the Equitability shows that the highest abundance of insect species was in case of variants 3 and 4 (Fig. 2 C).

The diversity indices (Shannon, Simpson, Equitability) were calculated also for harmful and useful insects grouped in order. After the identifications it was found that the insects from all experimental variants belong to the *Orthoptera, Coleoptera, Hymenoptera, Mecopera, Hemiptera, Megaloptera, Lepidoptera, Dermaptera, Diptera*, and *Araneae* orders (Fig. 3). The insects belonging to the *Orthoptera, Coleoptera, Hymenoptera, Mecopera, Hemiptera* orders have been identified in both years of study, those in the *Megaloptera* and *Lepidoptera* only in 2016 (Figure 3 A) while those from *Dermaptera*, *Dipter*, and *Araneae* orders were collected only in 2017 (Figure 3 B).



A B

Fig. 3 Diversity indices in 2016 (A) and 2017 (B) in grapevine plantations

CONCLUSIONS

The best distribution of useful insects was took place in 2017 in artificial grassing experimental variants with *Trifolium repens* var. silvestris and *Lotus corniculatus*.

A part of the insect species collected from the vineyards have been found in both years of study, they belong to the orders: Orthoptera, Coleoptera Hymenoptera, Mecopera, Hemiptera.

ACKNOWLEDGMENT

This article is based upon work from ADER 3.1.1 Research Theme*, ADER 3.1.1 "Conservation and management of genetic resources and biodiversity vineyards and fruit agro-ecosistem by developing and promoting innovative practices and methods effective eco-friendly environment",* supported by Research-Development Sectorial Plan, Ministry of Agriculture and Rural Development, Romania.

REFERENCES

Wilson H., Daane K.M., 2017, Review of Ecologically-Based Pest Management in California Vineyards. Insects, 2017, 8, 108; doi:10.3390/insects8040108.

Winter S., Bauer T., Strauss P., Kratschmer S., Paredes D., Popescu D., Landa B., Guzmán G., Gómez J.A., Guernion M., Zaller J.G., Batáry P., 2018, Effects of vegetation management intensity on biodiversity and ecosystem services in vineyards: A meta- analysis. *J Appl Ecol*. 2018; 00:1–12. https://doi.org/10.1111/13652664.13124.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓*Biology*
✓*Horticulture*
✓*Food produce processing technology*
✓*Environmental engineering*

"HEALTH CLAIMS" ON WINE LABELS AND THEIR ILLEGALITY

Voinea-Mic Cătălin[1*], Giugea Nicolae[1], Mărăcineanu Liviu[1]

University of Craiova, Faculty of Horticulture,
**Correspondance author e-mail: avocat_catalinvoinea@yahoo.com*

Keywords*: nutrition claim, health claim, labels, misleading, easily digestible wine, foodstuff, consumer*

ABSTRACT

The description and advertising of wine products through health claims can not be accepted, referring to the situation where European legislation prohibits expressly the use of these claims in the case of beverages that exceed 1.2 % by volume of alcohol

INTRODUCTION

Taking into consideration that the European legislation pays attention to the protection of consumers within the framework of protecting the health of the European citizens, this paper aims to focus on the limits of the advertising forms in the case of alcoholic beverages, especially of wine, referring to the tendency of producers, traders to present the "health benefits" of these products under limited circumstances, ignoring consciously the legal prohibitions on this issue, including the indirect causal links to the "beneficial effect," links that may have a major impact on health.

Given the particular impact of these "claims", the European legislator has established strict rules for the use of the "health claims" in order to ensure a high level of consumer protection and to facilitate wittingly the choice by establishing *ab initio* that the products introduced on the market, including the imported products, should be safe and properly labeled.

Once it has been established that a balanced and varied diet is a prerequisite for good health and the products taken separately have a relative importance in the context of global nutrition, the European legislator has agreed to regulate how to use these forms of advertising, forms that include also the wines, a category on which we will focus in this study, starting with a case [2] brought to the Court of Justice of the European Communities.

The present study, after presenting the field of legal regulation, aims to analyze a concrete case of "health claim" applied on the label of a wine, a case whose release by the European Court of Justice of the European Communities comes to establish the limits of the use of health claims in advertisement, regardless of the form, especially in the case of alcoholic products.

[2] Case C-544/10, REFERENCE for a preliminary ruling under Article 267 TFEU from the Bundesverwaltungsgericht (Germany).

MATERIAL AND METHODS

This paper has used as a basis for the study, the European regulations and European jurisprudence in the field, using the classic methods of legal interpretation of legislation and legal analysis of the text of parts of the procedural documents in some cases solved by the CJEU.

RESULTS AND DISCUSSIONS

According to Regulation[3] 1924/2006 on nutrition and health claims made on foods, all products placed on the market, including those imported, must present a "safety" characteristic and be labeled accordingly. It is well known that each trader is aiming to achieve high revenues from advertising that ensures a successful marketing of the product. Starting from the traders' tendency to maximize the qualities of the offered product, it is remarkable that there is an increased number of products that are subject to "special" publicity at the European Union level in the sense that the labels used in the presentation contain nutrition and health claims.

According to the Directive[4] no. 13/2000 on the approximation of the laws of the Member States relating to the labelling, presentation and advertising of foodstuffs, the labelling rules should contain a prohibition on misleading the purchaser or to attribute "medicinal characteristics" to the foodstuffs. In order to be effective, this ban should be extended to the presentation of foodstuffs and their advertising.

It is common knowledge that wine is part of the foodstuffs. Thus, according to art. 2 of Regulation 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety, the "food product" (or "foodstuff") means any product or substance, whether processed, partly processed or unprocessed, intended or reasonably expected to be ingested by humans. Also, according to the same paper, "foods" include beverages, chewing gum and any substance, including water, intentionally incorporated in food during their production, preparation or treatment.

In terms of “health claims", the above-mentioned Directive essentially prohibits the use of information by advertising likely to mislead the purchaser in relation to certain medicinal properties of foods.

The Directive 13/2000 EC generally prohibits the use of information that would mislead the purchaser or would attribute medicinal properties to foodstuffs. This Regulation aims to supplement the general principles of the Directive 13/2000 / EC and to lay down specific provisions on the use of nutrition and health claims on foods to be delivered as such.

According to Regulation (EC) no. 1924/2006, the food supplements (as defined in the Directive 2002/46/EC of the European Parliament and of the Council of 10 June 2002 on the approximation of the laws of the Member States relating to food supplements) presented in a liquid form and containing more than 1.2 % by volume of alcohol are not considered beverages.

It has also been established that health claims other than those referring to the reduction of disease risk and to children's development and health, based on generally accepted scientific evidence, should be subject to a different type of assessment and authorization. It is therefore necessary to adopt a Community list of such permitted claims, after consulting the European Food Safety Authority (hereinafter referred to as "the European Authority").

[3] Published in the Official Journal of the European Union L. 404/ 26.12.2006.
[4] Published in the Official Journal of the European Union L. 109, 6.05.2000.

Furthermore, the health claims based on recently established scientific evidence should be subject to accelerated authorization procedures in order to stimulate innovation.

The Regulation introduces the terms "*health claim*" and "*claim referring to the reduction of the disease risk*".

Thus, the "*health claim*" means any statement that declares, suggests or implies that there is a relationship between a food category, a food or one of its constituents and health. The "*disease risk reduction claim*" means any health claim that states, suggests or implies that a risk factor in the development of a human disease is significantly reduced by the consumption of a food category, a food or one of its constituents.

The same Regulation establishes unequivocally that, in order for a health claim to be accepted, it must meet the following conditions:

- it should not be false, ambiguous or misleading,
- it should not encourage or be able to tolerate excessive consumption of a food product,
- it should not be able to assert, suggest, or imply that a balanced and varied diet can not generally provide the proper amounts of nutrients,
- it should not refer to changes in the functions of the body which could induce fears or exploit such fears to consumer, either in the form of texts or in the form of images, graphics or symbolic representations.

The health claims are prohibited unless they comply with the general requirements set out above, are authorized in accordance with the law and they are included in the lists of permitted claims acting in accordance with Regulation (EC) no. 1924/2006[5].

Thus, the label/form of advertising accompanying a product may not refer to the general, non-nutritional or food-specific benefits of good overall health or health related to well-being unless such reference is accompanied by a specific mention included in the lists acting in accordance with the procedures laid down in the Regulation.

The health claims are only allowed if the following information are included on the labels or in the presentation and advertising if there are no such labels:

- an indication of the importance of a varied and balanced diet and a healthy lifestyle;
- the quantity of food and consumption pattern required to achieve the mentioned beneficial effect;
- where appropriate, a claim to persons who should avoid using the food in question;
- an adequate warning for products that are likely to pose a health risk if they are consumed in excess.

On the other hand, the Regulation stipulates that health claims are not subject to authorization if they describe or refer to:

- The role of a nutrient or other substance in the growth, development and functions of the organism
- Psychological and behavioral functions or
- weight loss or weight control, or reduction of hunger, increased satiety or decreased energy value of food, if they are based on generally accepted scientific evidence and are well understood by the average consumer in relation to the lists authorized at European level under this procedure.

Regarding the disease risk claims of children's development and health, the Regulation mentions that there may be suggestions on the reduction of disease risk and

[5] See Art. 13 and 14 of the normative act.

claims on children's development and health if they have been authorized in accordance with the procedure set out in Regulations in order to be included in a Community list of such permitted claims, accompanied by all the conditions necessary for the use of these claims.

In addition to the general requirements set out in the Regulation, the requirements on labelling (presentation or advertising) in the case of disease risk claims, must be accompanied by a statement indicating that the disease to which the claim refers has multiple risk factors and that the change of one of these risk factors may or may not have a beneficial effect.

Continuing the "enactment", The European Commission issued the Regulation[6] no. 155/2014 refusing to authorize certain health claims made on foods other than those referring to the disease risk reduction and on the development and health of children, establishing express cases of refusal of authorization for certain products in an annex for which an approval is sought for the inclusion of certain health claims.

We mention as an example the case of a request made by Nutrilinks Sarl, submitted pursuant to Article 13 (5) of Regulation (EC) No. 1924/2006, requesting the Authority to issue an opinion on a health claim related to the effects of the *Vitis vinifera* L. seed extract which was claimed to have a positive effect on the normal blood circulation. The mention proposed by the applicant was formulated, inter alia, as follows: "*It contributes to the promotion of blood circulation in legs* and feet".

On 14 December 2012, the Commission and the Member States received the scientific opinion from the Authority, which, on the basis of the data submitted, concluded that there was no cause-effect relationship between the consumption of the *Vitis vinifera* L. seeds extract and the claimed effect. Consequently, since the claim does not meet the requirements of Regulation (EC) No 1924/2006, it was decided that this "claim" should not be authorized.

Case Study. Court of Justice of the European Communities. Case "Deutsches Weintor eG against Land Rheinland-Pfalz". The legality of the "'easily digestible wine" claim

Taking into consideration that there is a European procedure for the authorization of health claims, the European legislator has also set some exceptions. Thus, the European legislation stipulates that health claims are not subject to authorization if they describe or refer to:

- The role of a nutrient or other substance in the growth, development and functions of the organism
- Psychological and behavioral functions or
- weight loss or weight control, or reduction of hunger, increased satiety or decreased energy value of food,

if they are based on generally accepted scientific evidence and are well understood by the average consumer in relation to the lists authorized at European level under this procedure.

According to Article 4 of Regulation No 1924/2006, beverages containing more than 1.2 % by volume of alcohol shall not bear health claims. Regarding the nutrition claims, only nutrition claims relating to low levels of alcohol or reducing the alcohol content or reducing the energy content of beverages containing more than 1,2 % by volume of alcohol are allowed. "

The case brought to the European Court of Justice of the European Communities has been the subject of a reference for a preliminary ruling on the interpretation of Article 2 (2) (5) and the first paragraph of Article 4 (3) of Regulation (EC) No 1924/2006 of the European Parliament and of the Council of 20 December 2006 on

[6] Published in the Official Journal of the European Union L. 50/ 20.02.2014.

nutrition and health claims made on foods. It was sent by a German court on the dispute between a German winemaking cooperative and the competent authority to supervise the commercialization of alcoholic beverages on the right to use the presentation of a health claim on a label/material.

The Winemaking Cooperative marketed wines from the Dornfelder and Grauer / Weißer Burgunder grape varieties with the description "Edition Mild" (Mild Edition), accompanied by a statement of "low acidity". On the label of this wine it was mentioned, among other things, that: "The delicate taste is obtained by using our special procedure LO3 "(LO3 Schonverfahren zur biologischen Säurereduzierung) for biological deacidification." The label on the neck of the wine bottles featured the inscription: "Edition Mild bekömmlich" (Mild Edition, easily digestible). In the price catalog, the wine was described by the use of the phrase: "Edition Mild - sanfte SÄure / bekömmlich" (mild edition – gentle acidity/ easily digestible).

The German authority responsible for supervising the marketing of alcoholic beverages contested the use of the term 'easily digestible' on the ground that it constitutes a 'health claim' within the meaning of the European regulations in question[7].

In its turn, the winemaking cooperative brought an action before a competent German administrative court requesting to be allowed to use the "easily digestible" description for the labelling of the concerned wines and for the advertising they make. In support of its action, it essentially stated that the description 'easily digestible' had no relation to health but merely referred to general well-being. It also claims that Regulation No 1924/2006 does not apply to descriptions traditionally used for food or beverages and which may have consequences for general well-being, such as the 'easily digestible' description of a digestible beverage.

On the basis of the initial situation that the wine is in the category of beverages containing more than 1.2 % by volume of alcohol, it should be pointed out that, according to the first paragraph of Article 4 (3) of Regulation No 1924/2006, the European Union legislature has prohibited without exception, any "health claim" in respect of this category of beverages.

In the deduction of judgment, it is noteworthy that the claim in dispute is capable of suggesting that, given the low acidity, the wine in question is adapted or acceptable for digestion. According to the claim included on the label / form of advertising, this wine would produce a beneficial nutritional or physiological effect. In other words, if you consume such a product, the digestion process will improve.

It is important to stress that the "improved" digestion process (commonly known as a medicine notion) is reported at the time immediately following the ingestion of the product, having a limited effect over time, as long as the consumed product is still found in the body of the consumer.

In relation to the case, it is questionable whether a description as 'easily digestible' can be qualified as a 'health claim', even if it does not imply a lasting improvement in the state of the body to which it derives the beneficial nutritional or physiological effect that the wine in question can produce.

The European Court of Justice, interpreting the rules of Regulation No 1924/2006, held that the "health claim" is defined on the basis of the relationship that must exist between the foodstuffs or one of its constituents on the one hand and the health, on the other hand. It must therefore be held that that the definition contains no indication either of the direct or indirect nature of that relationship, or of its intensity or duration. Under these circumstances, the term "relationship" must be understood in a broad sense.

[7] Infringement of Article 2 (2) (5) of Regulation No 1924/2006, which does not allow such claims for alcoholic beverages under the first paragraph of Article 4 (3).

It is important to emphasize that the relationship between product consumption and health condition should not be seen only in terms of limited effect, ignoring the other effects of consumption of the product in question. Thus, the Court held that, on the one hand, the notion of 'health claim' must not only concern a relationship involving an improvement in the health status due to the consumption of foodstuffs but also any relationship involving the absence or limitation of negative effects or health hazards which accompany or will otherwise result in such consumption and therefore the simple maintainance of good health despite this potentially harmful consumption. It must also be understood that the term 'health claim' refers not only to the effects of a given consumption of a certain quantity of foodstuffs, which may normally only cause temporary or passive effects, but also repeated, regular, even frequent consumption of such foodstuffs and which, on the other hand, has no temporary or passive effects.

Starting from the situation whereby the indications that promote the food and which indicate a nutritional, physiological, or other health advantage in relation to similar products guide the choice of consumers, it is undeniable that this choice has a direct influence on the total quantity of different nutrients or other substances which they decide to absorb, thereby justifying the restrictions on the use of those claims imposed by that regulation.

Consequently, the European Court of Justice has held that when analyzing the effects of the product on health, there must be taken into account both the temporary and passive effects and the cumulative effects that the repeated and long-term consumption of a particular foodstuffs has on its physical condition.

Returning to the cause of the judgment, referring to the description made by the parties, the "health claim" suggests that the wine is digested and absorbed well, which translates to the fact that the digestive system, therefore, a part of the human body does not suffer or suffer a little because of it, and that this system remains relatively healthy and intact even after a repeated consumption of cumulative and long-lasting quantities as this wine is characterized by a low acidity. Thus, the claim in question may suggest a lasting beneficial physiological effect, which is to maintain a good state of the digestive system, contrary to other wines which are supposed to cause, in the case of cumulative consumption, negative long-lasting effects on the digestive system and, consequently, for health.

In conclusion, the European Court of Justice has held that, in accordance with all the special conditions that have to be met by such mentions, nutrition and health claims must not be false, ambiguous or misleading, the prohibition being imposed much more in the case of alcoholic beverages. It is therefore essential that all claims of these beverages to be unambiguous so that consumers can adjust their consumption taking into account all the intrinsic risks associated with that consumption and thus effectively protect their health. The claims such as those in question from the main action are ambiguous, even misleading, if they relate to an alcoholic beverage. In fact, by stating only easily digestible, the mention in question is likely to encourage the consumption of the wine in question and, ultimately, to increase the inherent risks of uninterrupted consumption of any alcoholic beverages for the health of consumers. Therefore, the prohibition of such claims can be justified by the requirement to guarantee a high level of consumer health protection.

CONCLUSIONS

It is widely known that advertising is the engine of commerce. Any trader will try to capitalize its products by explaining briefly, concisely and with major impact the benefits of the product, especially when the form of advertising is done using a "health claim". By addressing the fair competition rules, traders should analyze thoroughly the impact of the product on health, taking into account all major and secondary factors aimed at triggering the "beneficial health" mechanism, with particular emphasis on " time ", referring to the fact that even the abuse of drugs is harmful to health.

Thus, in relation to the case under consideration, even if the wine in question favours the digestion, the claim being correct from a medicinal point of view under this limited aspect, the same claim "forgets" to inform the consumer that the risks inherent of alcohol consumption are not removed by the "easily digestible" promoted phrase. This claim is "misleading" as long as it attempts to induce the idea that the product is beneficial only in terms of digestion and the insertion of a "health claim" on the label / forms of advertising that omits to make known also the related risks of the ingestion of that product is contrary to law.

It remains at the discretion of the authorities and why not, of the interested parties (competitors on the market) to identify and notify the competent bodies, including the courts, whenever there is a finding on the market of products that are marketed and contain labels / forms of advertising in which "health claims" are often inserted and very often hidden, such as: "long life", "good blood circulation", etc.

REFERENCES

***Case C-544/10, REFERENCE for a preliminary ruling under Article 267 TFEU from the Bundesverwaltungsgericht (Germany);

***Council Regulation (EC) 178/2002;

***Council Regulation (EC) No. 1924/2006;

***Council Regulation (EC) no. 155/2014;

***Directive no. 13/2000 on the approximation of the laws of the Member States on the labelling, presentation and advertising of foodstuffs;

***Directive 2002/46 / EC of the European Parliament and of the Council of 10 June 2002.

Sections:

BIOLOGY

ENVIRONMENTAL ENGINEERING

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

ON THE FRESHWATER TRICLADID FLATWORMS (PLATYHELMINTHES, TRICLADIDA) IN THE URBAN AREAS OF CRAIOVA (ROMANIA) – PRELIMINARY DATA

Babalean Anda Felicia[1]*

*University of Craiova, Faculty of Horticulture, e-mail: anda_babalean@yahoo.com

Keywords*: Polycelis tenuis, Dendrocoelum lacteum, Girardia tigrina*

ABSTRACT

The paper presents preliminary data on the freshwater tricladid flatworms sampled in some springs and running waters of three urban areas in Craiova municipality: The Botanical Garden, The Romanescu Park and Balta Craioviţei area.The faunistic account comprises: Polycelis tenuis Ijima, 1884; Dendrocoelum lacteum (Müller, 1774) and Girardia tigrina (Girard, 1850) (an asexual population of presumable Girardia tigrina). The gross anatomy of the copulatory complex is presented and briefly discussed for P. tenuis and D. lacteum in relation with the literature. P. tenuis is for the second time reported in Romania. Short notes on the above mentioned species biology are given.

INTRODUCTION

Craiova is a town located in Oltenia Plain, SW Romania. The literature on the history of Craiova since the medieval period (Ciobotea et al., 1999) mentions numerous springs, watercourses, lakes and marshlands on the present territory of the city: Valea Vlăicii Brook, Stan Jianu Brook and the spring of Hagi Stan Jianu, Valea Orbeţilor Brook, Valea Episcopiei Brook, Valea Tabacilor Brook, Şerca Brook, Belcineanu Pond, Valea Fetii Brook and pool, Bibescu Pond with many springs, Valea Hanului Doctorului Brook, Craioviţa and Geanoglu pools.

During the development of the city, there have been elaborated several plans of urban systematization and most watercourses have disappeared as they were integrated in the sewerage system and introduced into the underground. Lakes and marshlands were drained, sanitized, or arranged in parks and recreational areas. Consequently, from the multitude of wetlands, in the urban part of Craiova there were preserved: Jianu Brook and Jianu Spring in the Botanical Garden, Bibescu Pond and Valea Fetii Brook in Romanescu Park and Balta Craioviţei Lake.

This paper is a contribution on the Tricladida flatworms in the above mentioned areas for which the author does not know any data to have been reported so far.

MATERIAL AND METHODS

The worms were removed from the underside of the submerged stones with a paint brush, fixed in Beauchamp 12 + 24 hours and preserved in ethanol 75^0. Selected specimens underwent paraffin inclusion, sagittal and frontal (horizontal) sections at 5 microns and Haematoxylin-Eosin staining.

The collecting sites and moments:

Romanescu Park: Bridge no.1: 2.04.2017 – *D. lacteum* – 1 ind., 5.01.2018 – *D. lacteum* – 6 ind.; Bridge no. 3: 2.04.2017 – *G. tigrina* – 20 ind., 5.01.2018 – *G. tigrina* – 23 ind.; High Bridge: 2.04.2017: *D. lacteum* – 2 ind., *P. tenuis* – 2 ind. *G. tigrina* – 2 ind.; Spring: 2.04.2017 – *D. lacteum* – 1 mature + 3 youngs, *P. tenuis* – 18 ind.; Concrete canal: 2.04.2017 – *D. lacteum* – 2 ind., *P. tenuis* – 2 ind., *G. tigrina* – 4 ind., 16.04.2017 – *D. lacteum* – 2 ind., *G. tigrina* – 3 ind.

Botanical Garden: Lake no. 1: 16.02.2018 – *D. lacteum* – 1 ind. (deteriorated during fixation); Rivulet no.1: 15.04.2016 – *D. lacteum* – 1 ind., *P. tenuis* – 10 ind., 23.03.2017 – *D. lacteum* – 2 ind., *P. tenuis* – 13 ind.; Rivulet no.2: 23.03.2017 – *D. lacteum* – 8 ind., *P. tenuis* – 3 ind.; Jianu Fountain Spring: 23.03.2017 – *P. tenuis* – 14 ind.

Balta Craiovitei Lake: Zeus spring: 10.04.2017 – *P. tenuis* – 43 ind.

Abbreviations for all figures: ad – adenodactyl; adb – adenodactyl bulb; adpp – adenodactyl papilla; adp – adenodactyl pore; bc – bursal canal; bh – bursal horns; cb – copulatory bursa; cm – circular musculature; com – common atrium; cod – common oviduct; eg – eosinophilic glands; ejd – ejaculatory duct; f – flagellum; fd – folds of the common atrium wall; g – gonopore; ma – male atrium; p – penis; pb – penis bulb; pp – penis papilla; sv – seminal vesicle; spv – spermiducal vesicles; spd – sperm ducts.

The histological slides are deposited in author personal collection and may be lend on request.

RESULTS AND DISCUSSIONS

The systematic account according to Sluys et al. 2009 includes:

Subord. Continenticola Carranza et al., 1998

Superfam. Planarioidea Stimpson, 1857

Fam. Planariidae Stimpson, 1857

1. *Polycelis tenuis* Ijima, 1884

Material examined – serial frontal and sagittal sections on 9 specimens:

No. 5 – serial frontal sections on 9 slides, Botanical Garden, 15.04.2016

No. 6 – serial sagittal sections on 35 slides, Botanical Garden, 15.04.2016

No. 7 – serial sagittal sections on 31 slides, Botanical Garden, 15.04.2016

No. 12 – serial frontal sections on 5 slides, Botanical Garden, 15.04.2016

No. 9 – serial frontal sections on 4 slides, Botanical Garden, 23.03.2017

No. 10 – serial sagittal sections on 34 slides, Botanical Garden, 23.03.2017

No. 11 – serial sagittal sections on 19 slides, Botanical Garden, 23.03.2017

No. 13 – serial frontal section on 7 slides, Balta Craioviţei-Zeus spring, 10.04.2017

Pt1 – serial frontal sections on 2 slides, the Romanescu Park (spring), 2.04.2017

The reconstruction of the copulatory apparatus was done using the slides of the specimen no. 10 – Fig. 5.

External morphology

The general aspect of living adult specimens is presented in Fig. 1 a, b. The mature specimens in fully stretched state are up to 11 mm long and 2 mm wide. The colour of the body is dark brown to black on the dorsal side and brownish on the ventral side in the living worms. The ocular bands include the mid-dorsal part of the head, measure 1/3 of the worm length in fixed specimens and consist of 30 – 35 eyes on each band. The pharynx represents ¼ of the body length and it is located in the posterior half of the body.

In all specimens, part of the copulatory complex (the large common atrium) is visible in living animals as a round white area situated in the middle of the posterior third part of the body – Fig. 1 a, b. The pharynx, the copulatory complex and part of the sperm ducts are visible on the ventral side of the fixed worms – Fig. 1c.

Fig. 1 *Polycelis tenuis* – external morphology
a – specimen from Zeus spring, 10.04.2017, swimming; b – living specimens from Zeus spring, 10.04.2017, in rest state on the water surface ; c – fixed specimen from the Botanical Garden, 15.04.2016

The copulatory complex – Fig. 2, 3, 4

The sperm ducts present spermiducal vesicles on both sides of the pharynx; they enter the penis bulb separately – Fig. 2a, 4a. The general aspect of the penis is of an elongate cone. The slides of all sagittal and frontal sections show the penis consisting of a well developed muscular, almost spherical bulb and a conic-cylindrical papilla. In most cases the bulb lacks a seminal vesicle, revealing only 2 ducts dichotomically branched surrounded by musculature – Fig. 4a, corresponding to the entrance of the sperm ducts. In few specimens the penis bulb houses a small seminal vesicle – Fig. 2a, 2b. The penis papilla reveals a compartmented/folded ejaculatory duct – Fig. 2a, 2b. The common atrium appears as a large space delimited by a folded wall; the folders take the aspect of adenodactyls– Fig. 2a, 3a.

The copulatory bursa is horn shaped. The bursal canal is large and opens into the common atrium. The two oviducts – Fig. 3b, 4b join into a common oviduct which runs between the bursal canal and the male atrium to open into the common atrium. The oviduct is surrounded by branched eosinophilic glands – Fig. 4b.

Habitat

Polycelis tenuis was found on submerged stones and sand in springs (Fântâna Jianu, Romanescu Park), concrete canals (Romanescu Park), and among vegetation in the spring of Balta Craioviţei-Zeus. Water temperature – 13-14° C in April in Romanescu Park; 18° C in Zeus spring.

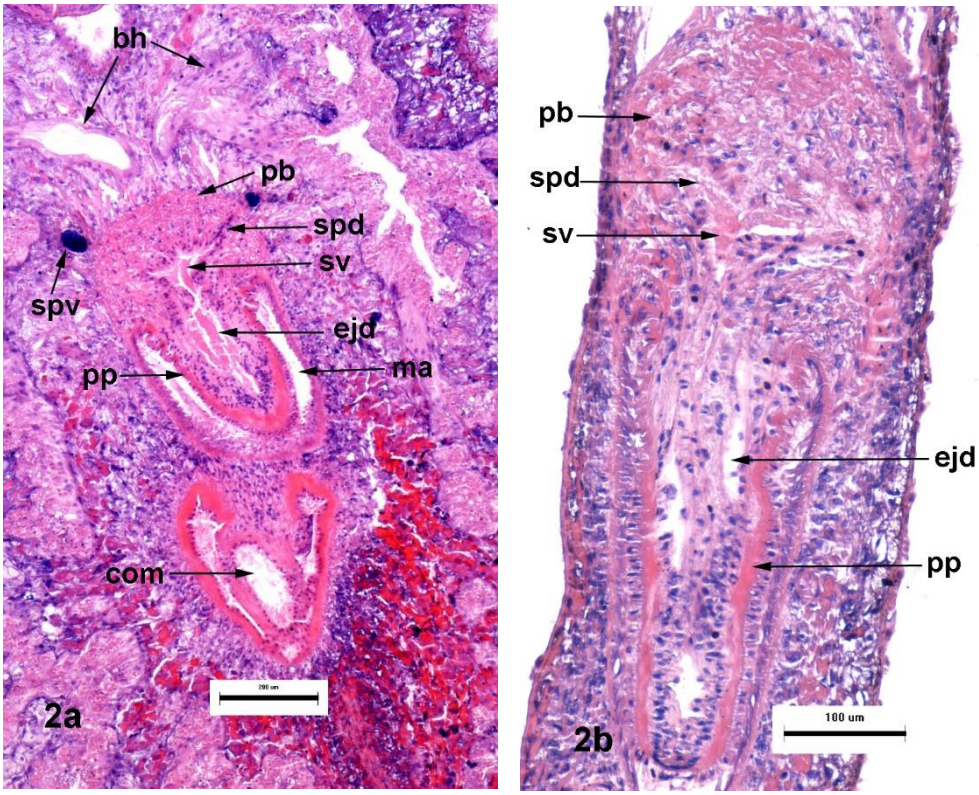


Fig. 2 *Polycelis tenuis* – aspects of the copulatory complex in different specimens: a – Botanical Garden, 23.03.2017, frontal section (slide 9.3.4), bar = 200μm; b – Botanical Garden, 15.04.2016, sagittal section (slide 6.25.3), bar = 100μm

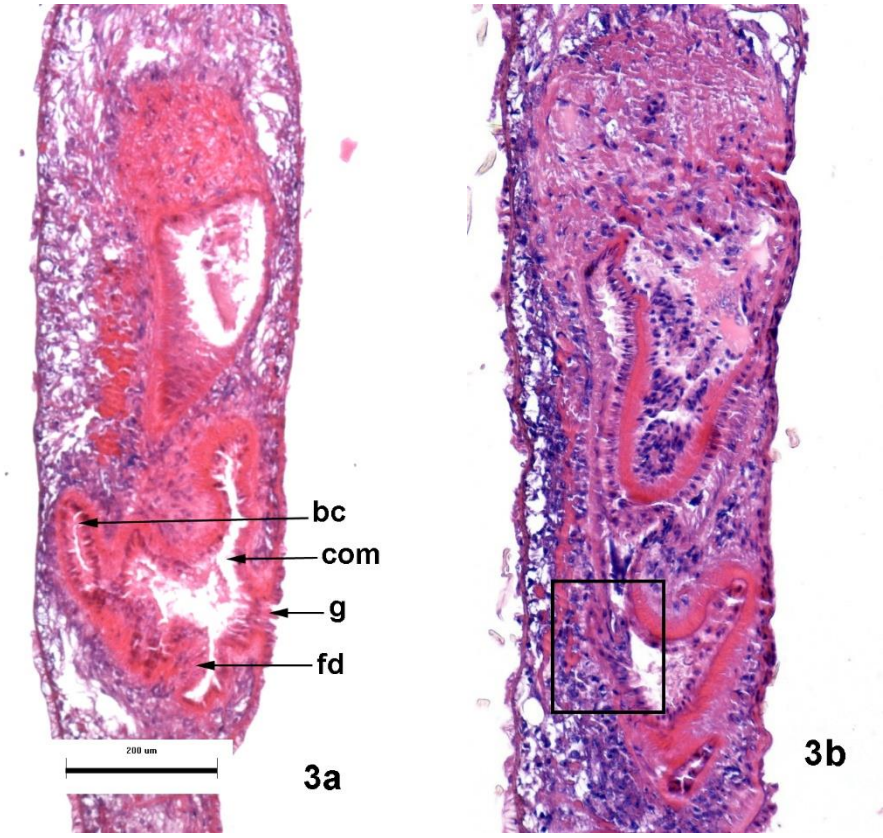


Fig. 3 *Polycelis tenuis* – aspects of the copulatory complex in different specimens:
a – Botanical Garden, 23.03.2017, sagittal section (slide 10.30.2), bar = 200μm;
b – Botanical Garden, 15.04.2016, sagittal section (slide 7.20.3) – the entrance of the common oviduct into the common atrium – in square

Discussions

The general aspect of the penis and the presence/lack of adenodacyls in *P. tenuis* is analysed in the English literature (Ball & Reynoldson 1981, Reynoldson & Young 2000). The folded, irregular ejaculatory duct is part of the original description in *P. tenuis* (Ijima, 1884, Fig. 2 – Bd.XL). This feature was also reported by Năstăsescu (1976). The lack of the seminal vesicles in most specimens might be associated with the physiological state. Instead, the dichotomy of the two vasa deferentia within the penis bulb is a mystery and lead to the idea of more than two entries (sperm ducts) into the penis bulb. The horn shaped bursa present in *P. tenuis* and *P. nigra* is discussed elsewhere (Taylor & Reynoldson 1962).

Polycelis tenuis was first recorded in the E and SE of Romania - Bucharest and Dobrogea by Năstăsescu (1976). In Oltenia Plain it is the second record of this species in Romania, thus extending to west the species geographical range.

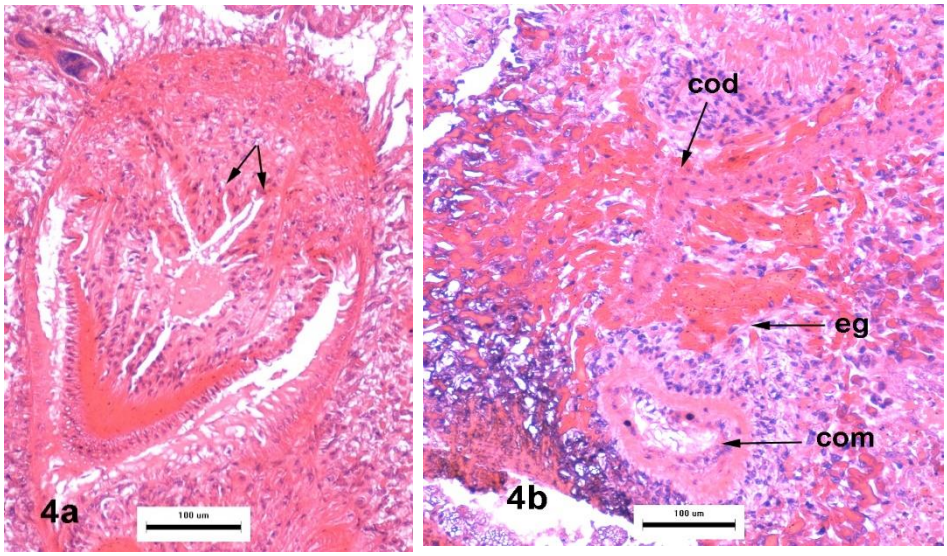


Fig. 4 *Polycelis tenuis* – aspects of the copulatory complex in different specimens: a - Botanical Garden, 15.04.2016, frontal section (slide 5.4.2) – the dichotomy of the sperm-ducts pointed by arrows, bar = 100µm; b – Balta Craioviţei-Zeus, 10.04.2017, frontal section (slide 13.5.2), bar = 100µm

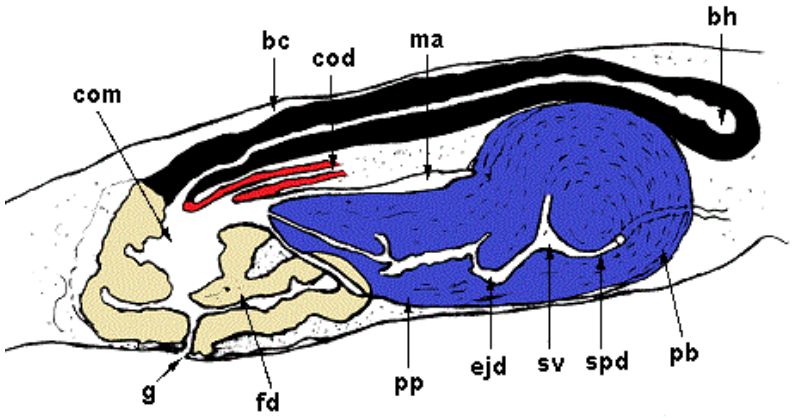


Fig. 5 *Polycelis tenuis* – the sagittal reconstruction of the copulatory apparatus (scale bar not available)

Fam. Dendrocoelidae Hallez, 1892

2. *Dendrocoelum lacteum* (Müller, 1774)

Material examined – serial frontal and sagittal sections on 3 specimens:

Dd1 – serial sagittal sections on 45 slides, Romanescu Park, 5.01.2018

Dd2 – serial sagittal sections on 35 slides, Botanical Garden, 23.03.2017

Dd3 – serial frontal sections on 11 slides, Romanescu Park, 5.01.2018

The copulatory apparatus was reconstructed using the sagittal serial sections on Dd1 specimen – Fig. 8.

External morphology

The general aspect of mature living specimens is presented in Fig. 6. The size of the living worms ranges between 18 mm/3mm in specimens from the Romanescu Park and 25 mm/3.5 mm in specimens from the Botanical Garden. The colour of the living worms varies from gray in the sample of the Romanescu Park to white and light pale-pink in the sample of the Botanical Garden.

Fig. 6 *Dendrocoelum lacteum* – the general aspect of living specimens: a – individual with a cocoon inside the body, Romanescu Park, 2.04.2017; b,c – Botanical Garden, 23.03.2017

The copulatory complex – Fig. 7

The sperm ducts enter the penis bulb separately and run separately on the lateral sides of the bulb. The penis is a short cone. The bulb consists of interwoven layers of musculature. The papilla is delimited by an internal layer of longitudinal muscles and an external layer of circular muscles which do not extend onto the flagellum. In frontal section (Dd3.6.3) the penis reveals a large cavity corresponding to the seminal vesicle and a short ejaculatory duct. The penis cavity is lined with a tall vacuolated epithelium which extends outside the penis in an everted flagellum. The adenodactyl is oval-elongated, almost of the same size of the penis, placed on the left side of the penis. It consists of a muscular bulb and a hollow papilla with a pore. The adenodactyl penetrates the common atrium.

The copulatory bursa is an ovoid sac lined with a low epithelium. The bursal canal opens into the common atrium. The oviducts join into a common oviduct which opens posterior into the common atrium.

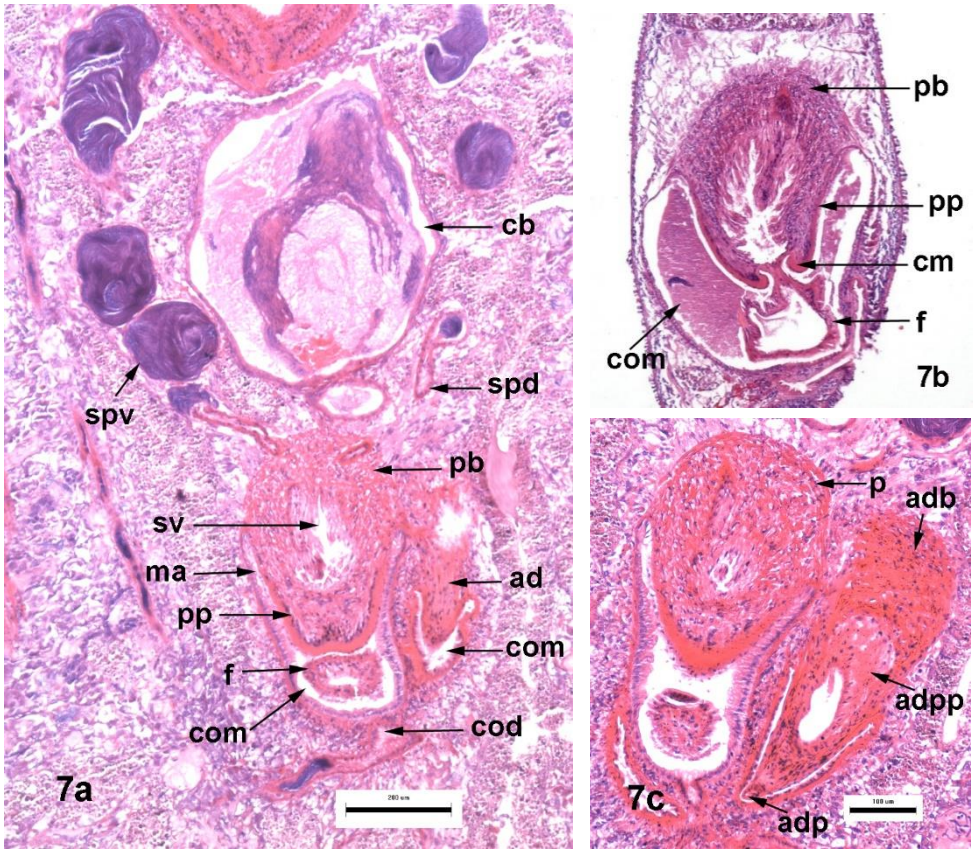


Fig. 7 *Dendrocoelum lacteum* (Dd1 – Romanescu Park, 5.01. 2018) – the copulatory apparatus in sagittal and frontal sections:
a – frontal section (slide Dd3.5.2), bar = 200μm; b – sagital section (slide Dd1.25.2);
c – frontal section (slide Dd3. 4.2) – the adenodactyl, bar = 100μm

Habitat

Dendrocoelum lacteum was found in small and slow running waters, under rocks situated near the banks, nearly without flow. Water temperature – 4.5° C in January.

Discussions

The taxonomic importance of some morphological characters was analysed and discussed in the genus Dendrocoelum: the adenodactyl structure and especially it musculature (Harrath et al., 2012), the penial flagellum and the bursal canal sphincter (Stocchino et al., 2013).

With respect to the aspect of the adenodactyl cavity, the examined specimens differ from *Dendrocoelum lacteum* described and figured elsewhere (Kenk, 1978). In the analysed

specimens, the adenodactyl with a strong bulb and a large cavity (hollow) within the papilla differs from that of *Dendrocoelum lacteum* figured by Kenk (1978, fig. 50) in which the papilla of the adenodacyl houses a duct. However, Ball and Reynoldson (1981) state a hollow adenodactyl in *Dendrocoelum lacteum*. Adenodactyl with a large cavity (hollow) and not a duct within the papilla is present in some Dendrocoelum s.l. species: *Dendrocoelum lacustre* (Stankovič), 1932-1938; *Dendrocoelum ochridense* (Stankovič & Komárek), 1927 (Kenk, 1978, fig. 41, 44); *Dendrocoelum (Dendrocoelides) debeauchampianum* Codreanu & Balcesco, 1967; *Dendrocoelum (D.) atriostrictum* Codreanu & Balcesco, 1967; *Dendrocoelum (D.) banaticum* Codreanu & Balcesco, 1967 (Codreanu & Balcesco, 1967, fig. 1, 2, 3); *Dendrocoelum (D.) vaillanti* de Beauchamp, 1954; *Dendrocoelum (D.) collini* (de Beauchamp, 1919); *Dendrocoelum (D.) polymorphum* Codreanu & Balcesco, 1967; *Dendrocoelum (D.) racovitzai* de Beauchamp, 1949; *Dendrocoelum (Neodendrocoelum) plesiophthalmus* de Beauchamp, 1937 (Gourbault, 1972, fig. 8.3, 10.1, 11.2, 12.1, 15.2); *Dendrocoelum amplum* Harrath & Sluys, 2012 (Harrath et al., 2012); *Palaeodendrocoelum romanodanubialis* Codreanu, 1950 (Codreanu, 1950, fig. 3). Most probably, the cavity of the adenodactyl – duct/hollow – is correlated with the physiological state as the same type of cavity is present in different morphological forms of Dendrocoelum, for instance in Dendrocoelum with flagellum and in Dendrocoelides without flagellum. By it histological structure, the flagellum of the specimen Dd1 satisfies the condition of the true flagellum discussed by Stocchino et al. (2013).

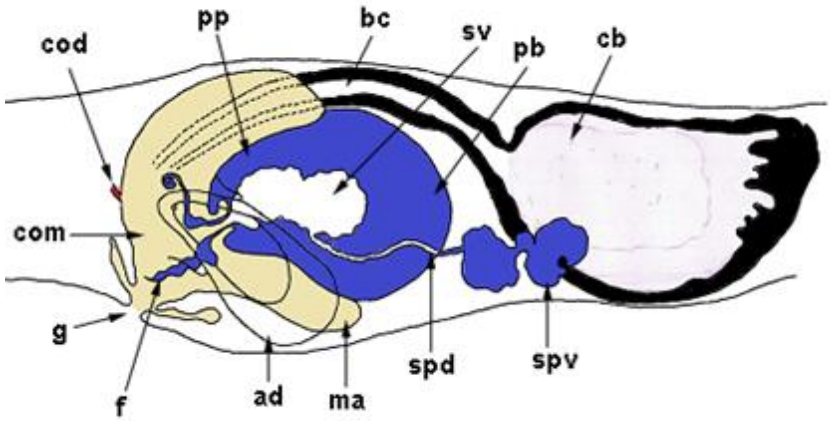


Fig. 8 *Dendrocoelum lacteum* – the sagittal reconstruction of the copulatory apparatus (scale bar not available)

Superfam. Geoplanoidea Stimpson, 1857
Fam. Dugesiidae Ball, 1974

3. *Girardia tigrina* (Girard, 1850)

Only asexual specimens were collected in April and January from Romanescu Park. The general aspect of living and fixed specimens is presented in Fig. 9. The body is brown-olive with white-yellow and dark-brown spots. The lateral sides of the body are white transparent with brown spots. The pharynx is pigmented. The head is sharp

triangular, with triangular auricles. The body of the living worms is up to 11 mm long and 1.5 mm wide for the worms sampled in January and up to 14-15 mm long for the worms sampled in April.

Some specimens sampled in April underwent asexual reproduction by fission, completely developed in nearly one hour. The resulted head and tail showed their own slow movement, the tail being faster than the head. The body of one individual shows clear marks of fission in two points – Fig. 9d. No specimen collected in January showed any sign of asexual reproduction.

Habitat – low polluted waters, temperature – 4.5° C in January, 13-14° C in April.

Fig. 9 *Girardia tigrina* – Romanescu Park
a – living worm, 5.01.2018; b, c – fixed worm, 5.01.2018 ventral and dorsal view; d – living worm in fission, 2.04.2017

Discussions

Because only asexual individuals were sampled, the assignment to *Girardia tigrina* is presumable. The asexual population assigned to *G. tigrina* resembles the general description of *Girardia tigrina* found elsewhere with respect to the external morphology (Ball & Reynoldson 1981, Kawakatsu et al. 2012, Reynoldson & Young 2000, Sluys et al. 2005 and included references). For the specimens from Craiova there are to be noticed the lateral white, transparent, brown-spotted marginal strips.

CONCLUSIONS

The preliminary data of this paper need more detailed and comprehensive studies to confirm the species identity and to establish their phylogenetic affinities on molecular and histological grounds.

The paleo-geographical evolution and the features of the hydrographic and hydrogeological basins of Oltenia Plain and Craiova area (Pleniceanu 1999, Savin 2000) outline the phylo-geographic perspectives on the knowledge of the freshwater Tricladida in this region.

ACKNOWLEDGMENT

Author is deeply grateful to: Dr. M. Niculescu for access to the histological facilities, Mrs. C. Micu for preparing the histological slides, Dr. G. Mogoşanu and Prof. M. Mogoanta at the Faculty of Medicine in Craiova for the Nikon photos, Dr. A. Vlăduţ for the help with the English translation of a draft of the manuscript, Prof. Dr. M. Năstăsescu and Prof. Dr. R. Sluys for general discussions and suggestions on the manuscript. The responsibility for the paper remains to author.

REFERENCES

Ball I. R., Reynoldson T. B., 1981, British Planarians, Platyhelminthes: Tricladida, Keys and notes for the identification of the species, Cambridge University Press, pp. 141.

Ciobotea D., Bădescu I., Zarzără I., Pleniceanu V., Avram C., Lucaks S., 1999, Grădinile şi Parcurile Craiovei. Pagini de Istorie şi Civilizaţie, Vol. VI, 35-69.

Codreanu R., 1950, O nouă tricladă epigee relictă din Defileul Dunării: *Palaeodendrocoelum danubialis* n.g., n. sp. Analele Academiei R.P.R., III (16), 599-622.

Codreanu R., Balcesco D., 1967, Sur le rapports entre les sous-genres Paradendrocoelum Kenk 1930 et Dendrocoelides de Beauchamp 1919 d'après les espèces obscuricoles du Banat et de l'Olténie. Revue Roumaine de Biologie, Zoologie, 12 (5), 337-349.

Gourbault N., 1972, Recherches sur les Triclades paludicoles hypogés, Mémoires du Muséum National d'histoire Naturelle, nouvelle série, série A, Zoologie, LXXIII, pp. 249 + 3 planches.

Harrath A. H., Sluys R., Ghlala A., Alwasel S., 2012, The first subterranean freshwater planarians from north Africa, with an analysis of adenodactyl structure in the genus Dendrocoelum (Platyhelminthes, Tricladida, Dendrocoelidae). Journal of Cave and Karst Studies, 74 (1), 48-57, DOI: 10.4311/2011LSC0215

Ijima I., 1884, Untersuchungen uber Bau und die Entwicklungschichte der Susswasser Dendrocoelen. Zeitschrift für wissenschaftliche Zoologie, Bd. XL.

Kenk R., 1978, The planarians (Turbellaria: Tricladida Paludicola) of Lake Ohrid in Macedonia. Smithsonian Contribution to Zoology, 280, 1-56.

Năstăsescu M., 1976, Despre trei specii ale genului Polycelis Ehrenberg 1831 (Tricladida – Paludicola) prezente în apele României. Studii şi Cercetări de Biologie, seria Biologie Animală, 28 (1), 3-8.

Pleniceanu V., 1999, Apele din Câmpia Olteniei, Edit. Universitaria, Craiova, pp. 354.

Reynoldson T. B., Young J. O., 2000, A key to the freshwater Triclads of Britain and Ireland with notes on their ecology, Freshwater Biological Association, No. 5, pp. 72.

Savin C., 2000, Apele subterane din zona Craiova, Edit. Tipored, pp.313.

Sluys R., Kawakatsu M., Ponce De Leon R., 2005, Morphological stasis in an old and widespread group of species: Contribution to the taxonomy and biogeography of the genus Girardia (Platyhelminthes, Tricladida, Paludicola). Studies on Neotropical Fauna and Environment, 40 (2), 155-180.

Sluys R., Kawakatsu M., Riutort M., Baguñà J., 2009, A new higher classification of planarian flatworms (Platyhelminthes, Tricladida). Journal of Natural History, 43 (29-30), 1763-1777, DOI: 10.1080/00222930902741669

Stocchino A. G., Sluys R., Marcia P., Manconi R., 2013, Subterranean aquatic planarians of Sardinia, with a discussion on the penial flagellum and the bursal canal sphincter in the genus Dendrocoelum (Platyhelminthes, Tricladida, Dendrocoelidae). Journal of Cave and Karst Studies, 75 (2), 93-112. DOI: 10.4311/2011LSC0252.

Taylor M. C., Reynoldson, T. B., 1962, The Population Biology of Lake-Dwelling Polycelis Species with Special Reference to *P. nigra* (Müll.) (Turbellaria, Tricladida). Journal of Animal Ecology, 31(2), 273-291.

Web references:

Kawakatsu M., Nishino M., Ogata K., Kuranishi N. B., Kobayashi N., Ohtaka A., *2012, Two North American Freshwater Planarian Species Now Naturalized in Japan: Girardia tigrina (Girard, 1850) and Girardia dorotocephala (Woodworth, 1897) ---In Connection with the Field Survey of Benthic Invertebrates*---, Kawakatsu's Web Library on Planarians: December 15, 2012.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

RESEARCHES ON THE INFLUENCE OF CLIMATE CHANGE ON THE QUALITY OF WINE-PRODUCTION PRODUCTION IN THE SÂMBREŞTI VINEYARD

Băducă Cîmpeanu C.[1], Marinică Ion[2], Mete L.[3]

[1]University of Craiova, Faculty of Horiculture
[2]University of Craiova, Faculty of Science, Craiova
[3]University of Craiova, Faculty of Horiculture, Master Vine-Wine Expertise
Correspondence author. E-mail: *cbaduca@gmail.com, metelaurentiu@yahoo.com*

Keywords*: grapevine, climatic changes, vineyard, ripering*

ABSTRACT

The Sâmbureşti vineyard is one of the most famous vineyards in Romania for the production of high quality wines, especially tomatoes. The prestige of Sâmbureşti wines is based on their quality due, first of all, to the grapes harvested at the optimum maturity, depending on the characteristics of the wine to be obtained. Grape breeding is a phenomenon closely related to the climatic conditions specific to the wine year. The climatic conditions specific to the Sâmbureşti vineyard are very favorable for obtaining high quality. In recent years, the phenomenon of climate change, also known as global warming, has a strong impact on viticulture and winemaking all over the world. In order to see to what extent climate change influences the quality of wine-growing, we conducted a study of the 5 main varieties cultivated in the Sâmbureşti vineyard (3 varieties for red wines and two varieties for white wines), which covered the wine years 2015, 2016 and 2017. The results show that under the influence of climate change, grape ripening is much earlier, which leads to the accumulation of higher amounts of sugar in grapes to technological maturity.

INTRODUCTION

Seasonal fluctuations in yield, grape composition and wine attributes, largely driven by variable climatic conditions, are major challenges for the wine industry aiming to meet consumer expectations for consistent supply, wine style and product quality (Cichi Daniela Doloris, 2006; Clingeleffer P.R., 2010). Is projected to have a significant effect on European viticultural geography. Detrimental impacts on winegrowing are predicted in southern Europe, mainly due to increased dryness and cumulative thermal effects during the growing season (Malheiro A. e.a., 2010).

The effect of temperature on berry composition is biologically interesting and has practical implications for wine attributes (Bonada M. and Sadras V.O., 2015). Vine phenology and grape ripening are highly dependent on water uptake conditions. Mild water deficit stress enhances grape quality for the production of red wines (Maracineanu L.C., 2011). Vine water status can accurately be assessed by means of stem water potential or carbon isotope discrimination measured on grape sugars. Quality losses through severe water stress can be avoided through the use of drought-adapted plant material, appropriate canopy management, yield reduction or the implementation of deficit irrigation (Van Leeuween C. e.a., 2009). Temperature and solar radiation

influence Vitis vinifera L. berry ripening. Both environmental conditions fluctuate cyclically on a daily period basis and the strength of this fluctuation affects grape ripening too. Additionally, a molecular circadian clock regulates daily cyclic expression in a large proportion of the plant transcriptome modulating multiple developmental processes in diverse plant organs and developmental phases. Circadian cycling of fruit transcriptomes has not been characterized in detail despite their putative relevance in the final composition of the fruit (Carbonell-Bejerano P. e.a., 2014).

The terroir and typic concepts are complex and have several dimensions little known outside the wine branch. Controlled by manufacturers and market executives, these concepts could be relevant communication vectors if consumers understand them too (Jourjon F. e.a., 2013, Muntean Camelia e.a., 2016).

The physiology of grapevine has already suffered significant impacts of global climate change over the last decades. Harvesting takes place earlier, although grape growers tend to wait longer for maturity. The content of the grains in sugar (and alcohol in wine) tends to increase, while phenolic and aromatic maturity is not always attained. Acidity tends to decrease with potential effects on wine aging capacity. Water supply is becoming shorter in many regions (Delrot S. e.a., 2010).

MATERIAL AND METHODS

We conducted a study in the vineyard of Sâmbureşti, where we followed the way the influence of climate change on the quality of the wine-growing production is felt. In order to accomplish the proposed goal, the research followed two directions: analysis of climatic data and oenological data analysis.

With regard to climatic data, we first performed an analysis of the multi-annual values for temperature, precipitation and insolation, the main climatic indicators for assessing climate favorability for viticulture. The benchmark ranges for a period of 40 years (1975-2014). The study of the multi-annual climate data aimed to characterize the specific climate of the Sâmbureşti vineyard by calculating the multi-annual average values for each month for temperature, precipitation and insolation. We have also watched to what extent, from these data, the phenomenon of climate change is confirmed or not.

With regard to oenological data we analyzed the productivity and quality of grapes at full maturity for a number of 5 varieties: 2 white varieties (Chardonnay and Sauvignon) and 3 red varieties (Merlot, Cabernet Sauvignon, Black Feteasca). All of these varieties are part of the new assortment of the Sâmbureşti vineyard, they are found in the young plantations, established in 2008-2010, through the program of conversion and restructuring in viticulture. Driving systems are different: Guyot for white varieties; the hop planted for red varieties, the planting distances are the same for all varieties: 2.2 m between rows, 1 m between plants per row, resulting in a density of 4545 vines/ha.

For all varieties, we followed the date when the full yield (corresponding to the maximum grain weights) of the production/hub (by multiplying by 4545 we obtained production per hectare), the sugar content and the total acidity of the grapes, ie the parameters determined at tracking the baking process.

RESULTS AND DISCUSSIONS

The analysis of the multiannual climatic synthesis data for the Sâmbureşti vineyard, presented in Table 1 shows that this vineyard enjoys particularly favorable climatic conditions for a quality viticulture. Along with soils and relief, the climate represents the natural environment of vine cultivation in the vineyard of Sâmbureşti, particularly favorable for obtaining high quality wines, both white and especially red.

The analysis of temperature data shows that one month in the year (January) has a negative multiannual average for a 40-year period. The other winter months (December and February) have positive multiannual average values, although over the course of these months they have recorded negative average temperatures. Also, negative monthly average temperatures were recorded outside the winter months in March and November, but they were rare and accidental. For the vegetative growing season, the values are very good.

For precipitations and the duration of sunshine, values are also favorable to vines, but with absolute values that vary within very wide limits, indicating that each viticultural year is different and which significantly influences wine-growing and its quality.

Table 1

Parameters of multiannual climatic indicators in the Sâmbureşti vineyard (1975 – 2014)

Temperature, ^{0}C				**Precipitations, mm**			**Insolation, ore**		
T^0 medie	Min.	**Average**	Max.	Min.	**Average**	Max.	Min.	**Average**	Max.
January	- 5,2	**- 0,5**	5,8	1,1	**51,1**	76,5			
February	- 5,7	**0,8**	7,4	2,5	**33**	84,3			
March	- 0,2	**5,8**	10,4	0,8	**34,5**	86,0			
April	7,1	**11,4**	14,3	2,4	**45**	151,4	138,1	**193,0**	292,8
May	13,5	**16,7**	20,5	18,4	**78,0**	281,8	146,9	**250,9**	350,5
June	17,6	**20,2**	23,1	8,4	**74,7**	165,2	212,3	**281,6**	364,0
July	19,5	**22,4**	26,9	7,4	**71,6**	211,4	257,1	**313,4**	399,3
August	17,4	**21,9**	25,3	5,6	**59,3**	191,8	211,5	**290,6**	399,3
September	13,6	**17,4**	21,9	2,6	**46,9**	191,8	135,4	**222,2**	282,6
October	8,8	**11,6**	14,7	0,2	**47,6**	140,2			
November	- 0,1	**5,4**	10,5	0,2	**41,4**	123,7			
December	- 3,1	**0,8**	5,2	0,2	**43,2**	139,9			
Annual	9,7	**11,5**	12,5	323,2	**611,0**	1156,8	**1101,3**	**1541,8**	**2088,5**

The average annual average temperature in the Sâmbureşti vineyard is 11.5°C. The coldest year was 1976 with an average temperature of 9.7°C, and the warmest year was 2007 with an average temperature of 12.5°C. Thus, the amplitude of annual averages was 2.8 ° C. The frequency of very cold years (mean temperature ≤10.0°C) is 6.0 % and very hot years (years with mean ≥12.0°C) was 16.0 %, which shows a higher high share of the very warm years compared to the very cold. The annual average temperature variation chart has an increasing linear trend, confirming the trend of global warming.

In the vineyards of Sâmbureşti, the spring is warm and warm, the summers are warm, with many tropical and hectic days, the autumns are long and warm and the winters are mild. In some time periods, "warm windows" are recorded, and agro-meteorological frost has a low frequency (8 % in December and 10 % in January). Under these conditions, the thermal regime is particularly favorable for the cultivation of all varieties of vine, especially those for red wines.

An overview of recording data from 1975 to 2014 for the duration of the Sunshine shows that the average monthly sunshine duration was 258.6 hours, the minimum duration was 135.4 hours recorded in the rainy month of September 1998 (94.5 L/m^2), the maximum duration was 399.3 hours recorded in an excessively drought and heat month July 2007 (7.4 L/m^2). The overall monthly sunshine graphs have a strongly increasing linear trend (excluding September), which is directly related to the global warming climate process, which has increased the number of warm days as well as those with variable or clear sky. The analysis of the monthly regime shows that it is particularly favorable to the vineyard culture with a peak in the warmest month - July.

If we refer to the multiannual average temperature, which is 11,5^{0}C for the reference range (1975-2014), it is noted that starting with 2007, with one exception (2011), all years had a mean temperature above the multiannual average, an aspect that must be borne in mind by the global warming phenomenon. This is confirmed by the average of the last 10 years, when a much higher average (11,75^{0}C) than the average of the first 10 years of the reference range (10,87^{0}C) results. So, at the Sâmbureşti vineyard level, the global warming phenomenon is as real as it can be demonstrated by the average annual temperatures.

This trend accelerated after 2014, 2015 being the first year in which the average global temperature exceeded by 1°C, the average of the last century. In 2016, the exceedance was even higher than in 2015, and 2017 is in the first three years the warmest on our planet, with extreme weather phenomena, according to the WMO provisional climate statement and the NASA Goddard Institute for Space Studies (GISS) report in New York. The report also highlights the impact on human safety, well-being and the environment.

The data in Table 2 highlights how the influence of climate change on wine-growing, the impact on grape production and quality parameters is manifested.

The study conducted on the 5 basic varieties of the Sâmbureşti vineyard range shows that all varieties reach maturity in 2016 more quickly than in 2015 with 2-4 days and in 2017 as compared to 2016, which means that in 2017 the full maturity of was reached 5-8 days earlier than in 2015 at all varieties studied. Thus, depending on the variety, the grapes have reached full maturity as follows; between September 8 and 18, 2015, between September 5 and September 15, 2016, and between September 3 and September 11, 2017. The main consequence of the early grapes' arrival at full maturity is that of the main parameters of grape composition - the contents in sugar and total acidity.

The full maturity moment is much more relevant for the study of the maturing dynamics compared to the time of harvest, as the latter varies according to the technological objectives to be pursued, and to what extent the grapes must be copts at the time of harvesting, according to the type of wine to be obtained.

The analysis of the data in Table 2 shows that in 2015 the grapes presented at full maturity between 206 and 212 g/L, in 2016 between 202 and 209 g/L, and in 2017 between 200 and 207 g/L. At the same time, total grape acidity values were between 4.05 and 4.06 g/L of H_2SO_4 in 2015, between 4.21 and 4.64 g/L of H_2SO_4 in 2016 and between 4.48 and 4,75 g/L H_2SO_4 in 2017.

Another very important element to be taken into account when assessing vineyard production is the yield or the level of production. If, in 2015, grape yields were between 2.04 and 2.18 kg/vine (9.27 to 9.90 t/ha), in 2016, at the time of reaching full maturity earlier, grape yields were between 2.08 and 2.28 kg/vine (9.45 and 10.18 t/ha), while in 2017 they were between 2.1 and 2.28 kg/vine (9.54 and 10.36 t/ha).

Table 2

Productivity and quality of grapes at full maturity

Year		Chard.	Sv. Bl.	Merlot	Cabernet S.	Fetească N.
2015	Date F.M.	8.IX	10.IX	14.IX	18.IX	18.IX
	Sugars, g/L	212	206	206	212	208
	A.T., g/L H_2SO_4	4,05	4,12	4,32	4,40	4,46
	Kg/vine	2,12	2,04	2,18	2,04	2,05
2016	Date F.M.	5.IX	8.IX	10.IX	14.IX	15.IX
	Sugars, g/L	209	202	204	209	205
	A.T., g/L H_2SO_4	4,21	4,31	4,44	4,52	4,64
	Kg/vine	2,16	2,08	2,24	2,08	2,18
	Date F.M.	3.IX	5.IX	7.IX	10.IX	11.IX

2017	Sugars, g/L	204	200	202	207	201
	A.T., g/L H_2SO_4	4,48	4,56	4,60	4,70	4,75
	Kg/vine	2,21	2,15	2,28	2,10	2,21

Chard - Chardonnay, Sv. Bl. - Sauvignon Blanc, F.M. - Full maturity

The results show that climate change significantly impresses on vineyard production in the vineyard of Sâmbureşti. In the wine industry the quality of grape raw material is a major factor in the quality of wines. The sugar and acidity content of the grapes at the time of full maturity is very good, especially since it is going to improve over the overmature, which creates particularly favorable premises for obtaining high-class, competitive domestic and export wines. In this respect, the global warming phenomenon has helped the quality of wine-growing.

CONCLUSIONS

The phenomenon of climate change is manifested in the vineyard of Sâmbureşti, with all the elements that define it, of which in this study we highlighted the significant increase of the average annual temperatures in the last decade. To characterize the climate of the vineyard we analyzed the climatic data for a period of 40 years (1975-2014). The data recorded during this study (2015-2017) show that this phenomenon was particularly noticeable in the last 3 years. The phenomenon of climate change, also known as global warming, has triggered a hurry in the baking process, which made grapes reach technological maturity sooner, even if it meant lower sugar contents, but they knew increases important to the technological maturity, respectively the harvest time. The limitation of grape production and the very good values of the main chemical constituents of grapes (sugars and acidity) have a predominant influence on the quality of the wine. From this point of view, it can be said that in the vineyard of Sîmbureşti during the years 2015-2017, have had a beneficial influence on wine-growing. In the future, it is to be expected that in the short and medium term, climate change will continue to be beneficial for wine-growing but in the medium to longer term, less favorable side-effects will start to appear.

REFERENCES

Bonada M., Sadras V.O., 2015. Review: critical appraisal of methods to investigate the effect of temperature on grapevine berry composition. Australian Journal of Grape and Wine Research, vol. 21, nr. 1, pag. 1–17.

Carbonell-Bejerano P., Rodríguez Virginia, Royo Carolina, Hernáiz Silvia, Moro-González L.C., Torres-Viñals M., Martínez-Zapater J.M., 2014. Circadian oscillatory transcriptional programs in grapevine ripening fruits. BMC Plant Biology, vol. 14, nr. 78, pag. 1-15.

Cichi Daniela Doloris, 2006. Modificările termice din ecosistemul viticol. (Cauze, efecte asupra viţei de vie, studii). Editura Universitaria Craiova.

Clingeleffer P.R., 2010. Plant management research: status and what it can offer to address challenges and limitations. Australian Journal of Grape and Wine Research, vol. 16, Nr. Special, pag. 25–32.

Delrot S., Medrano H., Or E., Bavaresco L., Grando S., 2010. Methodologies and Results in Grapvine Research; Springer: New York, USA, pag. 5–6.

Jourjon F., Wilson D., Symoneaux R., 2013. Le terroir: mythe ou réalité pour les consommateurs de vin? Revue Suisse Viticulture, Arboriculture, Horticulture, vol. 45, nr. 2, pag. 122–125

Malheiro A., Santos J., Fraga H., Pinto J., 2010. Climate change scenarios applied to viticultural zoning in Europe. Climate Research, vol. 43, no. 3, pp. 163–177.

Maracineanu L.C., 2011. Aplicaţii ale ecologiei în viticultură. Editura Universitaria, Craiova.

Muntean Camelia, Stoica Felicia, Băducă Constantin, 2016. Establishing the quality indicators of the red wines in Drăgăşani vineyard. Analele Universităţii din Craiova, seria Biologie, Horticultură, Tehnologia Prelucrării Produselor Agricole, Ingineria Mediului, vol. XXI (LVII), pag. 331-336.

Van Leeuween C., Trégoat O., Choné O., Bois B., Pernet D., Gaudillère J.P., 2009. Vine water status is a hey factor in grape ripening and vintage quality for red Bordeaux wine. How can it be assessed for vineyard management purposes? Journal International of Sciences Vigne Vin, vol. 43, nr. 3, pag. 121-134.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

CALAMINTHA OFFICINALIS MOENCH (*LAMIACEAE*) – HISTO-ANATOMICAL AND PRELIMINARY CHROMATOGRAPHIC RESEARCHES

Bejenaru Cornelia[1], Bejenaru Ludovic Everard[2], Biţă Andrei[2], Mogoşanu George Dan[2*], Scorei Iulia Daria[3], Blendea Antonia[1]

[1]Department of Vegetal & Animal Biology, Faculty of Pharmacy, University of Medicine and Pharmacy of Craiova
[2*]Department of Pharmacognosy & Phytotherapy, Faculty of Pharmacy, University of Medicine and Pharmacy of Craiova
[3]BioBoron Research Institute, S.C. Natural Research S.R.L., Craiova
** Correspondence author. E-mail:* mogosanu2006@yahoo.com

Keywords*: Calamintha officinalis Moench, Lamiaceae, histo-anatomy, polyphenols, thin-layer chromatography.*

ABSTRACT

The paper contains the histo-anatomical researches on the root, aboveground stem and leaf of Calamintha officinalis Moench species, as well as preliminary chromatographic analysis of the polyphenols content of Calaminthae officinalis herba. In the thin-layer chromatogram, chlorogenic acid was identified from the six-polyphenol components specific bands.

INTRODUCTION

Calamintha officinalis Moench, Calamint, Mountain Mint, *Lamiaceae* family, is an herbaceous, perennial, Eurasian species, 50–60 cm height, which blooms in July–September, spontaneous on well-drained dry grassy banks, calcareous soils, in the forests glades and meadows (Ciocârlan 2000, Singh et al. 2012a & 2012b).

The medicinal product *Calaminthae officinalis herba* contains many active principles, as follows: essential oil (*β*-bisabolene, germacrene D, piperitenone, *cis*-piperitone oxide), flavonoids (eriocitrin, eriodyctiol, acacetin), triterpenes, catechic tannin, phenolic acids (chlorogenic acid, *p*-coumaric acid), mineral salts (Karousou et al. 2012, Monforte et al. 2012, Singh et al. 2012a & 2012b).

The extractive preparations obtained from the aerial parts of *C. officinalis* exhibit numerous benefits, due to some useful pharmacological actions, such as: aromatic, antimicrobial and preservative, diaphoretic, expectorant, stomachic, anti-spasmodic, anti-inflammatory and anti-ulcer against alcohol-induced gastric mucosa injury in rats, bitter tonic, cicatrizing, hypoglycemic, antioxidant and antiproliferative *in vitro* on MCF-7 breast cancer cell line (Lemhadri et al. 2004, Moattar et al. 2015, Monforte et al. 2012, Singh et al. 2012a & 2012b).

Information about *C. officinalis* histo-anatomy is found in some specialty works (Singh et al. 2012a, Toma & Rugină 1998). The aim of our paper was the histo-anatomical study on the roots, aboveground stems and leaves of *C. officinalis* and the preliminary chromatographic investigation of polyphenols from the aerial parts (*Calaminthae officinalis herba*).

MATERIAL AND METHODS

Histo-anatomical analysis

The vegetal material was harvested in July 2016, from *C. officinalis* plants in blossom, spontaneous in the surroundings of Bozovici commune, Caraş-Severin County (southwestern Romania).

The roots, aboveground stems and leaves were fixed and stored in 70 % ethanol. Using botanical razor, the cross-sections and longitudinal-radial sections were performed.

After pre-washing with distilled water, the sections were clarified using Javel water (10 % sodium hypochlorite solution); the clarifying solution was subsequently removed by washing with distilled water.

A Congo red–chrysoidine mixture (Genevese reagent) was used for the staining of sections. Various colors were obtained starting from the composition of cell membranes: pink to red for cellulose and mucilages, pale red for cytoplasm, yellow for suberin and brown for lignin (Andrei & Paraschivoiu 2003).

Stained and mounted sections were analyzed on a Krüss binocular photon microscope (×4, ×10, ×20, and ×40 objectives).

Nikon Eclipse 55i binocular microscope coupled with a Nikon DS–Fi1 high definition charge-coupled device (CCD) video camera and Image-Pro Plus *ver*. 6.0 software package (Media Cybernetics) were utilized for shooting and for image acquisition and processing, respectively.

Considering the works of some classical authors (Toma & Rugină 1998), the histo-anatomical review of sections was validated accordingly.

Thin-layer chromatography (TLC) analysis

The preliminary analysis of polyphenols was performed on the aerial parts of *C. officinalis* (*Calaminthae officinalis herba*), using TLC CAMAG system (Muttenz, Switzerland) (Altemini et al. 2015, Bojić et al. 2013, Gîrd et al. 2014, Jug et al. 2018):

- stationary phase: TLC silica gel 60 F_{254} (Merck, Darmstadt, Germany) 10×10 cm precoated glass plates, pre-washed with chloroform–methanol (1:1, *v/v*) and activated by oven-drying (110^0C, 30 minutes);
- mobile phase: ethyl acetate–formic acid–methanol–water (15:1:0.1:1, in volumes);
- 10 mL of mobile phase were added in the developing twin-chamber and then oversaturated for 20 minutes;
- sample: 20 % methanolic extract of *Ononidis arvensis herba*;
- standards (Merck): 0.05 % methanolic solutions of caffeic acid, chlorogenic acid, quercetin and rutin;
- migration distance: 62 mm (sample application line – 8 mm, solvent front – 70 mm);
- sample (8 µL, 10 µL) and standards (2 µL) application: CAMAG Linomat 5 semiautomatic system – spray gas nitrogen, syringe volume 100 µL, dosage speed 150 nL/s, predosage volume 0.2 µL, bands length of 8 mm;
- plate drying: 5 minutes, at 25^0C (cold air dryer);
- photographing the chromatographic plate: UV light (λ 254 nm);
- detection: CAMAG TLC Scanner 3 photodensitometer, for densitogram and *in situ* UV light (λ 280 nm) spectra, without derivatization, deuterium–wolfram lamp, scanning speed 40 mm/s, data resolution 200 µm/step, measurement mode absorption;
- winCATS *ver.* 1.4.3 software package.

RESULTS AND DISCUSSIONS

Histo-anatomical analysis

Root

The cross-section in the lower third of the root highlighted round shape and secondary structure due to the libero-ligneous cambium. The following histological sequence was evidenced from the outside towards the inside of root: Rhizodermis is exfoliated. The first discernible layer is exodermis, consisting of large cells with suberin-impregnated walls. From place to place, passage cells are observed. The cortical parenchyma is made up of large oval cells, with thin, cellulosic walls that delineate small intercellular spaces. The last layer of the bark is endodermis, made up of a single layer of heterodiametric cells. At this level, Casparian strips and passage cells are observed. The conducting tissues are arranged on two concentric rings; predominates the secondary tissues, generated by the secondary meristem (libero-ligneous cambium). The phloem tissue forms a thin, external ring, consisting of sieve tubes, phloem parenchyma and annex cells. Occupying the central area of the root, the xylem tissue is made up of few metaxylem vessels of different calibers, disordered placed in the libriform tissue mass, pushing to the center small diameter protoxylem vessels, accompanied by some xylem parenchyma. The medullary rays are multicellular, uniseriate, cellulosic, at the level of the phloem tissue, and multi-cellular, uniseriate, lignified and sclerified, at the level of the xylem tissue ring. The medullary parenchyma is missing (Figure 1).

Aboveground stem

In the upper third, the aboveground stem exhibited four-edged shape and secondary structure due to the libero-ligneous cambium. On cross-section, from the outside to the inside of aboveground stem, the following histological sequence has been observed: The epidermis has approximately isodiametric cells, having thickened outer wall covered by a thin cuticle with toothed relief. The epidermal cells are slightly tangential elongated, with thin radial walls and thick tangential external and internal walls.

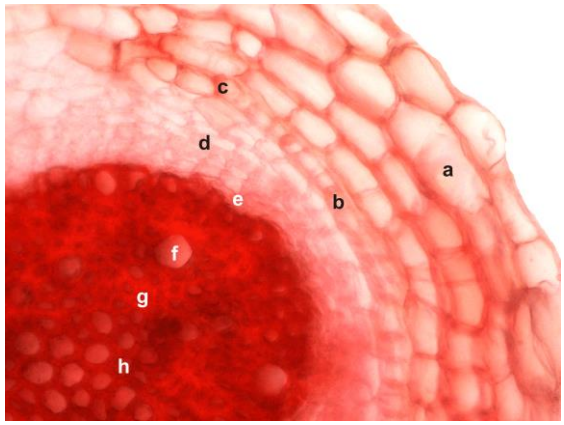


Figure 1. Cross-section through *C. officinalis* root: (a) cortical parenchyma; (b) endodermis; (c) Casparian strips; (d) phloem fascicle; (e) libero-ligneous cambium; (f) metaxylem; (g) libriform tissue; (h) protoxylem (Congo red–chrysoidine staining, ×400).

From place to place, there are stomata, rare multi-cellular, unseriate and elongated tector trichomes, but also short glandular trichomes with a unicellular secretory gland. The bark is organized into 5–7 layers of angular collenchyma, at the ribs' level,

and 2–3 layers of chlorenchyma, between the ribs. The inner area of the bark is parenchymatous. Inside the bark, there is a single layer of primary-type endodermis, made up of large cells, impregnated with suberin. The conducting tissues are organized into four big libero-ligneous fascicles of collateral open type, at the ribs' level, and four small libero-ligneous fascicles, resulting from the activity of libero-ligneous cambium. The small libero-ligneous fascicles are made up of phloem and xylem tissues only of secondary origin. The phloem tissue is made up of sieve tubes, some phloem parenchyma and annex cells. The medullary rays are multicellular, multiseriate, cellulosic. The periphloemic appearance of some discontinuous packages of sclerenchyma fibers is observed. The xylem tissue is made up of highly lignified and well-represented libriform tissue, near the intra-fascicular cambium, and of metaxylem with different calibers, disposed in radial strings towards the inner side of the large conducting fascicles. On the longitudinal-radial sections, the xylem vessels exhibit reticulate and helical thickenings. The primary xylem tissue is poorly represented, consisting of few primary xylem vessels and xylem parenchyma. Between the conducting fascicles of the xylem area, the medullary rays are wide and strongly lignified. The medullary parenchyma is well developed, of meatus type (Figure 2).

Leaf

Leaf's limb

In cross-section, the following histological sequence was evidenced from the outside towards the inside of leaf's limb: The upper epidermis consists of a single layer of large, flattened cells, having thickened tangential external and internal walls and thin radial walls.

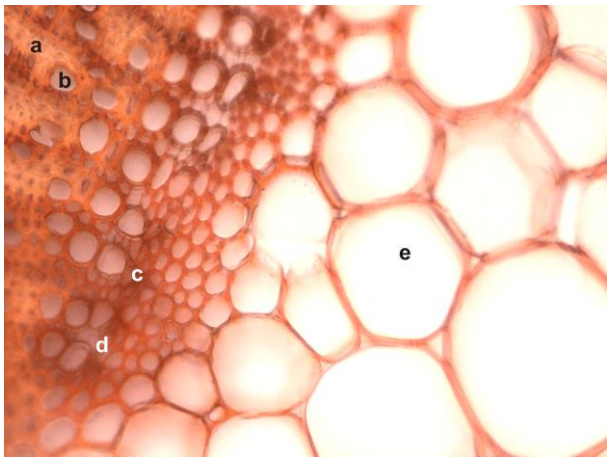


Figure 2. Cross-section through *C. officinalis* aboveground stem: (a) libriform tissue; (b) metaxylem; (c) protoxylem; (d) xylem parenchyma; (e) medullary parenchyma (Congo red–chrysoidine staining, ×200).

The outer walls are bulged and covered by a thin cuticle with toothed relief. Glandular trichomes with multicellular, seriate, unbranched pedicle, made up of 2–3 cells and a unicellular gland, are found in patches. The mesophyll consists of a single layer of palisade parenchyma, with large, elongated and chloroplast-rich cells, but also of 3–4 layers of lacunose parenchyma, having small cells with disordered layout and aeriferous spaces. Numerous small libero-ligneous conducting fascicles are found into the mesophyll. The mesophyll has bifacial type with dorsiventral structure. The lower epidermis consists of a single layer of small, tangential elongated cells, with thin radial

walls and slightly thickened tangential external and internal walls. The cuticle has a toothed relief. At this level, there are numerous diacytic stomata and glandular trichomes, with unicellular, short pedicle and multicellular gland, placed into the epidermal excavations. The median rib is slightly protruding and rounded to the abaxial face. In the central area, into the leaf's parenchyma, a single libero-ligneous conducting fascicle is found. Into the libero-ligneous fascicle, the xylem vessels have a seriate layout and the medullary rays are uniseriate, cellulosic. The leaf's limb has bifacial, dorsiventral, hypostomatic structure (Figure 3).

Petiole

On the cross-section, the petiole highlighted semi-elliptical shape, with two laterally adaxial wings. From the outside towards the inside, the following tissues sequence was evidenced: The epidermis is made up of a single layer of large, isodiametric cells, with thickened tangential external and internal walls and thin radial walls.

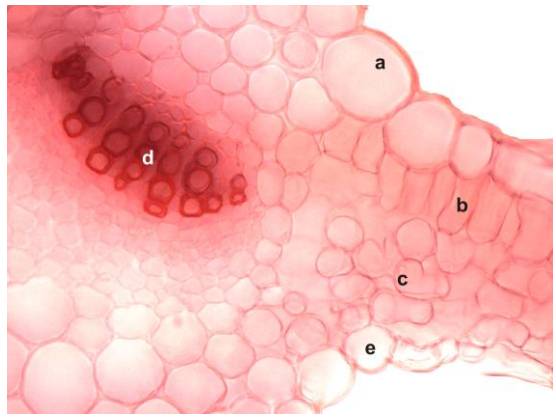


Figure 3. Cross-section through *C. officinalis* leaf's limb: (a) upper epidermis; (b) palisade parenchyma; (c) lacunose parenchyma; (d) libero-ligneous fascicle; (e) lower epidermis (Congo red–chrysoidine staining, ×400).

The outer walls are bulged and covered by a thin cuticle with toothed relief. From place to place are found diacytic stomata, rare multicellular, uniseriate, elongated tector trichomes, but also short glandular trichomes with a unicellular secretory gland. To the abaxial side and at the wings level, there are two layers of angular collenchyma. Into the fundamental parenchyma of meatus type, a large, centrally disposed libero-ligneous fascicle, with the primary xylem vessels arranged in radial strings, and two small conducting fascicles, at the wings level, are found (Figures 4 and 5).

Figure 4. Cross-section through *C. officinalis* petiole: overview (Congo red–chrysoidine staining, ×40).

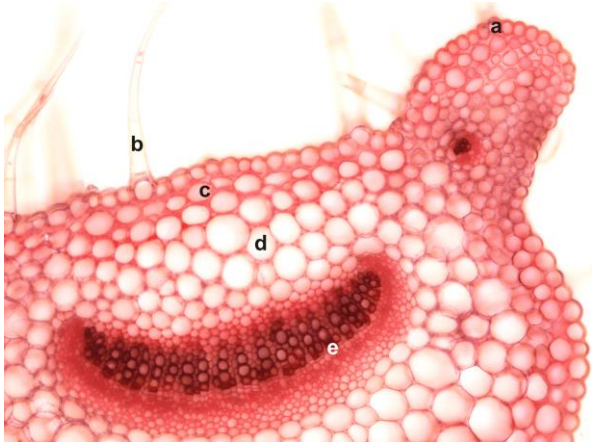


Figure 5. Cross-section through *C. officinalis* petiole: (a) epidermis; (b) tector trichome; (c) angular collenchyma; (d) fundamental parenchyma; (e) libero-ligneous conducting fascicle (Congo red–chrysoidine staining, ×100).

TLC analysis

The experimental data about preliminary TLC analysis of polyphenols from *Calaminthae officinalis herba* are highlighted in Figures 6–8. A concentration of 153.9 µg/mL chlorogenic acid (R_f 0.32) was quantified in 20 % methanolic extract, corresponding to 76.95 mg/100 g of dried vegetal product.

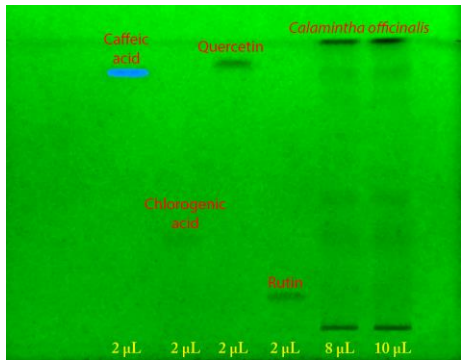


Figure 6. TLC chromatogram of polyphenols from *Calaminthae officinalis herba* 20 % methanolic extract (UV 254 nm, without derivatization). From left to right: first four bands – standards (2 µL); last two bands – sample (8 µL and 10 µL).

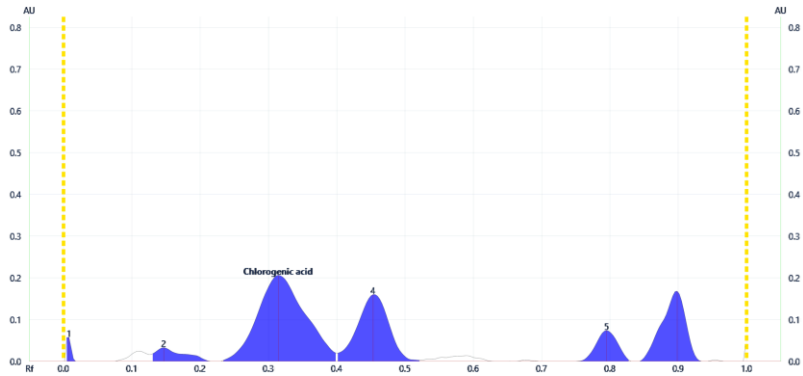


Figure 7. Densitogram of polyphenols (UV 280 nm, without derivatization) separated from *Calaminthae officinalis herba* 20 % methanolic extract. Chlorogenic acid was identified at R_f 0.32.

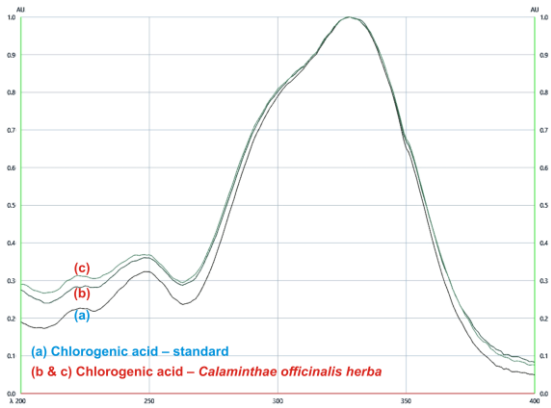


Figure 8. *In situ* UV spectra (UV 280 nm) of chlorogenic acid standard and compound separated from the analyzed sample.

CONCLUSIONS

The study highlighted the histo-anatomical specific features of the roots, aboveground stems and leaves of *Calamintha officinalis* and the preliminary TLC investigations on the polyphenols from *Calaminthae officinalis herba*. In the lower third, the root has round shape and secondary structure. In the upper third, the aboveground stem showed four-edged shape and secondary structure. The leaf's limb has bifacial, dorsiventral, hypostomatic structure and the petiole semi-elliptical shape, with two laterally adaxial wings. Chlorogenic acid was quantified in the 20 % methanolic extract (153.9 µg/mL).

REFERENCES

Altemini A., Watson D. G., Kinsel M., Lightfoot D. A., 2015, Simultaneous extraction, optimization, and analysis of flavonoids and polyphenols from peach and pumpkin extracts using a TLC-densitometric method. Chem. Cent. J., 9:39.

Andrei M., Paraschivoiu Roxana Maria, 2003, Microtehnică botanică, Edit. Niculescu, Bucureşti, 2003, 222 pp.

Bojić M., Simon Haas V., Sarić D., Maleš Z., 2013, Determination of flavonoids, phenolic acids, and xanthines in mate tea (*Ilex paraguariensis* St.-Hil.). J. Anal. Methods Chem., 2013:658596.

Ciocârlan V., 2000, Flora ilustrată a României. *Pteridophyta et Spermatophyta*, ediţia a 2-a revizuită şi adăugită, Edit. Ceres, Bucureşti, 1138 pp.

Gîrd C. E., Nencu I., Costea T., Duţu L. E., Popescu M. L., Ciupitu N., 2014, Quantitative analysis of phenolic compounds from *Salvia officinalis* L. leaves. Farmacia, 62(4):649–657.

Jug U., Glavnik V., Kranjc E., Vovk I., 2018, High-performance thin-layer chromatography and high-performance thin-layer chromatography–mass spectrometry methods for the analysis of phenolic acids. J. Planar Chromatogr., 31(1):13–22.

Karousou R., Hanlidou E., Lazari D., 2012, Essential-oil diversity of three *Calamintha* species from Greece. Chem. Biodivers., 9(7):1364–1372.

Lemhadri A., Zeggwagh N. A., Maghrani M., Jouad H., Michel J. B., Eddouks M., 2004, Hypoglycaemic effect of *Calamintha officinalis* Moench. in normal and streptozotocin-induced diabetic rats. J. Pharm. Pharmacol, 56(6):795–799.

Moattar F. S., Sariri R., Giahi M., Yaghmaee P., Ghafoori H., Jamalzadeh L., 2015, Antioxidant and anti-proliferative activity of *Calamintha officinalis* extract on breast cancer cell line MCF-7. J. Biol. Sci., 15(4):194–198.

Monforte M. T., Lanuzza F., Pergolizzi S., Mondello F., Tzakou O., Galati E. M., 2012, Protective effect of *Calamintha officinalis* Moench leaves against alcohol-induced gastric mucosa injury in rats. Macroscopic, histologic and phytochemical analysis. Phytother. Res., 26(6):839–844.

Singh P. P., Jha S., Irchhaiya R., 2012a, Pharmacognostical and physico-chemical investigation of the leaf of *Calamintha officinalis* Moench. Asian Pac. J. Trop. Biomed., 2(3):S1362–S1366.

Singh P. P., Jha S., Irchhaiya R., Fatima A., Agarwal P., 2012b, A review on phytochemical and pharmacological potential of *Calamintha officinalis* Moench. Int. J. Pharm. Sci. Res., 3(4):1001–1004.

Toma C., Rugină Rodica, 1998, Anatomia plantelor medicinale. Atlas, Edit. Academiei Române, Bucureşti, 320 pp.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓*Biology*
✓*Horticulture*
✓*Food produce processing technology*
✓*Environmental engineering*

ONONIS ARVENSIS L. (*FABACEAE*) – HISTO-ANATOMICAL AND PRELIMINARY CHROMATOGRAPHIC RESEARCHES

Biţă Andrei[1], Bejenaru Cornelia[2], Blendea Antonia[2], Scorei Iulia Daria[3], Bejenaru Ludovic Everard[1]*, Mogoşanu George Dan[1]

[1*]Department of Pharmacognosy & Phytotherapy, Faculty of Pharmacy, University of Medicine and Pharmacy of Craiova
[2]Department of Vegetal & Animal Biology, Faculty of Pharmacy, University of Medicine and Pharmacy of Craiova
[3]BioBoron Research Institute, S.C. Natural Research S.R.L., Craiova
** Correspondence author. E-mail:* ludovic_bejenaru@yahoo.com

Keywords*: Ononis arvensis L., histo-anatomy, polyphenols, thin-layer chromatography.*

ABSTRACT

For Ononis arvensis L. species, the paper presents the histo-anatomical researches on the aboveground stem and leaf, but also the preliminary chromatographic analysis of polyphenols content from the flowering aerial part. Of the nine specific bands for polyphenolic components from the thin-layer chromatogram, rutin was identified.

INTRODUCTION

Ononis arvensis L. sin. *O. hircina* Jacq., Field Restharrow, *Fabaceae* family, is an herbaceous, perennial, Eurasian continental species, 30–70 cm height, which blooms in June–July, being common in oak and beech forests, in the meadows and riversides. Unlike *O. spinosa* L., *O. arvensis* has no thorns and is a common species in Transylvania, northern Moldavia and Oltenia regions (Ciocârlan 2000).

Ononis species contain some useful active principles, such as: tetracyclic triterpene saponins (*α*- and *β*-onocerin), triterpene alcohols, isoflavones, lignans, coumarins, sterols (*β*-sitosterol), glycosylated phenyl benzyl ketones (onospin), essential oil, mineral salts (Langer et al. 1995, Mezrag et al. 2017, Sichinava et al. 2014, Tumova et al. 2011).

Ononidis radix and *Ononidis herba* medicinal products and their extractive preparations exhibit important pharmacological actions: diuretic, depurative, anti-lithiatic, antimicrobial, anti-inflammatory, cicatrizing, antioxidant, cytotoxic (Baldemir & Coşkun 2016, Dénes et al. 2017, Mezrag et al. 2017). The flowering aerial parts from *O. arvensis* species are recommended in Turkish ethnopharmacology for the treatment of urinary infections and skin ailments (Baldemir & Coşkun 2016).

The specialty papers contain some data about *O. arvensis* histo-anatomy (Dénes et al. 2017, Langer et al. 1995, Sichinava et al. 2014). The aim of our paper was the histo-anatomical analysis of the aboveground stem and leaf of *O. arvensis* species and the preliminary chromatographic investigation of polyphenols content from the flowering aerial part (*Ononidis arvensis herba*).

MATERIAL AND METHODS

Histo-anatomical analysis

Starting from *Ononis arvensis* plants in blossom, the vegetal material was collected in July 2017, from the surroundings of Stoeneşti commune, Vâlcea County (southwestern Romania).

The aboveground stems and leaves were fixed and stored in 70 % ethanol. The cross-sections and longitudinal-radial sections were obtained using botanical razor.

After prewashing with distilled water, the sections were clarified using 10 % sodium hypochlorite solution (Javel water). Then, the clarifying solution was removed by washing with distilled water.

For the staining of sections, Genevese reagent (a Congo red–chrysoidine mixture) was used. Taking into account the chemical composition of cell membranes, various colors were obtained: pink to red for cellulose and mucilages, pale red for cytoplasm, yellow for suberin and brown for lignin (Andrei & Paraschivoiu 2003).

To a Krüss binocular photon microscope, stained and mounted sections were analyzed on ×4, ×10, ×20, and ×40 objectives.

Nikon Eclipse 55i binocular microscope coupled with a Nikon DS–Fi1 high definition video camera was used to take photos.

Image-Pro Plus *ver*. 6.0 software package (Media Cybernetics) was applied for image acquisition and processing.

The histo-anatomical analysis of sections was achieved starting from some classical works (Toma & Rugină 1998).

Thin-layer chromatography (TLC) analysis

The preliminary analysis of polyphenols was made for the aerial parts of *O. arvensis* species (*Ononidis arvensis herba*), by applying TLC CAMAG (Muttenz, Switzerland) system (Altemini et al. 2015, Bojić et al. 2013, Gîrd et al. 2014, Jug et al. 2018):

- stationary phase: TLC silica gel 60 F_{254} (Merck, Darmstadt, Germany) 10×10 cm precoated glass plates, prewashed with chloroform–methanol (1:1, *v/v*) and activated by oven-drying (110^0C, 30 minutes);
- mobile phase: ethyl acetate–formic acid–methanol–water (15:1:0.1:1, in volumes), 10 mL added in the developing twin-chamber and then oversaturated for 20 minutes;
- sample: 20 % methanolic extract of *Ononidis arvensis herba*;
- standards (Merck): 0.05 % methanolic solutions of caffeic acid, chlorogenic acid, quercetin and rutin;
- migration distance: 62 mm (sample application line – 8 mm, solvent front – 70 mm);
- sample (8 µL, 10 µL) and standards (2 µL) application: CAMAG Linomat 5 semiautomatic system – spray gas nitrogen, syringe volume 100 µL, dosage speed 150 nL/s, predosage volume 0.2 µL, bands length of 8 mm;
- plate drying: 5 minutes, at 25^0C (cold air dryer);
- photographing the chromatographic plate: UV light (*λ* 254 nm);
- detection: CAMAG TLC Scanner 3 photodensitometer, for densitogram and *in situ* UV light (*λ* 280 nm) spectra, without derivatization, deuterium–wolfram lamp, scanning speed 40 mm/s, data resolution 200 µm/step, measurement mode absorption;
- winCATS *ver.* 1.4.3 software package.

RESULTS AND DISCUSSIONS

Histo-anatomical analysis

Aboveground stem

In the lower third, the cross-section through the aboveground stem has a round contour and secondary structure due to the libero-ligneous cambium. On the cross-section, from the outside to the inside of the aboveground stem, the following histological sequence has been highlighted: The epidermis is made up of large cells, having thickened outer wall covered by a thick cuticle with toothed relief. The epidermal cells are slightly tangential elongated, with thin radial walls and thick tangential external and internal walls. Stomata, cudgel-shaped glandular trichomes and multicellular, long tector trichomes are found in patches. The cortex is organized into 2–3 layers of chlorenchyma to the outside and of a meatus-type cortical parenchyma to the inside. The conducting tissues are organized into numerous libero-ligneous conducting fascicles of collateral-open type. The phloem tissue is made up of sieve tubes, phloem parenchyma and of annex cells. There is a sclerenchyma calotte on the phloem pole of each conducting fascicle. At the level of phloem tissue, the medullary rays are multicellular, multiseriate, cellulosic; near the sclerenchyma calottes, the medullary rays continue with a funnel-like dilatation parenchyma consisting of large, flattened cells. The circular-sinuous libero-ligneous cambium is found between the xylem and the phloem tissues. The xylem tissue is made up of metaxylem vessels of different sizes, arranged on radial strings in the libriform tissue. The metaxylem shows reticulate and helical thickenings, exhibited on the longitudinal-radial sections. Few protoxylem vessels accompanied by xylem parenchyma are found in the inner area of the xylem tissue. The medullary rays are multicellular, multiseriate (rarely uniseriated) and also lignified. The well-developed medullary parenchyma is of meatus type. There is a medullary gap in the central area (Figures 1–6).

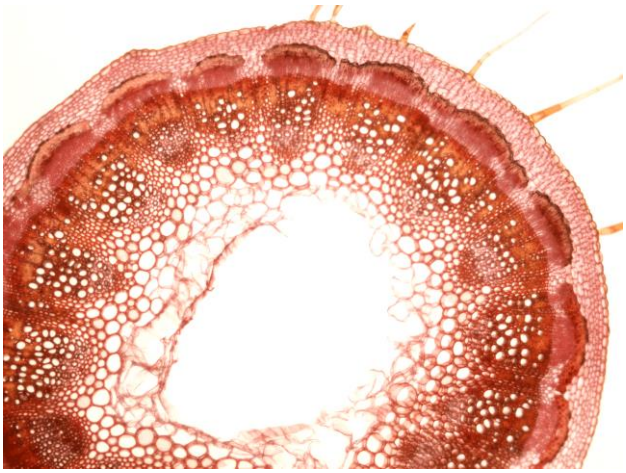


Figure 1. Cross-section through *O. arvensis* aboveground stem: overview (Congo red–chrysoidine staining, ×40).

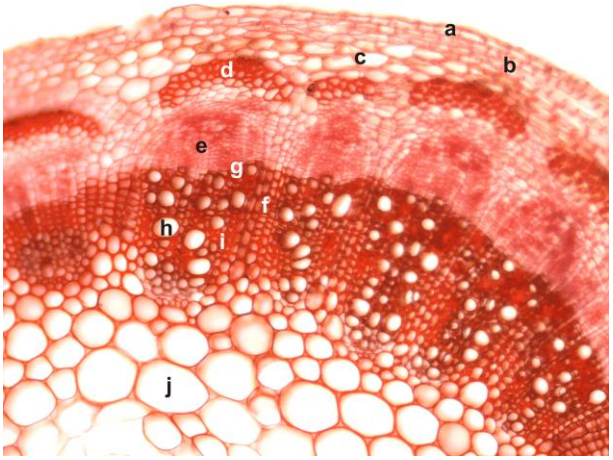


Figure 2. Cross-section through *O. arvensis* aboveground stem: (a) epidermis; (b) chlorenchyma; (c) cortical parenchyma; (d) sclerenchyma calotte; (e) phloem tissue; (f) medullary ray; (g) libero-ligneous cambium; (h) metaxylem; (i) libriform tissue; (j) medullary parenchyma (Congo red–chrysoidine staining, ×100).

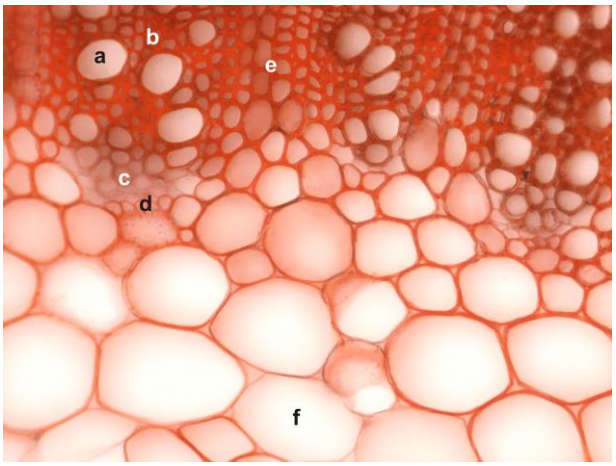


Figure 3. Cross-section through *O. arvensis* aboveground stem: (a) metaxylem; (b) libriform tissue; (c) protoxylem; (d) xylem parenchyma; (e) lignified medullary ray; (f) medullary parenchyma (Congo red–chrysoidine staining, ×200).

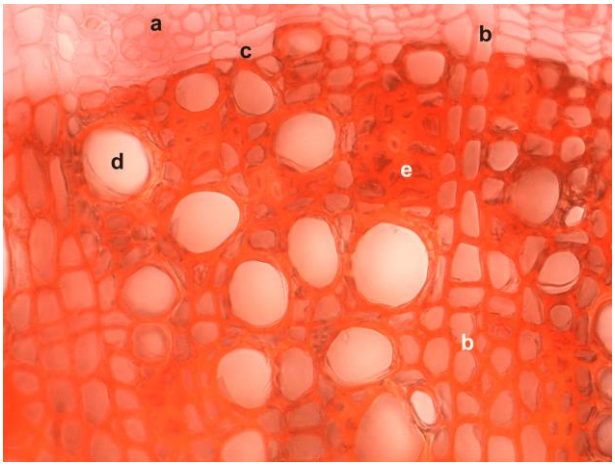


Figure 4. Cross-section through *O. arvensis* aboveground stem: (a) phloem tissue; (b) medullary ray; (c) libero-ligneous cambium; (d) metaxylem; (e) libriform tissue (Congo red–chrysoidine staining, ×400).

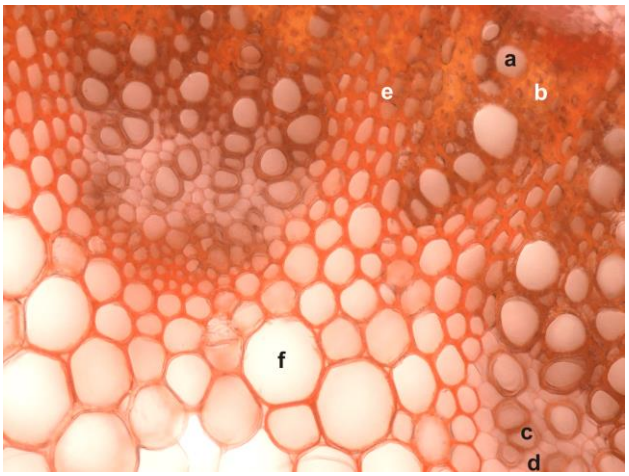


Figure 5. Cross-section through *O. arvensis* aboveground stem: (a) metaxylem; (b) libriform tissue; (c) protoxylem; (d) xylem parenchyma; (e) medullary ray; (f) medullary parenchyma (Congo red–chrysoidine staining, ×200).

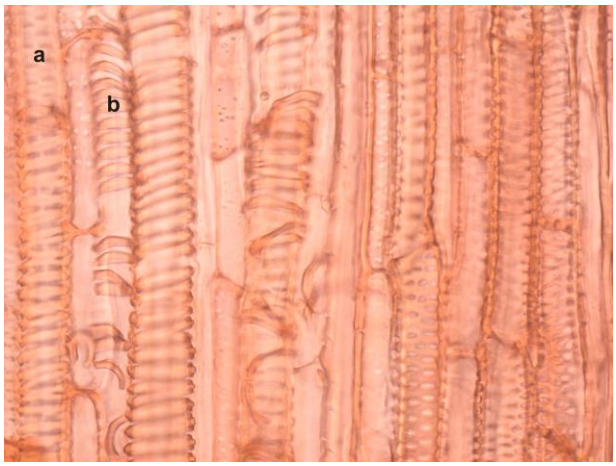


Figure 6. Longitudinal-radial section through *O. arvensis* aboveground stem: (a) reticulate xylem vessel; (b) helical xylem vessel (Congo red–chrysoidine staining, ×400).

Leaf

From the outside towards the inside of leaf's limb, the following histological sequence is evidenced in cross-section: The upper epidermis is made up of a single layer of large, flattened cells, with thickened tangential external and internal walls and thin radial walls. The external walls are bulged and covered by a thick cuticle with toothed relief. From place to place are found stomata and multicellular, long, cudgel-shaped glandular trichomes. The mesophyll consists of two layers of palisade parenchyma made up of large, elongated and chloroplast-rich cells, but also of 3–4 layers of lacunose parenchyma, composed of small cells with disordered layout, leaving aeriferous spaces between them. Into the mesophyll, there are many small libero-ligneous conducting fascicles, surrounded by assimilatory sheaths. The species presents C4 photosynthesis. The mesophyll has bifacial type and dorsiventral structure. The lower epidermis is made up of a single layer of small, tangential elongated cells, with thin radial walls and thickened tangential external and internal walls. The cuticle has a toothed relief. Stomata and multicellular, long, cudgel-shaped glandular trichomes were found at this level. In cross-section, on the abaxial face, the median rib is protruding and is rounded like a trough. Under the upper epidermis, there are two layers of palisade parenchyma. In the central area, there is only one libero-ligneous conducting fascicle that is placed in the leaf's parenchyma. Into the libero-ligneous fascicle, the xylem vessels have a seriate layout and the medullary rays are multicellular, uniseriate, cellulosic. The libero-ligneous fascicle is surrounded by assimilatory sheath and periphloemic protected by a sclerenchyma calotte. The leaf's limb has bifacial, dorsiventral, amphistomatic structure (Figures 7 and 8).

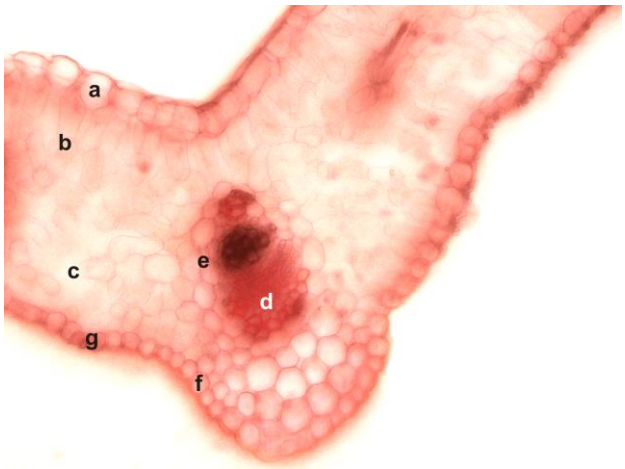


Figure 7. Cross-section through *O. arvensis* leaf's limb: (a) upper epidermis; (b) palisade parenchyma; (c) lacunose parenchyma; (d) libero-ligneous fascicle; (e) assimilatory sheath; (f) lower epidermis; (g) stomate (Congo red–chrysoidine staining, ×200).

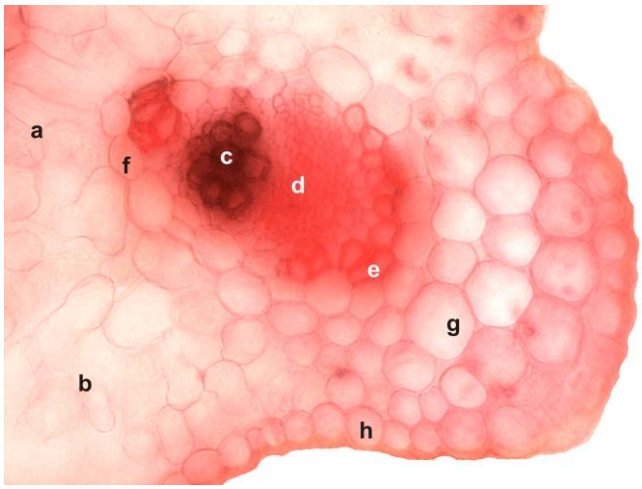


Figure 8. Cross-section through *O. arvensis* leaf's limb: (a) palisade parenchyma; (b) lacunose parenchyma; (c) metaxylem; (d) phloem tissue; (e) sclerenchyma calotte; (f) assimilatory sheath; (g) leaf's parenchyma; (h) lower epidermis (Congo red–chrysoidine staining, ×400).

TLC analysis

Figures 9–11 exhibited the experimental data concerning preliminary TLC analysis of polyphenols from *Ononidis arvensis herba*. An amount of 130.8 µg/mL rutin (R_f 0.13) was determined in the 20 % methanolic extract, corresponding to 64.5 mg/100 g of dried vegetal product.

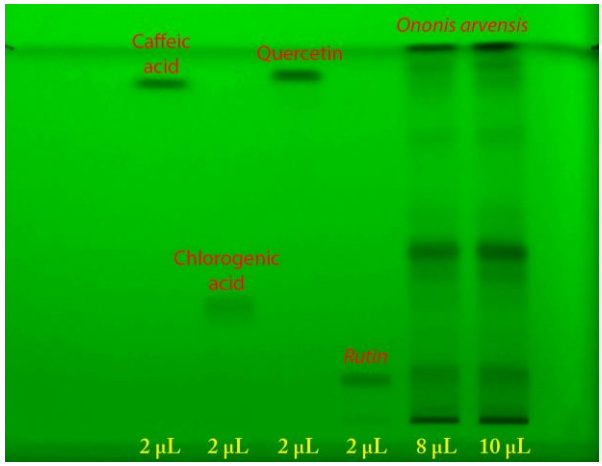


Figure 9. TLC chromatogram of polyphenols from *Ononidis arvensis herba* 20 % methanolic extract (UV 254 nm, without derivatization). From left to right: first four bands – standards (2 µL); last two bands – sample (8 µL and 10 µL).

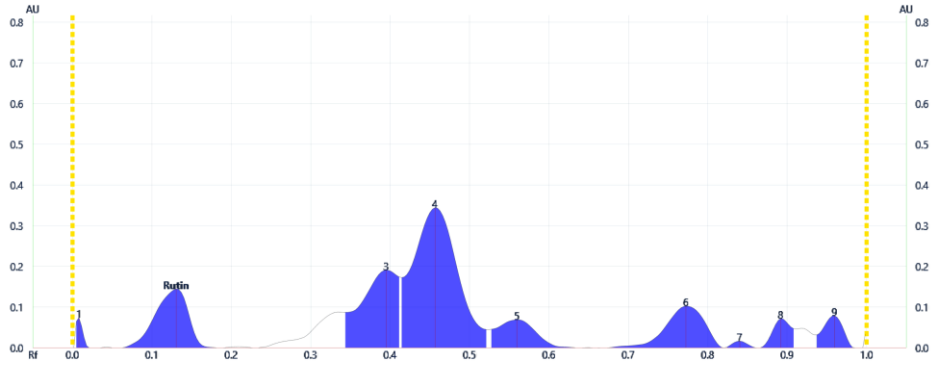


Figure 10. Densitogram of polyphenols (UV 280 nm, without derivatization) separated from *Ononidis arvensis herba* 20 % methanolic extract.
Rutin was identified at R_f 0.13.

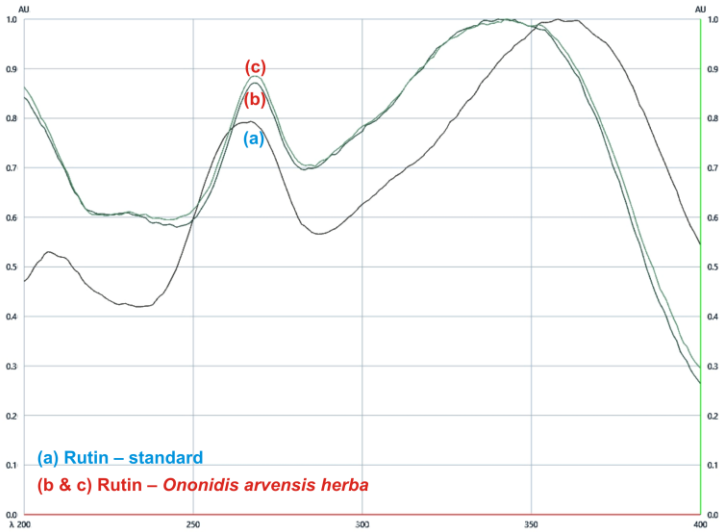


Figure 11. *In situ* UV spectra (UV 280 nm) of rutin standard and compound separated from the analyzed sample.

CONCLUSIONS

The histo-anatomical researches on the aboveground stem and leaf of *Ononis arvensis* species and the preliminary TLC analyses of the polyphenols from *Ononidis arvensis herba* were accomplished. In the lower third, the aboveground stem has circular contour and secondary structure (libero-ligneous cambium). The leaf's limb has bifacial, dorsiventral, amphistomatic structure. Rutin was identified and quantified (64.5 mg/100 g of dried vegetal product) among the nine specific bands for polyphenolic components from the thin-layer chromatogram.

REFERENCES

Altemini A., Watson D. G., Kinsel M., Lightfoot D. A., 2015, Simultaneous extraction, optimization, and analysis of flavonoids and polyphenols from peach and pumpkin extracts using a TLC-densitometric method. Chem. Cent. J., 9:39.

Andrei M., Paraschivoiu Roxana Maria, 2003, Microtehnică botanică, Edit. Niculescu, Bucureşti, 2003, 222 pp.

Baldemir A., Coşkun M., 2016, Comparative morphological studies on three endemic *Ononis* L. (*Leguminosae*) species growing in Turkey. Biol. Divers. Conserv., 9(1):82–91.

Bojić M., Simon Haas V., Sarić D., Maleš Z., 2013, Determination of flavonoids, phenolic acids, and xanthines in mate tea (*Ilex paraguariensis* St.-Hil.). J. Anal. Methods Chem., 2013:658596.

Ciocârlan V., 2000, Flora ilustrată a României. *Pteridophyta et Spermatophyta*, ediţia a 2-a revizuită şi adăugită, Edit. Ceres, Bucureşti, 1138 pp.

Dénes T., Bartha S. G., Kerényi M., Varga E., Balázs V. L., Csepregi R., Papp N., 2017, Histological and antimicrobial study of *Ononis arvensis* L. Acta Biol. Hung., 68(3):321–333.

Gîrd C. E., Nencu I., Costea T., Duţu L. E., Popescu M. L., Ciupitu N., 2014, Quantitative analysis of phenolic compounds from *Salvia officinalis* L. leaves. Farmacia, 62(4):649–657.

Jug U., Glavnik V., Kranjc E., Vovk I., 2018, High-performance thin-layer chromatography and high-performance thin-layer chromatography–mass spectrometry methods for the analysis of phenolic acids. J. Planar Chromatogr., 31(1):13–22.

Langer R., Engler S., Kubelka W., 1995, Comparative root anatomy of some perennial taxa of the genus *Ononis* L. Pharmazie, 50:627–629.

Mezrag A., Malafronte N., Bouheroum M., Travaglino C., Russo D., Milella L., Severino L., De Tommasi N., Braca A., Dal Piaz F., 2017, Phytochemical and antioxidant activity studies on *Ononis angustissima* L. aerial parts: isolation of two new flavonoids. Nat. Prod. Res., 31(5):507–514.

Sichinava M. B., Mchelidze K. Z., Churadze M. V., Alaniia M. D., Aneli D. N., 2014, Chemical composition and microstructural peculiarities of overground and underground vegetative organs of field restharrow (*Ononis arvensis* L.). Georgian Med. News, 231:88–94.

Toma C., Rugină Rodica, 1998, Anatomia plantelor medicinale. Atlas, Edit. Academiei Române, Bucureşti, 320 pp.

Tumova L., Tuma J., Dolezal M., 2011, Pyrazinecarboxamides as potential elicitors of flavonolignan and flavonoid production in *Silybum marianum* and *Ononis arvensis* cultures *in vitro*. Molecules, 16(11):9142–9152.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

SUCCESSFUL AGRICULTURAL WATER MANAGEMENT FOR WATER POOR ENVIRONMENTS LIKE KONYA BASIN, TURKEY

Bilal Acar, Ahmet Melih Yılmaz, Mehmet Akif Kalender

Department of Farm Buildings and Irrigation, Faculty of Agriculture, University of Selçuk, Konya-Turkey.
Corresponding E-mail: biacar@selcuk.edu.tr

Keywords: *Agriculture, Irrigation, water scarcity, crop pattern, environment.*

ABSTRACT

How to manage limited water supplies efficiently in water shortage environments is an urgent question to be answered. In examine our previous studies, following practical strategies are recommended for those regions: crop pattern should be designated in regard to the current water resources e.g. increasing cultivated lands of low water consuming crops; deficit irrigation is also good choice for water productivity even for energy efficiency. About 20-25 % deficit irrigation by drip system had no significant yield reduction by comparison to the full irrigation treatment for some field crops such as sugar beet, sunflower and corn plant; developing new crop cultivars using less water; and possibilities of bringing water from the neighbor river basins. In this paper, some applicable agricultural water management strategies were examined with detail for the water scant regions such as Konya, Turkey.

INTRODUCTION

Sustainable use of water resources is one of the most important key issues in agro-production in water shortage environments. Achievement of maximum yield from unit water is actual interest for farmers especially in those regions.

It is great job for water planners or managers to improve the water use efficiency in agriculture for coming 50 years if agro-production and climate trend continue with this present status. In those regions, water scarcity is very serious problem and there is a great challenge between the countries for reaching the fresh water resources. In general, withdrawals of water are about 70 %, and 20 % and 10 % in the sectors of irrigation, industry and municipality, respectively (Molden 2007).

As mentioned above agriculture is the single maximum user of fresh water resources as about 70 % worldwide even 75 % or more somewhere else (Anonymous 2003, Cihan § Acar 2016) and for minimizing the water use in such sector, one of the most important practical solution is correct irrigation program especially regions having the poor water supplies (Yavuz et al. 2015a, 2016a).

Morison et al. (2008) also reported that about 80-90 % of the total fresh water has used in agricultural activities and most of them in irrigation event. The water use therefore is unsustainable in many parts of the world and water resources, highly affected by climate change, are under great pressure. The notable efforts, therefore, have to be performed for maximum crop yield per unit water.

Well management of irrigation water supplies is perhaps one the most important issues for maximizing the yield and quality in agriculture. In order to increase agro-production, beside cultivation of farmlands with modern agricultural equipment's,

application of plant nutrients, and so on, maybe the most important is irrigation among the all those inputs. By irrigation, not only crop water requirement is met, but it also facilitate the crops for other activities such as easy uptaking the plant nutrient elements. In result, efficient management of irrigation water helps the water savings or minimizing the energy cost of irrigation. Energy cost is very high within agro-production inputs in Turkey (Bah § Acar 2017).

EFFICIENT WATER USE STRATEGIES IN AGRICULTURE FOR KONYA, TURKEY

Konya plain, one of the main agro-production centers of Turkey, is known as semi-arid climate having huge arable lands but limited fresh water supplies. In accordance of long-term meteorological data, annual precipitation is around 323 mm in many parts and only 90-100 mm of that has recorded in crop vegetation period. Irrigation is compulsory for better and qualified yield due to the low amount with none uniform rainfall distribution through the year. The available surface and groundwater potentials of Konya plain are about 2.94 billion m^3, 66 %, and 1.51 billion m^3, 34 %, respectively with a total of 4.45 billion m^3 (Anonymous 2015).

In general, groundwater resources have been used during the intense irrigation season between early June and September. In accordance of estimation, more than safely available water amount has used in irrigation and this is an indicator of none sustainable usage of groundwater resources (Anonymous 2015). In that case there is a gradual depletion in groundwater level year by year; about 14-15 m from 1974 to 2007 and 10-11 m from 1997 to 2007 (WWF 2008). Perhaps the main cause of such water level reduction is increasing the cultivated lands with favor of high water consuming crops such as corn without care of current water resources. Yavuz et al. (2016b) stated that ground water resources have to be used in irrigation of both field crops and vegetable plants since surface water resources are limited in most irrigation seasons. Therefore, many deep wells are available in Konya basin of Turkey. One of the most important production costs is energy and is used for pumping water from the groundwater reservoir to the irrigation lands. They suggested using deficit irrigation to reduce applied water to the crops. This results also reduction in electricity cost of irrigation. As known that energy productivity is necessarily prerequisites in all sectors including agriculture since energy cost is greater in Turkey than many of the other countries.

Total land potential of our basin, Konya Closed Basin, having or not projects is about 542 000 ha. In that amount, 370 000 ha of that is situated at Konya plain. All high water using summer crops and low water usage winter cereals have the shares of 60 % and 40 % land use, respectively. In examine the whole crop pattern together, net average seasonal water usage of crops is around 500 mm. Sprinkler is common irrigation technique and irrigation efficiency is satisfactory about 73 % in basin (Topak et al. 2008). Since, irrigation water directly has been taken from the deep wells within the irrigation areas so almost none water losses have occurred in water distribution networks. The other important issue that famers have very great experiences about all irrigation methods including sprinkler irrigation system management and that has resulted high water application efficiency. In accordance of our previous estimation, our safely available water is about 2.31 billion m^3 meeting irrigation of almost 342 000 ha farmlands. It clear shows that about 200 000 ha land is abundant and has been also irrigated by using the over water withdrawals from the groundwater supplies. In that case, every year about 1.40 billion m^3 water has used more from groundwater resources. On the other word, in accordance of our projections, those resources are not sustainable with this present usage. Yavuz et al. (2015b) also stressed that fresh water use in agriculture is

as about 75 %, more than the world average, so water saving strategies should be started firstly in irrigation.

Topak § Acar (2010) suggested that application of new irrigation techniques such as sprinkler and drip system by well management and finding the new irrigation water resources or making the some water development works are needed urgently for minimizing the stress on over water extraction from groundwater reservoir.

Water requirement of crop should be met on time to obtain maximum benefit. Correct irrigation program is needed to overcome that. Irrigation program or schedule is defined as when and how much water will be applied in one irrigation process.

Efficient management of limited water resources especially in water shortage regions is an urgent question to be answered. In that standing point, we need to use correct agronomy resulting using crops less water in both irrigated and none irrigated / rainfed farming system. Development of new crop cultivars require less amount of water is vital important for sustainable water resources (Parry et al. 2005).

The one of the most important practical alternatives in arid or semi-arid lands is application of deficit irrigation. It can be defined as the water application for crops lower than the full crop water requirements. By this way, some of the irrigation water is saved and such amount is diverted for the irrigation of extra-cropped lands (Fereres § Soriano 2007). The main target of deficit irrigation strategy is to improve the water productivity in agriculture or increase the income of farmers. More lands could be irrigated by same amount of water and crop production as well as the outputs will be improved by this way.

Our previous studies in region clearly showed that correct management of deficit irrigation by drip system has resulted significant water savings with little yield reduction. By this way, comparison to the full irrigation, up to 25 % deficit irrigation has not resulted remarkable yield reduction for some field crops such as sugar beet, corn, sunflower and dry bean (Acar et al. 2014).

On the other hand, a study by Fereres et al. (2003) showed that in regard to the water saving, deficit irrigation technique has resulted more successful in trees or vines by comparison to the field crops. The reason behind that a given deficiency in the applied water has caused higher decrease in transpiration than field crops so that better water saving is available. By the standpoint of water use efficiency, deficit irrigation is very beneficial technique firstly for trees.

The other applicable solution is government support or subsidizes the farmers who are processing the rainfed agriculture. Development or selections of new crop cultivars having very resistance to the dry conditions are very important for efficient water use in agriculture. Increasing the cropped lands with rainfed system has resulted not over water extractions from the groundwater supplies. Cereals, chickpea, lentil even squash are very alternative crops for preventing over water use from water resources.

CONCLUSIONS

Agriculture is the maximum fresh water user sector in Konya province of Turkey. One of the most important factors affecting the sustainable use of water resources in region is increase-irrigated land of high water consuming crops such as corn without control. Thus, current crop pattern is the main reason of the over water extraction from the groundwater resources. The area having the low water consuming crops such as cereals should be improved for sustainable water resources. In addition, modern irrigation technologies should be used more under well management. The other alternative is deficit irrigation by drip system and by this way up to 25 % water saving can be accomplished without significant yield reduction. For sustainable irrigation, there should be good cooperation between water management organizations and farmers. A proper training for water managers and farmers is very important role to play for efficient

water use in agriculture especially for water scant environments. We never forget that water is the backbone of the agriculture and sustainable use of water supplies is necessarily prerequisites for regions having water poor environments.

REFERENCES

Acar B., Topak R., Yavuz D., Kalender M.A., 2014, Is drip irrigation technique sustainable solution in agriculture for semi-arid regions? A case study of Middle Anatolian Region, Turkey. International Journal of Agriculture and Economic Development, 2 (2): 1-8.

Anonymous., 2003, Global Water Resources and Water for Agricultural Use in Japan. The Planning of Subcommittee, The Committee of Agricultural and Rural Development, The Council of Food, Agriculture and Rural Areas Policy (in MAFF), 20 ps.

Anonymous., 2015, DSİ. IV. Bölge Müdürlüğü Verileri. http://www2.dsi.gov.tr/bolge/dsi4/.Access date: 2 February (In Turkish).

Bah A., Acar B., 2017, Analysis of water use in irrigation for Konya-Çumra province of Turkey. World Journal of Innovative Research, 2 (1): 14-17.

Cihan I., Acar B., 2016, Performance of ova water user association in Konya-Turkey. World Journal of Innovative Research, 1 (2): 25-28.

Fereres E., Goldhamer D.A., Parsons L.R., 2003, Irrigation water management of horticultural crops. Horticultural reviews. Complied for the American Society of Horticultural Science's 100 th Anniversary HortScience, 38: 1036-1042.

Fereres E., Soriano M.A., 2007, Deficit irrigation for reducing agricultural water use. Journal of Experimental Botany, 58 (2): 147-159.

Morison J.I.L., Baker N.R., Mullineaux P.M., Davies W.J., 2008, Improving water use in crop production. Philosophical Transactions of the Royal Society B., 363: 639-658.

Molden D., 2007, Summary, water for food-water for life. A Comprehensive assessment of water management in Agriculture, 40 ps.

Parry M.A., Flexa J., Medrano H., 2005, Prospects for crop production under drought: research priorities and future directions. Am. Appl. Biol., 147: 211-226.

WWF., 2008, Türkiye' deki ramsar alanları değerlendirme raporu. Doğal Hayatı Koruma Vakfı,129 s., İstanbul (In Turkish).

Topak R., Suheri S., Acar B., 2008, Climate-Agricultural Drought-Irrigation with Environmental Concern in Konya Closed Basin, 11-12 September 2008, proceedings, Konya: 67-76 (In Turkish).

Topak R., Acar B., 2010, Sustainable irrigation and importance of technological irrigation systems for Konya Basin. TABAD, Tarım Bilimleri Araştırma Dergisi, 3 (2): 65-70.

Yavuz D., Yavuz N., Seymen M., Turkmen M., 2015a, Evapotranspiration, crop coefficient and seed yield of drip irrigated pumpkin under semi-arid conditions. Scientia Horticulturae, 197: 33-40.

Yavuz D., Seymen M., Yavuz N, Turkmen M., 2015b, Effects of irrigation interval and quantity on the yield and quality of confectionary pumpkin grown under field conditions. Agricultural Water Management, 159: 290-298.

Yavuz D., Yavuz N., Suheri S., 2016a, Design and management of a drip irrigation system for an optimum potato yield. Journal of Agricultural Science and Technology,18: 817-830.

Yavuz D., Yavuz N., Suheri S., 2016b, Energy and water use for drip-irrigated potato in the Middle Anatolian region of Turkey. Environmental Progress & Sustainable Energy, 35: 212-220.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

EVALUATION OF THE PHYTOREMEDIATION PROPERTIES OF THE INVASIVE SPECIES *SOLIDAGO* GENUS

Bobuľská Lenka[1]*, Čekanová Katarína[1], Demková Lenka[1], Oboňa Jozej[1], Sarvaš Ján[2]

[1]University of Prešov, 17. Novembra 1, Prešov, Slovakia
[2]University of Economics in Bratislava, Research and Educational Centre of Bio Energy, Kapušany, Slovakia
* *Correspondence author. E-mail*: lenka.bobulska@unipo.sk

Keywords*: bioremediation, heavy metals, invasive plants, Goldenrod*

ABSTRACT

Regeneration of heavy metal-polluted and heavy metal-degraded sites has remained a global challenge despite the existence of numerous conventional physico-chemical techniques that can be applied. Application of the inexpensive "green" and sustainable technique of phytoremediation is unrivalled. Because invasive plants can survive in harsh conditions and they represent big threat for natural biodiversity, the knowledge about their ecology in polluted sites is still important. This study aimed to investigate the potential phytoremediation ability of invasive species of Solidago genus in the polluted area in Slovakia. The elements tested were Cd, Cu, Pb and Cr in the soil samples, as well as in the plant material. Samples to obtain heavy metal concentration were determined using by atomic absorption spectroscopy (AAS). Bioconcentration (BCF) and translocation factors (TF) were also calculated. As expected, in the polluted areas that are located close to the source of pollution, the limit values of the heavy metals exceeded several times. Cr, Cu and especially Pb were the elements removed most efficiently by different parts of the plant material (mainly by the plant leaves and root material). Based on the BCF and TF, Solidago genus might be considered as potential accumulator of Pb, Cu and Cr.

INTRODUCTION

Pollution of soil environment by toxic substances is a very serious problem. Although heavy metals are naturally occurring elements that are found throughout the earth's crust, most environmental contamination and human exposure result from anthropogenic activities such as mining and smelting operations, industrial production and use, and domestic and agricultural use of metals and metal-containing compounds (Tchounwou et al. 2014, Angelovičová et al. 2015). Their bioavailability is influenced by physical factors such as temperature, phase association, adsorption and sequestration. It is also affected by chemical factors that influence speciation at thermodynamic equilibrium, complexation kinetics, lipid solubility and octanol/water partition coefficients. Biological factors such as species characteristics, trophic interactions, and biochemical/physiological adaptation, also play an important role (You et al. 2018, Schweizer et al. 2018). Phytoremediation as a remediation technology that has been receiving attention lately as the results from field trials indicate a cost savings compared to conventional treatments. It uses various plants to degrade, extract, contain, or immobilize contaminants from soil and water. The genus *Solidago* is an invasive species in Slovakia. It occurs both in habitats only weakly impacted anthropogenic factors as well as in habitats subjected to intensive transformation by humans. In natural and semi-natural population in Slovakia, this genus is represented by three species, two of them

are considered as invasive species: *Solidago canadensis* (L.) (Canadian goldenrod) and *Solidago gigantea* Aiton (Giant goldenrod) (Pavek 2011). These species were brought to Europe from North America in the 18th century (Guzikowa & Maycock 1986) and the expansion of *Solidago* sp. can be attributed to the fact that it produces large numbers of seeds with the greater germination potential of all *Solidago* sp. (Szymura 2012). Nowińska et al. (2012) and Yang et al. (2008) presented that this invader tolerates high concentration of heavy metals in soil which is demonstrated by the presence at sites near emitters of pollution. It also has been emphasized that the plant had great tolerance of chemical properties of the ground, such as the soil pH and the content of minerals and organic matters (Pużyńska et al. 2012, Bielecka et al. 2017).

The main aim of this study was to investigate the potential phytoremediation ability of invasive species *Solidago* genus in the polluted area in Slovakia.

MATERIAL AND METHODS

Study area

The research was conducted in two environmentally loaded areas of Košice city. The localities are known for its industrial activities, predominantly focused on steel production. The mail problems in this region is high accumulation of lead and cadmium in soil and water ecosystems. The control site was also selected in the locality with low anthropogenic impact on environment (Figure 1).

Plant and soil assays

We collected 5 individuals of *Solidago* sp. from 5 places within the locality (total set of 75 plant materials were collected). Soil samples were also collected (5 on each locality, the total of 15 soil samples). Plant material and soil samples were transported into the laboratory and dried at room temperature. After drying, plant material was divided into individual parts: roots, plant stem, leaves and flowers. Soil samples were homogenized and sieved through 2 mm sieve opening and stored in plastic bags until analyzed. Total content of heavy metals (Cd, Pb, Cr and Cu) were determined in accredited laboratory by AAS (Atomic Absorption Spectrometry) method for biological and soil material. Additionally, soil pH/KCl, soil moisture and organic carbon were also determined in soil samples.

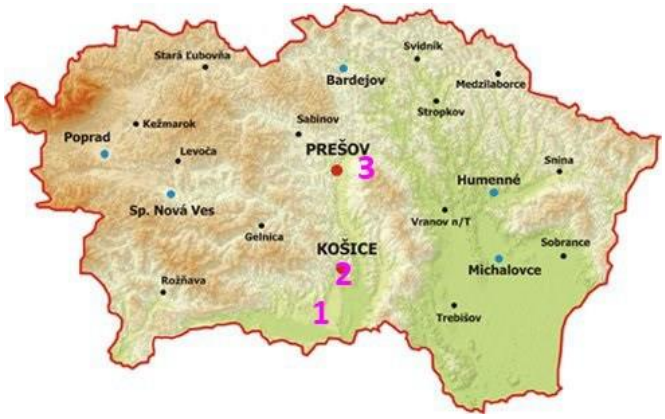


Figure 1. Sampling points 1 and 2 indicate polluted site in Košice city, sampling point 3 shows control site

Bioconcentration factor (BCF) and translocation factor (TF)

The bioconcentration factor is defined as a ratio of the monitored contaminant in the biological material in relation to soil/substrate dry material in mg kg^{-1} (Dryžalowska & Falandysz 2014). Green plants are able to uptake and accumulate heavy metals and metalloids from soil/substrate, which has a significant impact on the health risk resulting from their consumption.

The BCF was calculated as follows:

$$\mathrm{BCF} = \frac{\text{Total content of heavy metal in dried biological samples (mg/kg DW)}}{\text{Total content of heavy metal in dried soil samples (mg/kg DW)}}$$

The translocation factor helps to recognize in which part of the plant material are heavy metals predominantly accumulated. TF is defined as a ratio of the heavy metals concentration in overhead part of the plant in relation to the concentration of heavy metals in plant roots (Singh et al. 2010).

The TF was calculated as follows:

$$\mathrm{TF} = \frac{\text{Total content of heavy metal in the overhead part of the plant (mg/kg)}}{\text{Total content of heavy metal in plant roots (mg/kg)}}$$

RESULTS AND DISCUSSIONS

For the evaluation of phytoremediation ability of *Solidago* genus, determination of soil pH, humidity and other factors are also crucial. Therefore, the value of the soil reaction is one of the very important soil property. The pH value of the soil affects the solubility of the heavy metals in the soil, hence its use by living organisms. Increased acidity of the soil reduces/increases the solubility of many substances (Angelovičová et al. 2015). Another primary factors are organic carbon and soil moisture and its availability. Table 2 shows the average values of selected physico-chemical properties in soil environment.

Table 1

Average values of selected physical and chemical soil properties

Sampling points	Soil moisture (%)	pH/KCl	Organic carbon (%)
1	16.77	6.9	2.5
2	15.44	6.7	2.2
3 (control site)	19.49	6.3	3.3

In all sampling points, soil reaction can be classified as slightly acidic and neutral environment. According to organic carbon content, the soil is moderate humus (Fejér & Bobuľská 2015) and the biggest portion of organic matter represents control site. Table 2 shows the average values of selected heavy metals in the individual parts of plant material, as well as in the soil system.

Table 2

Average values of heavy metals in the individual parts of plant material and soil system

Sampling points	Parts of plant material	Cd (mg(kg)	Pb (mg/kg)	Cr (mg/kg)	Cu (mg/kg)
1	Roots	0.56	22.09	18.82	31.18
	Plant stem	0.33	9.26	12.48	22.87
	Leaves	0.30	701.50	26.20	46.92
	Flowers	0.18	135.24	34.00	199.56
	Soil	5.71	278.82	387.34	516.75
2	Roots	0.63	34.95	440.11	48.92
	Plant stem	0.34	17.56	21.38	29.27
	Leaves	0.24	155.00	17.91	22.30
	Flowers	0.21	45.49	29.39	112.45
	Soil	3.33	167.74	161.83	262.34
3 (control site)	Roots	0.51	6.91	38.43	75.10
	Plant stem	0.33	1.10	43.75	67.51
	Leaves	0.25	32.71	14.48	17.84
	Flowers	0.23	5.80	25.71	90.63
	Soil	0.97	38.48	52.52	59.47
Limit values (for soils)		1.00	70.00	60.00	50.00

Because of heavy metal accumulation by roots, the concentration of metals is different in each part of the plant. The concentration of Cd in all parts of *Solidago* sp. stagnates despite the varying concentrations in the soil at each site. The greatest accumulation of Cd is in the root and the lowest in bloom. The highest Pb accumulation was in leaves, where sampling site which was most polluted exceeded 2.5 times the Pb content in the soil. At other sites, the metal content in the leaves almost bounded the Pb content in the soil. Additionally, the high concentration of Pb was also measured in the flowers. It seems that with the increasing concentration of Pb in the soil, the Pb content in the flowers is also directly increased and the accumulated metal in the flowers is able to contain about a sixth of the metal compared to the soil. In the above-ground areas, the accumulated Cr content at each site was low compared to the amount of metal in the soil. Content of Cu was generally highest in flowers. At the control site, the Cu content in the root, stalk and flowers exceeded the soil content of determined metal.

Table 3 represents the sum of the bioconcentration factor (BCF) and translocation factor (TF) in the above-ground part of the plant material.

Table 3

Sum of the BCF and TF in the above ground part of the plant material

Sampling points	Sum of the factors	Cd (mg(kg)	Pb (mg/kg)	Cr (mg/kg)	Cu (mg/kg)
1	BCF	0.06	0.27	0.18	0.43
	TF (Plant stem)	0.59	0.42	0.66	0.73
	TF (Leaves)	0.54	1.76	1.39	1.50
	TF (Flowers)	0.32	6.12	1.81	6.40
2	BCF	0.14	3.03	0.19	0.52
	TF (Plant stem)	0.65	0.16	1.14	0.90

	TF (Leaves)	0.49	4.73	0.38	0.24
	TF (Flowers)	0.45	0.84	0.67	1.20
3 (control site)	BCF	0.85	1.03	1.60	2.96
	TF (Plant stem)	0.65	0.16	1.14	0.90
	TF (Leaves)	0.49	4.73	0.38	0.24
	TF (Flowers)	0.45	0.84	0.67	1.20

More precise determination of the accumulation of heavy metals provides BCF. The Cd value is in all locations BCF<1, representing a minimum accumulation of this metal. According to BCF in details, Pb is preferentially accumulated in above-ground parts of plant material, mainly in leaves. Cr is preferably accumulated by root system. TF values that represents the ratio of the heavy metal content in the above-ground portions and the root content, the highest values shows Pb. According to Baker (1981), *Solidago* sp. can be considered to a good accumulator of Pb and Cu.

According to one-way ANOVA (Table 4), Pb and Cr showed the significantly highest correlation among the localities. The highest accumulation ability of Pb was confirmed in leaves, for Cr it is in roots and Cu in flowers.

Table 4

One-way ANOVA for the metals in the plant material among the localities and parts in plants

Heavy metals	factor	Df	F value/p value
Cd	Locality	2	0.102
Pb		2	6.988**
Cr		2	5.544**
Cu		2	0.615
Cd	Plant parts	3	204.000***
Pb		3	10.140***
Cr		3	7.328***
Cu		3	15.450***

Invasive plant species are often characterized as very resistant to changes of pH, climate and other environmental conditions (Bielecka et al. 2017). Work by Yang et al. (2005) has shown that many species of *Solidago* have developed various mechanisms for the accumulation of metals (Cu, As, Zn, etc.) and resistance to the metal stress. The largest plant intake among the analyzed metals reached Pb, which was also proven in studies of Yang et al. (2007) where *Solidago canadensis* was studied and showed the interaction with this metal in highly contaminates site. The amount of Pb from each site did not exceed TF>1, which confirms that Pb is predominantly accumulates in the above part of plant material compared to the roots system. Cr, unlike other metals, is found in various plant parts, but with respect to BCF, this metal shows lower portion in the samples compared to Pb and Cu. The plant organ of Cd accumulation is preferably the root system according to TF. Metals from the highest content to the lowest have the following sequence: Pb> Cu> Cr> Cd. The results of the statistical comparison between the values of metals in the selected sites can confirm that *Solidago* sp. is able to accumulate some heavy metals. Hinman (2005) created a list of plants that were studied for phytoremediation, including *Solidago canadensis*. Invasive plants have a strong prerequisite to become hyperaccumulators, which was also shown in the work of Dissanayake et al. (2002) who studied the potential accumulation effect in contaminated soil for two invasive plants: *Lantana camara* L and *Wedelia trilobata* L. with a positive result.

CONCLUSIONS

In the industrial areas, pollution of soil environment became very serious problem. Polluted soils are no longer suitable for agricultural production because they lose common biochemical properties which may cause the reduction of soil fertility and decline soil quality and health. Phytoextraction is a method in which the content of pollutants is accumulated in plants, preferably in above ground parts. Accumulated metal can be removed without big problems by harvesting plants without any major interference with the environment. Such environmentally friendly methods can be the most sensible way of removing pollutants compared to the technologies that cause secondary air or groundwater pollution and are usually extremely expensive. Goldenrot genus (*Solidago* sp.), a very widespread plant in Slovakia, for its invasive nature and relatively large biomass was a promising candidate for its use of a hyperaccumulator of heavy metals in soil ecosystem. The invasive *Solidago* sp. is considered as Pb and Cu accumulator and the possible accumulator of Cr. For better and more accurate determination, we recommend the analysis of a particular species. Considering, that the plant species are invasive, they cannot be directly used and thus directly control the rate and capacity of the accumulation, as well as the application and regulation of the metal in the plants.

ACKNOWLEDGEMENT

The work was supported by the Agency of Ministry of Education, Science and Sport of the Slovak Republic, the grant VEGA n. 1/0326/18 and VEGA n. 2/0013/16.

REFERENCES

Angelovičová L., Bobuľská L., Fazekašová D., 2015. Toxicity of heavy metals to soil biological and chemical properties in conditions of environmentally polluted area Middle Spiš (Slovakia). Carpathian Journal of Earth and Environmental Sciences, 10(1): 193-201.

Baker A.J.M., 1981. Accumulators and excluders – strategies in the response of plant to plant heavy metals. Journal of Plant Nutrition, 3(1-4): 643-654.

Bielecka A., Królak E., Biardzka E., 2017. Habitat conditions of Canadian goldenrot in a selected region of eastern Poland. Journal of Ecological Engineering, 18(4): 76-81.

Dissanayake U.S., Tennakoon K.U., Priyantha N., 2002. Potential of two invasive plant species, *Lantana camara* L and *Wedelia trilobata* L., for selective heavy metal uptake. Ceylon Journal of Science (Biological Science), 29: 1-11.

Dryžalowska A., Falandysz J., 2014. Bioconcentration of mercury by mushroom *Xerocomus chrysenteron* from the spatially distinct location: levels, possible intake and safety. Ecotoxicology and Environmental Safety, 107: 97-102.

Fejér J., Bobuľská L., 2015. Soil Science (in Slovak). Prešov: FHPV, Prešovská Univerzita v Prešove, 121 p.

Guzikowa M., Maycock P.F., 1986. The invasion and expansion of three North American species of goldenrot (*Solidago canadensis* L. sensu lato, *S. gigantean* Ait. and *S. graminifolia* (L.) Salisb.) in Poland. Acta Societatis Botanicorum Poloniae, 55:367-384.

Hinman C., 2005. Sampling of plant species studied for phytoremediation. Low impact development. Technical guides manual for puget sound. Washington: Washington State University, 256 p.

Nowińska K., Kokowska-Pawlowska M., Patrzałek A., 2012. Metals in *Calamagrostis epigejos* and *Solidago* sp. from reclaimed post-industrial westelands. Ecologia terenów Wiejskich, Nr 3/III, Polska Akademia Nauk, Oddział w Krakowie, pp. 91-100.

Pavek P.L.S., 2011. Plant guide for Canada goldenrot (*Solidago canadensis*). USDA Natural Resources Conservation Service: Pullmann, WA.

Pużyńska K., Stokłosa A., Stupnicka-Rozdynkiewicz E., 2012. The impact of ecological conditions on *Solidago* sp. occurrence. Zeszyty Naukowe Uniwersytetu Przyrodniczego we Wrocławiu, Rolnictwo C, 584: 89-98.

Schweizer S.A., Seitz B., van der Heijden M.G.A., Schulin R., Tandy S., 2018. Impact of organic and conventional farming systems on wheat grain uptake and soil bioavailability of zinc and cadmium. Science of the Total Environment, 639: 608-616.

Singh R., Singh D.P., Kumar N., Bhargava S.K., Barman S.C., 2010. Accumulation and translocation of heavy metals in soil and plants from fly ash contaminated area. Journal of Environmental Biology, 31(4): 421-430.

Szymura M., 2012. Evaluation of ability for generative and vegetative reproduction of goldenrods occurred in Poland. Zeszyty Naukowe Uniwersytetu Przyrodniczego we Wrocławiu, Rolnictwo CI, 585: 103-112.

Tchounwou P.B., Yedjou C.G., Patlolla A.K., Sutton D.J., 2014. Heavy metals toxicity and the environment. Lunch A. (Ed.). Molecular, Clinical and Environmental Toxicology, Volume 3: Environmental Toxicology. Springer: Berlin, pp. 133 – 164.

Yang R.Y., Tang J.J., Yang Y.S., Chen X., 2007. Invasive and non-invasive plant differ in response to soil heavy metal lead contamination. Botanical Studies, 48(4): 453-458.

Yang R.Y., Yu G.D., Tang J.J., Chen X., 2008. Effects of metal lead on growth and mychorrhizae of an invasive plant species (*Solidago canadensis* L.). Journal of Environmental Science, 20: 739-744.

Yang X.E., Jin X.F., Feng Y., Islam E., 2005. Molecular mechanisms and genetic basis of heavy metals tolerance/accumulation in plants. Journal of Integrative Plant Biology, 47(9): 1025-1035.

You T., Liu D., Chen J., Yang Z., Dou R., Gao X., Wang L., 2018. Effects of metal oxide nanoparticles on soil enzyme activities and bacterial communities in two different soil types. Journal of Soils and Sediments, 18(1): 211-221.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✔ *Biology*
✔ *Horticulture*
✔ *Food produce processing technology*
✔ *Environmental engineering*

RESEARCH ON THE PHYSIOLOGY OF SOME WOODY SPECIES IN THE COMANESTI HILLS FROM MEHEDINTI COUNTY, ROMANIA

Buse-Dragomir Luminita[1], Nicolae Ion[2]

1.University of Craiova, e-mail: luminita25dragomir@yahoo.com
2. University of Craiova, e-mail: ionnicolaebio@yahoo.com

Key words: *forest, photosynthesis, transpiration, respiration, chlorophyll*

ABSTRACT

The forest from the hills of Comanesti is characterized by the presence of a large number of wood species. They are in a continuous competition for water and mineral sources, but also for light. The photosynthetic productivity is influenced by the density of trees and shrubs, the amount of light reaching the leaves, the amount of water in the environment.

Transpiration records a noticeable diurnal variation, but also a seasonal variation in all species that were studied.

The content of chlorophyll pigments shows significant variations due to the amount of light and nutrients in the soil, and the compensation point of light varies widely, plants exhibiting ombrophilous or heliophilous particularities depending on it.

INTRODUCTION

Comăneşti Hills are located in Mehedinţi County, west of the Motru River, and belong to the commune Bala, the village of Comăneşti. These appear as a set of prolonged ridges, separated by wide valleys, generally with a more evolved, relatively lower relief, which carries the traces of a less violent denudation than that from the east of Jiu river (Sîrbu Anca, 2007).

The altitude varies between 150-402 m, the coordinates being 44 ^{0}58 latitude and 22 ^{0}54 longitude (http//google. maps).

The area has been proposed for protection and conservation and is now fully owned by the state, being used as a forest found. The site hosts two threatened species at European level and 36 vascular taxa included in the Red List of Romania (Sîrbu Anca et al., 2007).The skeletal substrate represented by erodisols and regosols, which is slightly brittle, causes, during the torrential rains that the respective hills are subjected to, the erosion process.

The research carried out in 2018 in Comăneşti Forest was aimed at establishing the eco-physiological particularities of some wood species, a particular emphasis being placed on the influence of light and water factors, factors that play a primordial role in forest ecosystems.

More recent information on the flora and vegetation in the research area comes from Costache (2011). After Ciocârlan (2009), the territory under investigation falls within the Central European Region, Danubian-getic province, Getic Plateau District

The physical-geographic, pedo-climatic and phyto-geographical aspects justify the great floristic diversity and complexity of the vegetal groups existing in this part of

the country, as evidenced by Roman (1974), in the southern part of the Mehedinti Plateau, as well as in the Upper Basin of Motru, (Maloş 1977, quoted by Costache, 2011) of course with some peculiarities.

The Comăneşti Hills are crossed from east to west by the Pistriţa brook, a tributary of the Motru River. On the northern side, another tributary flows from it, the stream of Călugăriţa.

It was considered important to study the eco-physiology of some ligneous species, because the plants from these forest ecosystems, living in communities, find themselves in special living conditions than those in the isolation state. By coexisting in large numbers on limited surfaces, mutual relationships are established between them, where competition for light, water and mineral salts plays a decisive role.

When the association is heterogeneous, the phenomenon of competition appears, the more endowed individuals monopolize a larger share of water or nutrient reserves, all these factors influence the course of the physiological processes.

The vegetation period is also decisive for the CO_2 balance and for the annual yield of the production. If the vegetation period is long enough, even with a rather modest assimilation intensity, an appreciable gain of biomass is achieved. If CO_2 assimilation is possible only for a relatively short period of time, even if the plants have a high photosynthetic capacity, the yield of production remains very low.The most useful contribution that physiologists can make to forestry is to determine which physiological processes are inhibited by particular stresses and suggest to tree breeders what characteristics will minimize the inhibitory effects of these stresses (Kramer PJ, 1986)

Abiotic and biotic stresses elicit changes in normal physiology of trees. Plant growth regulators (PGR) are involved in the stress response and appear to have two roles: 1) to minimize the impact of the stress on the tree and; 2) to trigger stress resistance mechanisms. In the latter case the PGR-induced changes appear to enhance resistance to subsequent stress. This cross-adaptation to stress is important in trees (https://link.springer.com/article/).

Leaf physiological parameters were mainly influenced by the light gradient, whereas crown morphological and whole-tree parameters were mainly influenced by tree size. When tree is small, a greater proportion of whole-tree biomass was allocated to roots. However, physiological differences between the species decreased with decreasing light and most morphological differences tended to disappear with increasing tree size, suggesting that many species differences in shade-tolerance are expressed mainly during the seedling stage (Delagrange et all, 2004).

Evergreen species are thought to have leaf traits supporting lower photosynthesis and transpiration rates, in order to conserve water during dry periods. Evergreen species had similar assimilation rates but lower photosynthetic water-use efficiency (PWUE) than deciduous species, possibly to extend their leaf life spans by protecting their photosynthetic machinery from overheating through evaporative cooling. Species of humid and semi-arid environments did not differ with respect to assimilation rate or PWUE, but semi-arid species did have smaller leaf sizes and greater leaf potassium and phosphorus concentrations. These traits may enable semi-arid species to maximize growth during episodes of favorable moisture availability (Kyle W, 2013).

Wendy S.et all (2012) find that chlorophyll content index was highly correlated with foliar N concentration, which may be useful in detecting nutrient deficiencies, although the relationship was species dependent.

MATERIALS AND METHODS

Research has been done on the species: *Cornus sanguinea, Acer tataricum, Carpinus betulus, Carpinus orientalis.*

On the biological material which was the subject of this research were determined: the intensity of leaf transpiration, the intensity of photosynthesis, the respiration intensity, the light compensation point, the content of assimilating pigments.

Transpiration, photosynthesis and leaf respiration were determined using the LCi portable apparatus, measuring in parallel the photosynthetic radiation (PAR) and the temperature in the assimilation chamber. The advantage of using this apparatus is that it is possible to do a lot of determinations without the detachment and damage of the plant material.

The light compensation point (the amount of light intensity at which photosynthesis is equal to respiration) was calculated by the determination of photosynthesis at different light intensities. The values obtained were compared to the intensity of respiration in the dark.

The chlorophyll pigment content of the leaves was determined with the Minolta portable chlorophyll-meter, the data being expressed in SPAD units.

The intensity of net assimilation was determined in July 2018 by the method of rings. Leaf halves were detached, dried at 105 °C, and after 48 hours the halves remaining on the plants were detached, the difference after drying and weighing at the analytical balance representing the amount of biomass accumulated in that range of time.

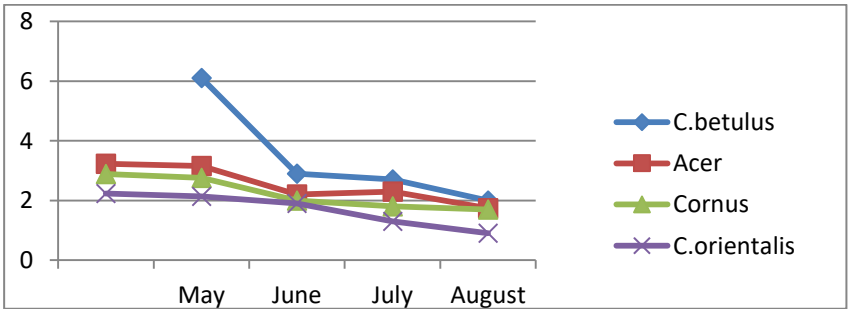
RESULTS AND DISCUSSIONS

Intensity of transpiration

The determinations made in May - August 2018 showed significant variations in the intensity of transpiration. The highest values were recorded in spring for all plants under study, values due to both the higher amount of water in the soil and the fact that the younger leaves have a thinner cuticle and can lose a lot of water at this level.

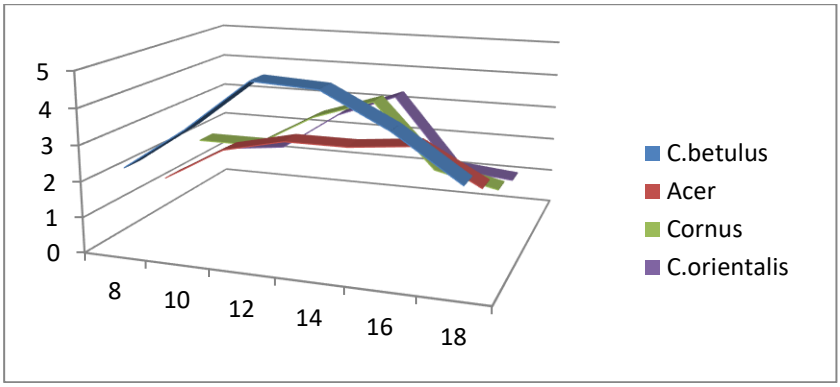
In the summer months, low sweat intensity can not be correlated with air temperature but with low water absorption due to low soil moisture.

The most intense transpiration was observed at *Carpinus betulus,* the lowest values being recorded at *Carpinus orientalis* (graphic1).



Graphic 1. Seasonal variation of transpiration (mmol H_2O / m^2 / s)

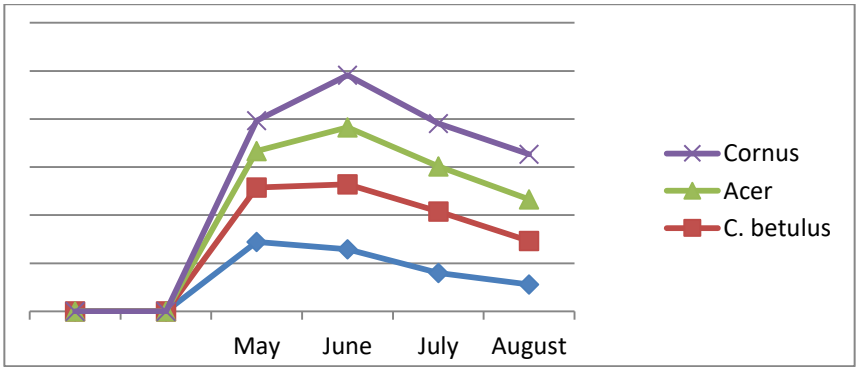
The diurnal variation of transpiration was determined at different times of the day, from the data shown in graph 2 being observed a peak of the process at around 15^{00} o'clock and a minimum in the early morning hours. The largest diurnal fluctuations of transpiration are found in *Carpinus betulus* (graphic 2).



Graphic 2. Diurnal variation of transpiration intensity (mmolH_2O / m^2 / s)

Intensity of photosynthesis

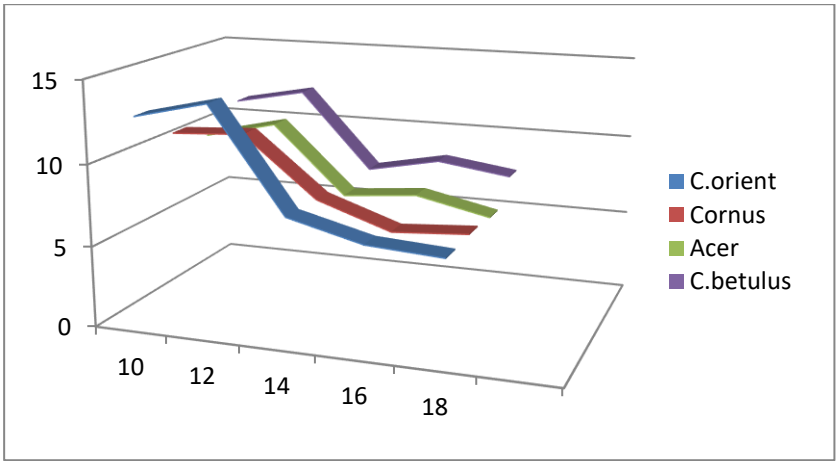
Due to the different stages of development and climatic conditions, in 2018, there was a seasonal variation of photosynthesis, with a maximum in June and minimum values in August (graphic 3). The highest values of photosynthesis intensity were recorded in *Cornus sanguinea* .



Graphic 3. Seasonal variation in the intensity of photosynthesis (µmolCO_2 /m^2 /s)

The diurnal variation of photosynthesis was determined in June 2018.

Leaf determinations at an active photosynthetic radiation of 30-90 µmol / m2 / s and at a temperature of 25-31 ° C revealed that the intensity of the photosynthesis process varied between 6.9 and 12.73 µmol / m2 / s (graphic 4). The greatest variations of this process were observed in *Cornus sanguinea.*



Graphic 4. Diurnal variation in the intensity of photosynthesis (μmolCO_2 /m^2 /s)

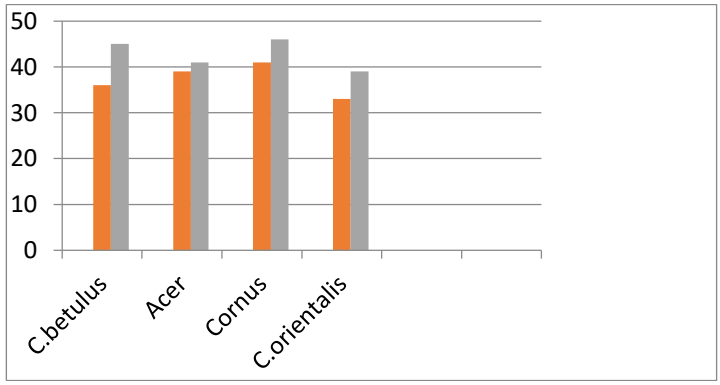
Content in chlorophyll pigments

Research on assimilating pigments has shown their great variability, quantitative and even qualitative, due to their sensitivity to internal and external factors.

The study of chlorophyll pigments in different populations and under different ecological conditions could provide some information on their role in ecosystems. Knowing the correlation between the content of chlorophyll pigments and the photosynthesis process, the in-depth investigation of this physiological index could allow the characterization or differentiation of some locations.

Forest ecosystems, through the complex structure of the vegetal component built both vertically and horizontally, determine a great variability of the foliar exposure conditions for the reception of sunlight. The assimilating pigments, as the main solar energy receptors, react by adapting to these differences, manifested by changes in the total content and changes in the ratio of chlorophylls a and b.

For the study of chlorophyll pigments, determinations were made in the months of May and July 2018. Graphical data shows that all species had a higher content in July (graphic 5).

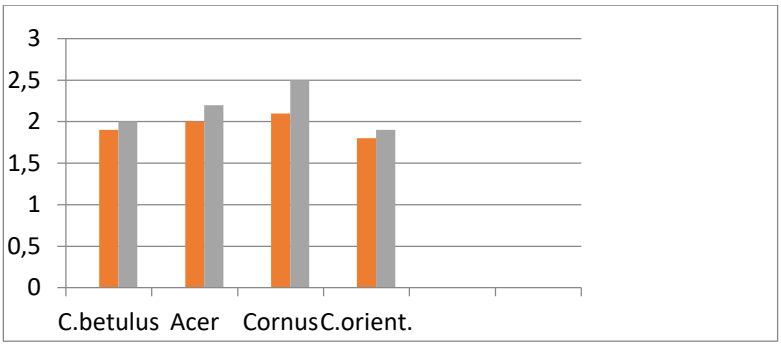


Graphic 5. chlorophyll content of leaves (SPAD units)

Intensity of net assimilation

From the data presented in graphic 6, it appears that there were significant differences in the two months of determinations, with higher values being recorded in July.

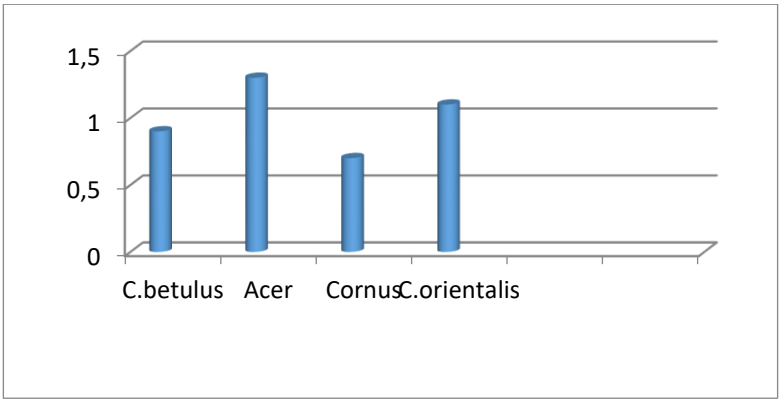
Among the species that were studied, the most intense assimilation process was observed at *Cornus sanguinea* (2.5 g dry substance / day /m^2 leaf).



Graphic 6. Intensity of net assimilation (g dry substance/ day / m ^{2} leaf)

Intensity of leaf respiration

The intensity of leaf respiration was determined with the Lci analyzer, by covering the assimilation chamber with foil paper, to prevent light penetration and the photosynthesis process. It was necessary to know this parameter in order to determine the value of the light compensation point for each of the studied species.



Graphic 7. Leaf respiration intensity (µmolCO2 / m2 / s)

The determinations were carried out in May at 26 °C. From graphic 7, it appears that the leaves of *Cornus sanguine*a have the least intense respiration, the most intense process being measured in the leaves of *Acer tataricum.*

The light compensation point

In the Comanesti forest, after the appearance of the leaves of the tall trees, the shading of the low vegetation is very pronounced.

Knowing that young trees, shrubs and grasses can not accumulate biomass if they do not get enough light, it was important to know the minimum growth limit, which

must be above the light compensation point. Knowledge of PC value is of great importance because under this value plants no longer produce organic substances, and the body lives out of its reserves.**(**Atanasiu, L., Polescu, L., 1988).

To find out the compensation point, we compared the intensity of photosynthesis determined at different times of the day, so at different intensity of light, with the value of respiration intensity in the dark.Data obtained reveals that among the studied species, *Cornus sanguinea, Acer tataricum* have the lowest values of the compensation point, behaving as ombrophyllous plants (Table 1).

Table 1

Compensation point of light (lx)

Plant	Compensation point (lx)
Carpinus betulus	320
Acer tataricum	310
Cornus sanguinea	200
Carpinus orientalis	600

The highest value of the compensation point was recorded at *Carpinus orientalis,* that has a heliophylous character, as it is also present in the specialized literature (Neţoiu C et al., 2008).

CONCLUSIONS

The determinations made in May-August 2018 revealed significant variations in the intensity of leaf transpiration. The highest values were recorded in spring for all plants under study, values due to both the higher amount of water in the soil and the fact that the younger leaves have a thinner cuticle and can lose a lot of water at this level.

The most intense transpiration was recorded at *Carpinus betulus,* the lowest values being measured at *Carpinus orientalis,*

The most intense photosynthesis was recorded in *Cornus sanguinea*, and the low assimilation being found at *Carpinus orientalis.*

Research on assimilated pigments showed their large quantitative variability, due to their dependence on internal and external factors.

Cornus sanguinea and *Acer tataricum* have the lowest values of the compensation point, acting as ombrophyllous plants. The highest value of the compensation point was recorded in *Carpinus orientalis,* which can be included in the heliophylllous species group.

REFERENCES

Atanasiu, L., Polescu, L. 1988. *Fotosinteza, sau cum transformă plantele lumina soarelui*, Ed. Albatros, Bucureşti,

Ciocârlan V. 2009. *Flora ilustrată a României*, Edit. Ceres Bucureşti

Costache I., 2011. *Flora şi vegetaţia bazinului hidrografic inferior al Jiului,* Ed. Universitaria, Craiova

Delagrange S., Messier C., Martin J. Lechowicz Pierre Dizengremel , 2004, *Physiological, morphological and allocational plasticity in understory deciduous trees: importance of plant size and light availability* , *Tree Physiology,* Volume 24, Issue 7, 1 P 775–784,

Kyle W. Tomlinson, Lourens Poorter, Frank J. Sterck, Fabian Borghetti, David Ward, Steven de Bie and Frank van Langevelde,2013, *Leaf adaptations of evergreen and deciduous trees of semi-arid and humid savannas on three continents,* Journal of Ecology 101, p 430–440

Kramer J. P.,1986, The rol of physiology in forestry, Tree Physiology, vol.2, Issue 1-2-3-1, p1-16

Neţoiu C.,Vişoiu D., Bădele O., 2008, *Dendrologie*, Ed. Eurobit, Timişoara

Roman N., 1974, *Flora si vegetatia din sudul Podisului Mehedinti*, Ed Academiei

Sîrbu Anca et al., 2007. *Arii speciale pentru protecţia şi conservarea plantelor în România*, Ed. Victor B Victor, Bucureşti. 396 pp.

Wendy S, Klooster Bert M.,Cregg R.,Thomas Fernandez, Pascal Nzokou. 2012. *Growth and physiology of deciduous shade trees in response to controlled-release fertilizer*, Elsevier

http://google.maps

https://link.springer.com/article/10.1007/BF00043955

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

ECOTECHNOLOGICAL CONCEPTS FOR LOGGING

Chisăliţă Ion[1,2*], Ciontu Cătălin-Ionel[1], Cântar Ilie-Cosmin[1]

1 – National Institute for Research and Development in Forestry „Marin Drăcea"
2 – Univeristy of Agricultural Science and Veterinary Medicine of Banat „King Michael I of Romania" from Timisoara, Faculty of Horticulture and Forestry
*chisalita_ion@yahoo.com

Keywords*: ecotechnological, logging, forest, skidder, cableway*

ABSTRACT

The paper aims to present some of the ecotechnological concepts in logging, applicable in our country. The first part of the paper defines the new technologies of logging in the current concept, as well as the modern ecoproductive machinery intended to be used with the new technologies.

The work continues with the presentation of the material and the research methods used. Thus, books, magazines, brochures and international databases were used. The research methods used were: bibliographic documentation and practical experience, as well as analysis and synthesis for the elaboration of the results and conclusions of the study.

In the results and discussions are presented the basic principles regarding the ecotechnology in the logging and respectively the ecotechnological trends toghether with the characteristics of the current systems and their swot analysis.

The paper ends with the conclusions that bring together the most important ideas regarding the ecotechnological concepts in the logging as well as the most pertinent strengths and weaknesses of the swot analysis realized.

INTRODUCTION

New logging technologies in the present context represent the mode of succession of operations in the structure of the process specific to this activity, carried out with a system of machines that needs to be performing from the point of view of forest ecosystem protection and achieving the maximum economic efficiency.

Protecting the forest ecosystem means minimal damages for trees, seeds and soil on the logging process, so that the impact always falls below the threshold of supportability.

Some modern competitive machinery regarding ecoproductivity criteria such as funiculars and forwarders can work very well individually, but can produce spectacular productivity when used in an integrated way (Dima 2013). By integrated mode of operation is meant the optimal combination of machines, for their exploitation under the specific conditions of the field, of the quantity and the dimensional quality of the timber extracted from the forest.

Modern low-impact technologies can not be conceived without the large-scale introduction of funiculars, all the more because of the lack of accessibility in Romania and without the prospect of having an optimal road network in the near future.

MATERIAL AND METHOD

The materials used to achieve the proposed aim and objectives in this paper, are books, magazines, brochures, international databases and specialized papers addressing the issue of the ecotechnological concepts of logging.

Below are presented research methods used (bibliographic documentation, practical experience, analysis and synthesis).

The bibliographic documentation, ie the collection from all possible sources for the achievement of the objectives of this paper, was made using sources from the Romanian and foreign literature, regarding the low impact exploitationlogging activity. In this way, documentation has been carried out on how forest exploitation technologies with a low impact on the forest ecosystem are designed and used in similar forests.

The Code of Best Forest Practice Ireland 2000 has also been an important bibliographic source through its objectives to promote forest practices in the forestry technology process to improve the use standards and reduction of environmental impact. This is a document that has been reviewed and adjusted by numerous experts from FAO member countries, universities, research institutes, non-governmental organizations, and the private sector (F.A.O Forest Harvestin Bulletin 2003).

The practical experience used for conducting this research was accumulated in the forestry field for a long time in the centralized economy before 1989 and on the market economy after 1989 and to the present with a long transition period between the two phases.

The experience in the wood exploitation and processing activity is also based on the activity carried out in the area of the private commercial companies, for a period of approx. 10 years after 2001 and where it was possible to observe the evolution of this field in the Romanian market economy (Chisăliţă et al 2015).

The analysis and synthesis, used for the processing of data collected from the specialized bibliography, were used to formulate the conclusions of this study.

RESULTS AND DISCUSSIONS

Basic principles for ecotechnologies in logging

Concerning the basic principles on ecotechnology in logging, the ecotechnological methods of logging are characterized by (Horodnic 2014):

- rationalizing the use of tractors;
- extension of cable installations as basic equipment;
- developing optimal transport networks to reduce collection distances;
- the use of tandem trolleys with performing machines that collect the wood in the young crop;
- application of the methods of exploitation in short assortments („Shortwood Harvesting System") and technology („Forwarding").

Logging technology with reduced impact can be defined as a way of organizing the activity based on careful planning and strict verification of the implementation of those woodworking operations correlated with a modern machine system that avoids the negative effects that can occur in the case of conventional logging systems (Horodnic 2014).

Regardless of what kind logging equipment with low-impact we are talking about, the common features of ecotechnologies are:

- establishing an optimal pace of interventions in crop in order to ensure a sufficiently long period for regeneration and a rate of increase in the volume and quality of the remaining trees (frequent interventions increase the risk of damage);
- minimizing the damage to the crop remaining or its development environment;

- minimizing the width of the collection paths and the surface on which they are carried out;
- carrying out the activity in favorable conditions by the technological adaptation to the state of the land and the weather;
- the design of the works must include alternative variants for different working conditions on the same exploited surface;
- reducing the pressure of the ground by using low-pressure tires and / or large contact surface;
- appropriate training of workers and coordinators of logging activities; in many cases, forest workers are poorly trained and underpaid, resulting in negative environmental impacts and economic losses;
- providing protection equipment and machines with improved ergonomic features; additional indirect costs in the event of work-related accidents may be up to 6 times higher than direct operating costs;
- proper realization and maintenance of forest roads by: ensuring a profile adapted to the area, permanent maintenance of the wear layer and drainage system of precipitation water, avoiding collecting by pulling or semi-pulling on forestry roads;
- directed tree felling, also taking into account the way of collection; In the case of gathered with the cable by pulling (independent winches or mounted on the chassis of the forestry tractor), it is preferable to target the oblique fall in relation to the approach path;
- correct placement of storage surfaces (primary platforms); it is preferable to use the edge of the road over a longer length rather than create a single extended surface within the crop;
- post-exploitation assessment is particularly important for both the operating company and the forest manager as measures for improving the logging can be established;
- rehabilitation of the degraded land following the collection of wood and repairing the damages on the affected area due to the negative impact of some exploitation operations is mandatory;
- collection with low impact results in higher costs (about 20 %) due to design and organization activity that involves time and effort in addition to the conventional system.

The tandem use of machinery and the achievement of an integrated work on the basis of ecoproductive technologies means respecting principles and achieving higher economic and ecological outcomes. Cableways, forwarders, skidders can work very well individually, but they can generate spectacular productivity with a proportional reduction in impact on the soil if used in an integrated fashion. By integrated working method is meant the optimal combination of the equipment for the exploitation under specific conditions of land and the wood extract from the forest (Dima 2013).

This beneficial concept both economically and ecologically is based on the following:

- large-scale introduction of cableways, especially as ecological machines. Modern cable installations with powerful drive groups and trolleys that can carry up to 4 tons of load are a solution that suits the conditions in Romania (Ionașcu et al 1999). These machines can be used for gathering wood in tandem with trolleys or independent winches, but mostly skidding and nearing to a distance of 1000 m where they can achieve an average productivity of 100 cubic meters each day (www.wyssen.com).
- the downstream transport of wood should be made with modern high-capacity skidders, which can also be used to collect wood at the foot of the slopes by skidding and nearing (www.irum.ro) and which according to the experiments can reach a productivity of 1000 cubic meters / month. The alternative to skidder is the 12, 14 or 18

tonne forwarders, the ability to transport the timber suspended in the primary platform (Pulkki 2013).

- in the case of production of 2500-3000 mc / month, depending on the nature of the exploited wood, the processor heads can be used either for resinous or hardwoods, so that the wood can be cut and measured in the shortest possible time. Measurement of this wood as it is sorted and cut by processors is done automatically.
- wood harvesting (felling, cross cutting and trimming out) will be done with modern mechanical saws (Stihl, Husqvarna, Dolmar, Jonsered, etc.). Where conditions of species and relief permite, harvesters are used which performs verified productivity in Romania of approx. 200 mc / day (Oprea et al 2004).

Improved technological lines, those that are always proposed but not properly implemented, and due to ambiguities in norms and legislation, but also in the company capitalization mechanism, in the present conception are based on the forwarder that is approaching as opposed to classical ones that rely solely on the skidder tractor in the full process of exploitation.

These modern technological lines have the great advantage of productivity and ecological character (ecoproductive technologies, ecotechnologies, low impact technology systems) include the following:

- the use of the skidder tractor only when the winch is mounted on the tractor as well as the short-distance skidding and difficult trails inside the parquet;
- the proximity of the woodworking by using a forwarder tractor that has a higher productivity than the skidder, does not destroy the colectting routes it runs, consequently reduces operating costs while improving the environmental impact;
- the use of cableways, also only inside the surface of the felling area, on trails with slopes unconventional to the tractor, and on the nearest distance that exceeds the surface of the felling area, use the forwarder tractor;
- the studies and experiments carried out have revealed the following differences between the technological lines based on the current working technique in the logging in our country, respectively with skidder tractor at the hauling and the improved (proposed) technological lines based on the forward tractor at hauling. Comments were made on the TAF 650 tractors and the John Deere forward tractor (Oprea et al 2004):
- labor productivity gains through the introduction of improved technology lines of 20-53 %;
- forward tractor productivity up to 2 times greater than that of the skidder tractor for the same close distances as a result of higher travel speeds to forwarder tractors (www.interforst.at);
- labor cost reductions by introducing improved technology lines, 28-34 % due to higher productive efficiency and forward tractor over the skidder tractor;
- maintenance costs - working mc / wood collected on the forward tractor compared to the skidder tractor, by 15-23 % lower (for distances between 1000 - 2000 m).

Trends in the ecotechnology of wood exploitation

Today in Romania, analyzing the context in which logging takes place, we find that these are generally not conducive to ecoproductive forest exploitation for at least the following reasons:

- there is a tendency to reduce the areas that are through cuts and which cause a small volume of exploitation on the surface of the felling area, restricting the use of eco productive machinery;
- operators are constantly aiming at reducing operating costs, making as much rebate as possible from the observance of forestry restrictions and in the absence of

clear rules and procedures for exploitation in the Romanian system and easy to apply and monitor.

"Reduced Impact Forest Harvesting" is a working system based on the controlled implementation of specific harvesting and harvesting operations with low levels of damage to soil, water and further development of trees, a system that ensures perpetuation of forest functions and its economic viability after exploitation (F.A.O. Forest Harvesting Bulletin 2003).

In the current context of low-impact logging on the forest ecosystem, the objectives of the wood exploitation act can be concretized as follows:

- permanent placement in the exploitation process on the surface of the felling area, the operations to collected, removed and near, in the ecological restrictions, together with the technical and economic ones;
- maximizing the value of the exploited timber, the final product of the wood exploitation (primary raw wood sorts or raw wood sorts) by efficient sorting techniques, applied with professionalism;
- minimizing the costs of timber exploitation through appropriately applied techniques and technologies while at the same time providing a modern machine system to be used in an integrated system according to the characteristics and working conditions on the surface of the felling area.

In this context, woodworking engineering must serve and apply "low impact technologies" that apply the principles of industrial ecology to forestry to reduce the impact on the forest ecosystem.

Features of current collection systems

Currently known collection systems are: manual, tractor, cart-load, cableways, helicopter. A swot analysis of collection systems sets out the opportunities and barriers to their application according to the field conditions and the aim of reducing the impact on the forest ecosystem in the harvesting process.

Table nr. 1

SWOT analysis

Collection system	Strong points	Weaknesses
Manual	• apply without arrangement of collection paths; • simple equipment to equip workers • low investment; • easy to organize.	• hard work; • low productivity; • risks of occupational diseases.
Tractor	• average costs; • relatively simple technology; • generally skilled workforce.	• damage to the relatively large environment; • high collection roads densities, a large area get out of production; • slope limitation.
Cart-load	• reduced damage to the soil, the trees and the seed; • low costs and very small investment; • very high mobility compared to the density of forest.	• small collection distances; • small pieces of wood; • limited to the collected operation, at most removed.

Cableways	• reduced impact on the forest ecosystem; • relatively average costs compared to achieved productivity.	• difficult assembly and disassembly involving qualified workforce; • Relatively large investments.
Helicopter	• high productivity; • low density of forest roads; • reduced environmental impact.	• very expensive; • requires a very precise organization.

Table nr. 2

Opportunities and barriers

Collection system	Opportunities	Barriers
Manual	• working distances up to 100 m, optimum <50 m.	• distances greater than 100 m; • limited working time.
Tractor	• working distances up to 500 m, optimally up to 200 m; • gradients of less than 60 % on dry land; less than 40 % on wet ground; less than 25 % on snow and less than 10 % on ice.	• distances greater than 500 m; • gradients of more than 60 % on dry land, more than 40 % on wet ground, more than 25 % on snow and more than 10 % on ice.
Cart-load	• longitudinal sloping on full 20 % ramp; • longitudinal slope on full slope driving and 40 % downhill racing.	• longitudinal tilt on full ramping 20 % higher; • longitudinal sloping in full slope and ramping more than 40 %; • Working distance greater than 2000 m.
Cableways	• working distances less than 2000 m; • gravity cableways at land inclinations above 15^0; • Non-gravity cableways at inclinations of less than 15^0.	• operating costs higher than the value of the wood in the area to be exploited; • distances less than 300 and above 2500 m; • Load weight of up to 4 tons.
Helicopter	• lack of forest roads; • the value lean of the wood mass to be exploited higher than the operating costs.	• operating costs higher than the value of the wood to be exploited

CONCLUSIONS

The tandem use of the equipment and the achievement of an integrated work is all the more justified because the road infrastructure is well below the optimum but also of poor quality and the accessibility of the national forestry fund covers only 65 % of our forests, being even lower in the area of exploitable stands.

Using only skidders in the integrated manner with the funicular, at their high productivity, can lead to the clogging of the primary platform access road in a week, due to the creation of narrow places in the tandem of unpredicted machinery to work in an integrated way. The alternative to skidders in this case is the forwarders.

The use of processor heads leads to the management of the wood in the primary platform and to dischargement in the assortments, knowing the algorithms for transforming the standing wood mass into wood assortments, taking into account the technological consumes and waste highlighting in the exploitation process (Chisăliță 2014).

With regard to improved technology lines, the forwarder can also move on forest roads where, due to their condition, they are impractical for specialized transport vehicles. The displacement of the forwarder tractors in the logging yardt, although to be done on more demanding routes, does not burden the operating costs significantly regarding the other advantages outlined above.

Regarding the trends in the ecotechnology of wood exploitation, analyzing the context in which the forest exploitation takes place in Romania, we find that these are generally not favorable for ecoproductive forestry exploitations. From a structural point of view, a low-impact technology system does not differentiate from a conventional one, but what has to be done constantly is to choose those exploitation ways that reduce the consequences of damage to the residual trees, seedling and soil below the threshold of supportability.

Swot analysis of collection systems reveals the fact that cableways and cable installations have the least impact on the forest ecosystem. Their limitations are related to the small distances and small dimensions of the wood collected in the case of the workshop and, in turn, to the large investments and the need for qualified workforce in the case of cable installations.

Harness logging are suitable to be used up to 500 m (optimally up to 200 m) and on land with less than 60 % slope land. Funiculars can be used up to 2000 m for slopes up to 15^0 for non-gravitational funiculars and over 15^0 for gravitational funnels.

REFERENCES

Chisăliță, I., 2014, Exploatări forestiere. Îndrumar de proiectarea și organizarea, Editura Eurostampa, Timişoara;

Chisăliță, I., Moatăr, M., Crăciunescu, A., Ștefan, C., Banu, C., Fora, C., Alina, D., Stanciu, S., 2015, Time to change the management of the forest exploitation in romania - a national priority geoconference on water resources, Forest, marine and ocean ecosystems, VOL II (SGEM 2014), Book Series: International Multidisciplinary Scientific GeoConference-SGEM, pp. 509-519;

Dima, P., 2013, Utilaje forestiere folosite integrat, Meridiane Forestiere, anul 16 , nr.2. pp. 79;

Horodnic, S., 2014, Sisteme tehnologice forestiere cu impact ecologic redus, Editura Universităţii, Suceava;

Ionașcu, Gh., Iordache, E., Derczeni, R., 1999, Noutăţi în construcţia şi exploatarea instalaţiilor cu cablu la colectarea lemnului, în „Pădurea românească în pragul mileniului trei”- Lucrările sesiunii ştiințifice jubiliare consacrate aniversării a 50 de ani de învățământ silvic superior la Braşov, Editura Universității „Transilvania” din Braşov;

Oprea, I., Sbera, I., 2004, Tehologia exploatării lemnului, Editura Tridona, Olteniţa;

Pulkki, R., 2013, Machine specifications and operating techniques, Faculty of Forestry, Lakehead University, Canada;

Pulkki, R., 2013, Cuttolength, treelength or full tree harvesting?, Faculty of Forestry, Lakehead University, Canada;

***, 2000, Code of Best Forest Practice Ireland: planning the thinning operation, Forest Service, Department of the Marine and Natural Resources, Dublin, Ireland , pp.124-128;

***, 2003, F.A.O. Forest Harvesting Bulletin, vol.13;

***,S.C.IRUM S.A.Reghin, http://www.irum.ro

***,Wyssen Seilbahnen AG, http://www.wyssen.com

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

FOREST SOILS FROM BANAT. DISTRIBUTION BY PHYTO-CLIMATIC ZONES AND COUNTY FOREST ADMINISTRATIONS

Chisăliţă I.[1,2*], Ciontu C. I.[1], Cântar I. C.[1]

1 – National Institute for Research and Development in Forestry „Marin Drăcea"
2 – Univeristy of Agricultural Science and Veterinary Medicine of Banat „King Michael I of Romania" from Timisoara, Faculty of Horticulture and Forestry
*chisalita_ion@yahoo.com

Keywords: *County Forest Administrations, Banat, soils, phyto-climatic areas*

ABSTRACT

Using existing forest inventory database from Timisoara Forest Research Station, an analysis has been made of the distribution of forest soils in Banat, by classes and types of soil, phyto-climatic belt and County Forest Administrations. In the first part of the paper, a presentation of forest distribution in the region were made. The calculations show that the largest areas are occupied by cambisols (281,389.4 ha - 62 %) and luviosoluri (131.992.4 ha - 29 %). Cambisols are spread mostly on the mountain-premonton altitudinal (FM1+FD4) where it occupies 132,365.4 ha (47 %) followed by FD3 with 103,617.9 ha (37 %). These soils generally provide favorable conditions for beech. Luvisols are mostly distributed in FD2 (68,373.6 ha - 52 %) followed by FD3 (31.754,2 ha - 24 %) and FD1 (20.101,0 ha - 15 %). It is worth mentioning that these soils are favorable for Turkey oak, ocuppying 21 % of the Timiş County Forest Administration surface. Cernisols (6 %) are almost entirely composed from rendzine, mostly located in FD3 (15,040.5 ha - 58%). Knowing the distribution of soils on phyto-climatic levels, correlated with their favorability for certain species can serve both as an overview and as a general orientation for forest management.

INTRODUCTION

Soil, as an integral part of the forest sites, has a very important role in forest life. In a certain climatic context, the productivity of forest vegetation depends on the favorability of soil conditions, the extent to which trees can develop the root system (soil thickness, ecological useful volume), and the nature of the ecological soil complex (Chiriță et al 1977).

Under comparable regional and local climatic conditions, the relationship between water, air, and nutrients can be different from one soil to another and can cause fundamental changes in the stands composition and their vigor of growth when water, air and soil nutrients they are not balanced (Păunescu 1975).

According to the ecosystem concept, the forest ecosystem is an open system (Malița et al 1979) based on the existence of a main process of production, transformation and decomposition of organic matter, whose intermediate product is humus, whose qualitative qualities "depend on the biochemical content of the necromase, the specificity of the decomposing populations, the thermal, ionic and water regime of the soil" (Doniță et al 1990). As such, the types of forest ecosystems are classified within humification groups, being homogeneous from the point of view of biosynthesis, bio-decomposition and water regime of air, ionic and soil acidity (Doniță et al 1990).

Within the ecosystem, the forest sites has a more pronounced autonomy and a higher permanence than biocenosis, resulting in the importance of knowledge of forest soils, components of the forest sites.

Forest soils are heavily influenced by relief, slopes and exposition the thickness of the soil profiles, "especially the humus horizon, the regions of humidity, trophicity, consistency and temperature in soils" (Chiriță et al 1977). But the slope of the forest lands is very important and in another aspect, "the existence of a general predisposition of the Romanian geographic space to the floods" (Giurgiu 1978). As for a particular situation in the Banat forest area in terms of land slope, an analysis has been made in the work.

The zoning of the forests in our country, ie the establishment of territorial zoning units on latitude and altitude was made on the basis of the natural spread of large forest formations indicating special qualitative microclimates that meet on surface stretched under geographic zoning conditions (Doniță et al 1981). Geographic zoning conditions mean relief conditions in which soils and vegetation are formed only under the influence of the local climate and not local climates or special substrate conditions. For Romania the indicators formations are spruce, beech, sessile oak, pedunculate oak, Turkey oak, Hungarian oak, greyish oak and pubescent oak. A single zoning unit has been used that usually has a sub-zone rank or a bioclimatic layer. The name of altitudinal plant layer starts in all cases with the altitude-related character of their area, linked to the zonal forestry formation that inhabits it (Chiriță et al 1977).

In the paper was presented and analyzed the distribution of forest soils on altitudinal plant layer.

MATERIAL AND METHODS

In the first part of the paper there was a concise presentation of Banat forests, using data from the specialized literature and forest management plan, were presented the distribution of the forests in the region, the geographical and ecological conditions, the altitudinal ranges of the plants layers, etc.

In order to achieve the goal, the database of the existing forest inventory at the Timisoara Forest Research Station was used. Data was used up to the year 2000, before massive forest retrocessions when there was a larger volume of centralized data for analysis. Data processing was done on soil types and classes, respectively on bioclimatic zones. The analysis was made both on the whole region and on the forestry directions, given the complex character of the phytogeographical conditions in the region. All the forest units (describing the soil types) of the two forestry directions have been included. In the analysis of the distribution of forests on climatic zones reference was also made to the distribution of the main forest species.

Given the fact that the inclination of the land influences both the formation and the soil characteristics and the hydrological regime under separate conditions in the Banat forest area, an analysis was also made of the distribution of the forest lands by slope categories and forest directions. The categories used are (Târziu 1997): without inclination (< 3G), gentle (3-5 G), moderate (3-15 G), fast (15-25 G), very fast (25-45 G), the steep (> 45 G).

The location of the main profile network, the description of these profiles, as well as the location and description of the control profiles in each forest units was done simultaneously with the collection of data such as: the relief shape, the terrain configuration, the exhibition, the slope, the altitude, the type of the site, litter and type of flora. The main profile network was drawn up on the basis of a preliminary naturalistic study, which, at the time of the forest management planning work,it got indesit, if necessary was (*** Îndrumar pentru amenajarea pădurilor 2000). When analyzing the

distribution of soils, some general appreciations were made regarding their favorability for certain species according to some data from management plan forestry. The processed data concerned a forest area of 373,510.9 ha from the Caraş-Severin County Forest Administration and 79,114.9 ha from the Timişoara County Forest Administration, with a total of 452,625.8 ha for the whole Banat Forest area.

RESULTS AND DISCUSSIONS

The forests occupy in Banat approx. 28.7 % of the total area of the region, most forest areas (over 65 %) being located at the mountains (Bîndiu et al 1995). The county of Timiş, typical of the plain, has only 11,8 hectares of woodland, while Caras-Severin County has extensive hectares of massive forests (about 45 % of the total), with a country record (Bîndiu et al 1995).

In Banat there is an overlap of mountain and northern elements with elements of Mediterranean and Southern origin, mountain elements descending appreciably to the plain and vice versa (Grigore, Schrott, 1973), Banat being a bridge between the Balkans and Central Europe, between the East and the West, there is almost everywhere an interference of very complex geographic and ecological areas (Bîndiu et al 1995). The forests of Banat vegetate in all bioclimatic areas from the subalpine forest layer to the forest steppe.

Layers occupy the following altitudinal intervals (Doniță et al 1981): spruce forests over 1450 m (only in the ecological subregion F_2 Tarcu-Poiana Ruscăi), mixtures of beech with resinous, 1350-1450 m (in subregion F_1 Cerna-Semenic) and 900-1350m (in F_2 Tarcu-Poiana Ruscăi), mountain beech 800-1250min F_1 and 800-1350m in F_2, hilly beech 500-800 m in both subregions, sessile oak and sessile oak with Turkey oak 300-500 m, Turkey oak-Hungarian oak (150 m) 200-300 m, oaks of meadow 100-200 m (only in the subregion F_2), oaks of meadow and depression 70-200m (only in O1 sub-region, Timis Plain).

The first three floors of vegetation: subalpine forest, mountain spruce and mountain mixes are quite poorly represented (totaling only 5 % of the forests of Banat). Spruces are frequent only in the Tarcu-Godeanu massif and at high altitudes. The most extensive forest areas, on the whole of the region, are located on the montane-premontaneous layer (33 %) and the hilltop layer sessile oak, beech and sessile oak-beech (34 %). Beech are best represented in the mountain area, both vertically and horizontally.

It is worth mentioning that in Banat the beech form a higher limit for the forest vegetation, but the beech is well represented on the hilly layer of sessile oak, beech and sessile oak-beech trees. Majority forms pure arboretums. The sessile oak make the transition to the beech in the upper part or to Turkey oak - Hungarian oak at the bottom. The last 3 layers of vegetation totalizing 6 % of Banat forests. Oak and plains are represented fragmentarily.

Forest soils have formed in different soil inclination conditions. In the Caraş-Severin County Forest Administration, slopes very quickly occupy 67 % of forest area, and slopes quickly occupy 25 %. This requires a great deal of planning and cutting due to the hydrological role of the forest and the recent increase in flood numbers and intensity.

In the Timis County Forest Administration, 33 % of the forests are on very fast slopes and 25 % on fast slopes.

Throughout the surface of the Banat forest were recorded soils classified in the following classes: 1 – Cambisols (281.389,4 ha – 62 %), 2 – Spodosols (3.524,8 ha – 1 %), 3 – Pelisols (9.586,7 ha – 2 %), 4 – Chernisols (25.837,6 ha - 6 %), 5 – Luvisols (131.992,4 ha – 29 %), 6 – Anolisols (294,9 ha), totalizing 452.625,8 ha (100 %).

So cambisols and luviosols occupy the vast majority of the Banat forest land (91 %).Cambisols are predominantly spread on the mountainous-premontaneous layer of beech forests (FM1 + FD4), where they occupy 132,365.4 ha (47 %), followed by FD3 - the hilltop layer sessile oak, beech and sessile oak-beech forests with 103,617.9 ha (37 %). On the FM1 + FD4 layer they are mostly distributed in the Caraş-Severin County Forest Administration (94 %), the eutricambisols occupying 47 %, and the districabisols 53 %. In the Timis County Forest Administration the cambisols are mostly distributed in FD3 (39 %) followed by FM1 + FD4 (35 %) and FD2 (25 %). In these layers, the eutricambisols represent (97 %) and are spread on slopes very fast (mostly) or fast, which ensure a good drainage of precipitation waters, and so a large part of the water does not participate in the processes of pedogenesis.

Cambisols rich in humus and in exchange bases, airy and permeable, slightly acidic, provide superior edaphic conditions for high productivity beech and for oak or oak mixes with beech. But the beech forms in Banat the stretched out forests and the poorer cambisols in the bases of exchange and even more acidic but with a large edafic volume and good ventilation.

Table 1

The distribution of forest soils on bioclimatic areas in Banat forests*

Bioclimatic area	Soil class	Soil types	D.S. Caraş-Severin	%	D.S. Timiş	%	Total Banat (ha)	%
1. Subalpine forest layer (Fsa)	Cambisols (CAM)	Districambisols (DC)	260,5	59	-		260,5	59
	Spodisols)SPO)	Prepodzol (EP)	121,3	27	-		121,3	27
	Pelisols (PEL)	Pelosols (PE)	62,0	14	-		62,0	14
	Total Fsa		443,8	100	-		443,8	100
2. Mountain layer of spruce (FM_3)	Chernisols (CER)	Rendzina (RZ)	82,8	-	-		82,8	-
	Cambisols (CAM)	Eutricambisols (EC)	4749,2	-	-		4749,2	-
		Districambosols (DC)	12739,5	-	-		12739,5	-
		Total	17488,7	95	-		17488,7	95
	Spodisols (SPO)	Prepodzols (EP)	672,7	-	-		672,7	-
		Podzols (PD)	230,3	-	-		230,3	-
		Total	903,0	5	-		903,0	5
	Pelisols (PEL)	Pelosols (PE)	20,8	-	-		20,8	-
		Vertosols (VS)	0,6	-	-		0,6	-
		Total	21,4	-	-		21,4	-
	Total FM_3		18495,9	100	-		18495,9	100
3. Mountain-mixture layer (FM_2)	Cambisols (CAM)	Eutricambisols (EC)	51,0	-	-		51,0	-
		Districambisols (DC)	3656,1	-	-		3656,1	-
		Total	3707,1	62	-		3707,1	62
	Spodisols (SPO)	Prepodzols (EP)	1543,1	-	-		1543,1	-
		Podzols (PD)	495,1	-	-		495,1	-
		Total	2038,2	34	-		2038,2	34
	Pelisols (PEL)	Pelosols (PE)	241,6	-	-		241,6	-
		Vertosols (VS)	14,1	-	-		14,1	-
		Total	255,7	4			255,7	4
	Total FM_2		6001,0	100			6001,0	100
4. Mountaineering-premontan layer beech (FM_1+FD_4)	Chernisols (CER)	Rendzina (RZ)	7630,8	6	-		7630,8	5
	Luviosols (LUV)	Preluvosols (EL)	180,3	-	-		180,3	-
		Planosols (PL)	3802,0	-	173,6	2	3975,6	-
		Total	3982,3	3	173,6	-	4155,9	3

	Cambisols (CAM)	Eutricambisols (EC)	57404,6	-	9245,8	-	66650,4	-
		Districambosols (DC)	65715,0	-	-	-	65715,0	-
		Total	123119,6	89	9245,8	98	132365,4	90
	Spodisols (SPO)	Prepodzols (EP)	441,6	-	20,7	-	462,3	-
	Pelisols (PEL)	Pelosols (PE)	2244,6	-	-	-	2244,6	-
		Vertosols (VS)	43,2	-	4,0	-	47,2	-
		Total	2287,8	2	4,0	-	2291,8	2
	Total FM_1+FD_4		137462,1	100	9444,1	100	146906,2	100
5. The hilltop layer of sessile oak, beech and sessile oak-beech (FD_3)	Chernisols (CER)	Rendzina (RZ)	15040,5	11	-	-	15040,5	10
	Luvisols (LUV)	Luvosols (LV)	1142,0	-	550,3	-	1692,3	-
		Planosols (PL)	28753,1	-	1308,8	-	30061,9	-
		Total	29895,1	21	1859,1	15	31754,2	20
	Cambisols (CAM)	Eutricambosols (EC)	86968,8	-	9566,2	-	96535,0	-
		Districambosols (DC)	6409,9	-	673,0	-	7082,9	-
		Total	93378,7	65	10239,2	85	103617,9	67
	Pelisols (PEL)	Pelosols (PE)	3339,7	*-	3,6	-	3343,3	-
		Vertosols (VS)	1044,9	-	2,2	-	1047,1	-
		Total	4384,6	3	5,8	-	4390,4	3
	Total FD_3		142698,9	100	12104,1	100	154803,0	100
6. The hilly layer of the quercus (sessile oak, Turkey oak, Hungarian oak, mixtures of these) and hills (FD_2)	Chernisols (CER)	Rendzina (RZ)	2993,6	-	-	-	2993,6	3
	Luviosols (LUV)	Luvosols (LV)	2015,6	5	4802,8	-	6818,4	-
		Planosols (PL)	40566,8	-	20988,4	-	61555,2	-
		Total	420582,4	66	25791,2	79	683736	71
	Cambisols (CAM)	Eutricambisols (EC)	16778,8	-	6551,4	-	23330,2	-
		Districambosols (DC)	100,5	-	135,3	-	235,8	-
		Total	16879,3	26	6686,7	20	23566,0	24
	Pelisols (PEL)	Pelosols (PE)	1392,2	-	12,0	-	1404,2	-
		Vertosols (VS)	331,4	-	180,1	-	511,5	-
		Total	1723,6	3	192,1	1	1915,7	2
	Total FD_2		64178,9	100	32670,0	100	96848,9	100
7. The hilly layer quercus with oak (sessile oak, Turkey oak,	Luviosols (LUV)	Luvosols (LUV)	283,9	1	451,8	-	735,7	-
		Planosols (PL)	3872,1	-	15493,2	-	19365,3	-
		Total	4156,0	99	15945,0	97	20101,0	97
	Cambisols (CAM)	Eutricambosols (EC)	-	-	116,1	1	116,1	1

Hungarian oak, mixtures of these) (FD_1)	Andisols (AND)	Andosols (AN)	54,8	-	19,3	-	74,1	-
	Pelisols (PEL)	Vertosols (VS)	2,9	-	321,2	2	324,1	2
	Total FD_1		4213,7	100	16401,6	100	20615,3	100
8. Forest field (FC=CF)	Chernisols (CER)	Chernozem (CZ)	-	-	46,8	1	46,8	1
	Luvisols (LUV)	Preluvosols (EL)	-	-	3232,7	-	3232,7	-
		Luvosols (LUV)	-	-	3926,2	-	3926,2	-
		Alosols (AL)	-	-	260,5	-	260,5	-
		Planosols (PL)	-	-	188,3	-	188,3	-
		Total	-	-	7607,7	93	7607,7	93
	Cambisols (CAM)	Eutricambisols (EC)	-	-	267,7	3	267,7	3
	Andisols (ABD)	Andosols (AN)	-	-	220,8	3	220,8	3
	Pelisols (PEL)	Vertosols (VS)	16,6	-	-	-	16,6	
	Total CF		16,6	-	8143,0	100	8159,6	100
9. Silvosteppe (Ss)	Chernisols (CER)	Chernozem (CZ)	-	-	43,1	12	43,1	12
	Pelisols (PEL)	Pelosols (PE)	-	-	9,1	-	9,1	-
		Vertosols (VS)	-	-	299,9	-	299,9	-
		Total	-	-	309,0	88	309,0	88
	Total Ss		-	-	352,1	100	352,1	100
Total			373510,9	-	79114,9	-	452625,8	-
% Banat			83		17		100	

* The soil classes and types are in accordance with the Romanian Soil Taxonomy System (SRTS 2003)

In both County Forest Administrations occupied by cambisols are located on the two mentioned layers (84 % Caraş-Severin County Forest Administration and 74 % Timiş County Forest Administration), mentioning that in the Timiş County Forest Administrations 25 % of the areas are located on the FD2 layer. Luvisols are mostly distributed in FD2 (68,373.6 ha - 52 %) followed by FD3 (31.754,2 ha - 24 %) and FD1 (20.101,0 ha - 15 %). On the County Forests Administrations predominate in FD2 (Caraş-Severin County Forest Administration 42,582.4 ha - 53 % respectively Timiş County Forest Administration 25,791.2 ha - 50 %). Altitude differences are grouped on the upper layers in the Caraş-Severin County Forest Administration (42 %) and in the lower layers in the Timiş County Forest Administration (46 %). In FD2 they are predominantly represented by planosols (90 %) and luvosols (19 %). Planosols occupy 95 % of the forest lands in the Caraş-Severin County Forest Administration and 81 % in the Timiş County Forest Administration.In FD3 majority there are the planosols (95 %), occupying 96 % of the lands of Caraş-Severin County Forest Administration and 70 % in Timiş County Forest Administration, followed by luvosoluri. It should be noted that these soils provide favorable conditions for the Turkey oak, a species that occupies 21 % of the forestry area of the Timis County Forest Administration.

Chernisols occupy 6 % of the forest area of Banat, being half the majority rendzine (only 89.9 hectares of chernozems in the area of forest plain and forest steppe). They are distributed almost on all vegetation layers (some with very small areas), mainly in FD3 (15,040.5 ha - 58 %) followed by FM1 + FD4 (7.630.8 ha - 30 %) and FD2 (2.993,6 ha 12 %). The rest of the forest areas are occupied by pelisols (2 %), spolisoluri (1 %) and only 284.9 ha of andisols.

CONCLUSIONS

The forests of Banat vegetate in special conditions at the interference of very complex geographic and ecological areas. The forest lands are situated predominantly by sloping very quickly slopes, in the Caraş-Severin County Forest Administration they occupy 67 % and in the Timiş County Forest Administration 33 %, which requires an increased care for the planning and execution of cutting trees.

Banat forest soils belong mostly to the cambisol class 281,389.4 ha (62 %) and luvisolles 131,992.4 ha (29 %). Cambisols are spread on the whole of the region, mostly on the montane-premontan layer of beech (FM1 + FD4) where it occupies 132,365.4 ha (47 %) followed by FD3 the hilltop layer sessile oak , beech and sessile oak-beech with 103,613.9 ha (37 %). The paper presents their distribution by types and County Forest Administrations. Cambisols are generally favorable for beech.

Luvisols are mostly spread in FD2 68,373.6 ha (52 %), both in the Caraş-Severin County Forest Administration 42,582.4 ha (53 %) and in Timiş County Forest Administration 25,791.2 ha (50 %). They are predominantly represented by planosols (95 %) in the Caraş-Severin County Forest Administration and (81 %) in the Timis County Forest Administration. These soils provide favorable conditions for the Turkey oak.

Chernisols occupy 6 % of the forest area of Banat being almost entirely made of rendzine.

The distribution of soils on phytoclimatic levels, correlated with their favorability for certain species, can serve as a general orientation for forest management.

REFERENCES

Bîndiu, C., et al., 1995, Pădurea seculară. Cercetări ecologice în Banat, Ed. Mirton, Timişoara;

Chiriţă, C., et al., 1977, Staţiuni forestiere, Ed. Academiei R.S.R.;

Doniţă, N., et al., 1981, Zonarea şi regionarea ecologică a pădurilor din R.S.R., Redacţia de propagandă tehnică agricolă;

Doniţă, N., et al., 1990, Tipuri de ecosisteme forestiere din România, seria a II-a, Redacţia de propagandă tehnică agricolă;

Grigore, S., Schrott, J., 1973, Flora şi vegetaţia Banatului, Tipografia Universităţii Timişoara;

Giurgiu, V., 1978, Conservarea pădurilor, Ed. Ceres;

Maliţa, M., et al., 1979, Sisteme în ştiinţele naturii, Ed. Academiei R.S.R;

Păunescu, C., 1975, Solurile forestiere I, Ed. Academiei R.S.R;

Tîrziu, D., 1997 – Pedologie şi staţiuni forestiere, Ed. Ceres:

***, 2003, Sistemul roman de taxonomie a solurilor (SRTS);

***, 2000, Îndrumar pentru amenajarea pădurilor.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓*Biology*
✓*Horticulture*
✓*Food produce processing technology*
✓*Environmental engineering*

THE FOREST SOILS FROM ARAD COUNTY

Cântar Ilie-Cosmin[1]*, Dincă Lucian[2]

[1] „Marin Drăcea", National Institute for Research and Development in Forestry, Timisoara
[2] „Marin Drăcea", National Institute for Research and Development in Forestry, Braşov
* *Correspondence author. E-mail*:: cantar.cosmin@yahoo.com

Key words: *luvisol, eutric cambisol, gleysol, humus*

ABSTRACT

The aim of this paper is to realize a description of forest soils from Arad County. The work material is represented by soil analysis data from forest management plans made in the period 1985-2015 from 22 forest districts, meaning 483 soil profiles and 1332 pedo-genetical horizons. The soils found in Arad are characteristic to the area of low hills (luvisols, preluvisols, eutric cambisols). However, field soils (phaeozems), mountain soils (dystric cambisols) and even azonal soils (fluvisols, gleysols) are present, in the order of their spreading: luvisol (moderately acid, mezobazic in Ao and Bt and oligomezobasic in El, with a high total cationic exchange capacity, well supplied with nitrogen and intensely humiferous), eutric cambisol (moderately acid, mezobazic, with a high total cationic exchange capacity, very well supplied with nitrogen and intensely humifeous), preluvisol (moderately acid, mezobazic, with a high total cationic exchange capacity, very well supplied with nitrogen and intensely humiferous), gleysol (eubazic, with a very high total cationic exchange capacity, very well supplied with nitrogen and moderately humiferous).

INTRODUCTION

Based on data from the National Statistical Institute, the forest area from Arad Forest District is 211.470 ha for the year 2015 (www.insse.ro). The state administration, Romsilva National Forest Institute, manages through its 10 Forest Districts, 102.329 ha (www.rosilva.ro). The difference between the above numbers is represented by private forests which occupy an important percentage in this county.

Forest soils are an essential part of forest ecosystems (Spârchez *et al., 2011,* Dincă *et al.,* 2006). The purpose of this paper is to realize a description of soils from Arad county's forest area.

MATERIAL AND METHODS

During the forest management activity, amongst other works, soil samples from profiles situated in characteristic areas are also harvested. These samples are then analyzed at the soil laboratory from "*Marin Dracea*" National Institute for Research and Development in Forestry. The following parameters are taken into account: pH, humus content, content of carbonates, base exchange capacity (Sb), hydrogen exchange capacity (Sh), total cationic exchange capacity (T), base saturation degree (V), texture, total nitrogen. The methods used in the analysis of soil samples are acknowledged at national and international level (Dinca L. *et al.,* 2012).

The present paper takes into account soil samples harvested in the period 1985-2015 from 22 forest districts belonging to Arad Forest Management District (Amenajamentele Ocoalelor Silvice: Beliu (1995, 2006, 2015); Bârzava (2007); Ceala (1992, 2002, 2012); Chişinău Criş (2002, 2012); Gurahonţ (1994, 2005, 2014); Lipova (2007); Radna (2006, 2015); Săvârşin (1985, 1996, 2006); Sebiş Moneasa (2005, 2014); Valea Mare (2009, 2012)). As a whole, 483 soil samples and 1332 pedo-genetical horizons were analyzed. The repartition of soil types and main chemical properties of soils (pH, base saturation degree, total cationic exchange capacity, humus and nitrogen content) were analyzed.

RESULTS AND DISCUSSION

Types of soils from Arad Forest District

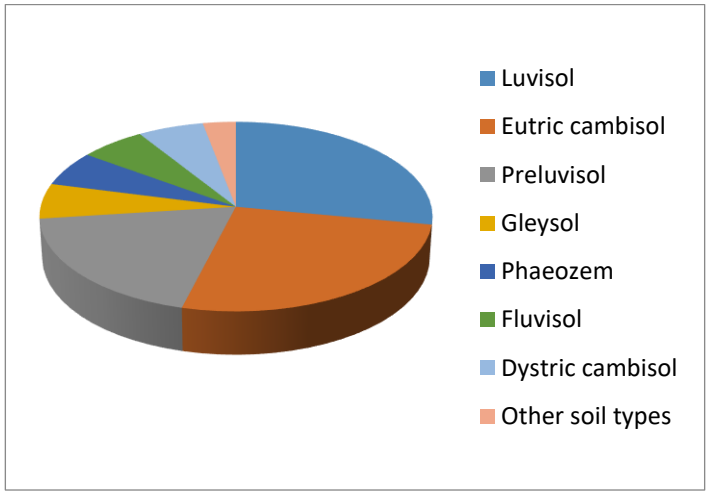


Figure 1. The percentage of forest soils identified in Arad District

The most widespread types of soils are the ones from Luvisols (47 %) and Cambisols (32 %) classes. As types of soils, the most widespread is luvisol (28 %), followed by eutric cambisol (26 %) and preluvisol (19 %). These soils are followed as spreading by a group of 4 soils that occupy each 6 % of the county's forest area: gleysol, phaeozem, dystric cambisol and fluvisol (figure 1). Other types of soil (alosols, soloncheaks, solonetz, rendzic leptosols, entiantrosols) represent 3 % of the total forest soils from this area.

At the level of our country, dystric cambisol occupies the first place as spreading in forest soils (2.292.35 ha, meaning 35 %), the luvisol 2nd place (1.440.052 ha, meaning 22 %), eutric cambisol the 3d place (with a total area of 869.909 ha, meaning 13 %), and preluvisol the 5 place (335.050 ha, meaning 5 %), (Dincă L. *et al*., 2014). It can be observed that all 4 mentioned soils are also occupying significant areas in Arad Forest District. Iliuţă *et al.* (2012) have identified on 182.080 ha from Arad Plain the presence of chernozems on 44 % of the area, followed by eutric cambisol (22 %), vertisol (12 %), phaeozem (8 %) and gleysol (5 %). Vlad *et al.,* (2007) have identified the following percentages occupied by soils from the total agricultural acreage in the surveyed area from Arad county (775.409 ha of which 511.520 ha is represented by agricultural fields): 30.53 % chernozems, 25.11 % luvisols, 14.91 %, protisols, 11.82 % pelisols, 6.80 %

cambisols and of total forest acreage in surveyed area 47,79 % are luvisols and 46,68 % are cambisols. Şohrenţ and Rusu (2009), have found in Miniş-Măderat vineyards perimeter from Arad County, 6 types of soils: preluvisol (30 %), eutric cambisol (24 %), vertisol (20 %), fluvisol (10 %), chernozem (10 %) and gleysol (6 %).

Soil solution reaction

In regard with the soil solution reaction, this was calculated on pedogenetic horizons, differentiated for the most widespread types of soils (eutric cambisol, luvisol), but also for the ones at which the values of this parameter re different (large at phaeozem and fluvisol and lower for dystric cambisol) (figure 2). The lowest values of pH are registered for dystric cambisol, this being a strongly acid soil, while the largest pH values are for fluvisol and phaeozem, weakly alkaline soils. All the other soils are moderately acid. In the second horizon, the pH is larger, due to the rocks formed on parental materials that are rich in calcium and pheromagnesium minerals (Târziu *et al.,* 2004). The largest amplitude pH variation is found in fluvisols, soils formed through the accumulation of slime (which are of different types and have as such a variable pH).

Borza *et al.* (2007) have found the following pH distribution for Arad County's soils: highly acid (pH<5)-3.2 %, moderate acid (pH=5.1-5.8)-38.4 %, low acid (pH=5.9-6.7)-38.4 %, neutral (pH=6.8-7.2)-6.6 %, low alkaline (pH=7.3-8.4)-19.3 % and moderate and excessive alkaline (pH>8.5)-2.2 %. The luvisol reaction in the Gurahont Depression is as follows: of the 8.938 ha of arable land, 1.609 (18 %) are acid, 5.810 ha (65 %) are less acid, 536 ha (6 %) have a neuter reaction and 983 ha (11 %) have an alkaline reaction (Balaşcău and Borza, 2011). Acid preluvisols were also identified in other areas of the country (Chisăliţă *et al.,* 2015, in O.S. Făget, D.S. Timiş). Iliuţă and Ţărău (2013), found from 755.409 ha, of which 511.520 ha arable terrains that moderate and strong acid covers 150.000 ha, moderate alkaline cover 45.000 ha and strong and excessive alkaline 16.000 ha.

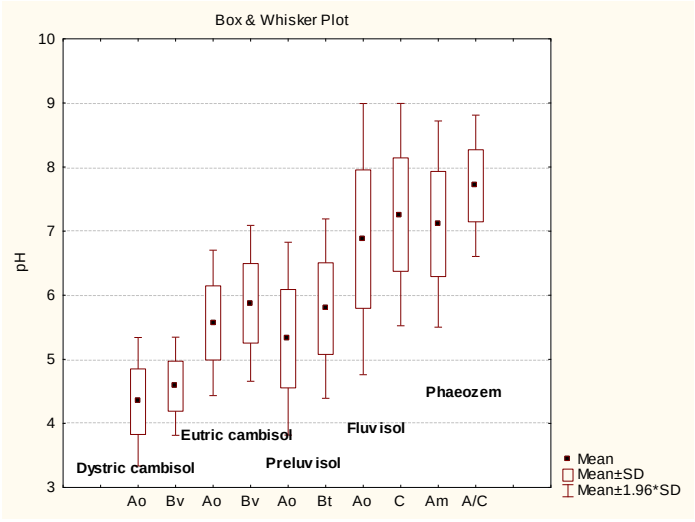


Figure 2. pH variation of genetic horizons for the most widespread forest soils from Arad

Base saturation degree

The values on pedo-genetic horizons were also calculated for the base saturation degree. The most widespread soils from the area (luvisol, eutric cambisol and preluvisol) were analyzed, together with gleysol, a soil with a good representation in this county, in comparison with other areas of the country (figure 3).

It can be observed that the variation amplitude of this parameter is high for all soils. By analyzing the average value of the base saturation degree, it can be observed that it is situated in the interval 55 – 65 % for eutric cambisol and preluvisol, both soils being mezobazic, the luvisol is mezobazic in Ao and Bt and oligomezobasic in El, while gleysol is eubasic.

Total cationic exchange capacity

In regard with the total cationic exchange capacity, an average value per profile was calculated and rendered as table for each type of soil (Table 1).

All soils have a large cationic exchange capacity (figure 4). The largest value of this parameter is registered for gleysol, while the lowest is for dystric cambisol.

For luvisols from Arad area, Mihuţ and Niţă (2014), have established that the total cation exchange capacity is very small in A and E horizons (under 10 me/100 g soil), may increase up to double the horizon iluvial becoming middle (20-35 me/100 g soil).

Humus

A very important soil parameter is the humus content (Dincă L., 2015). In regard with it, the average content from the A horizon was determined for each type of identified soil (Table 1). Gleysol and fluvisol are moderately humifer soils, while dystric cambisol, luvisol, eutric cambisol and preluvisol are intensely humiferous (figure 5).

The humus quantities from this district are similar with the average values for forest soils calculated for the entire country (Dincă *et al.,* 2012). Toth *et al.* (2012), have established that for Cacica are, the humus content in soils indicates a good supply, the weighted average being 3.24 %.

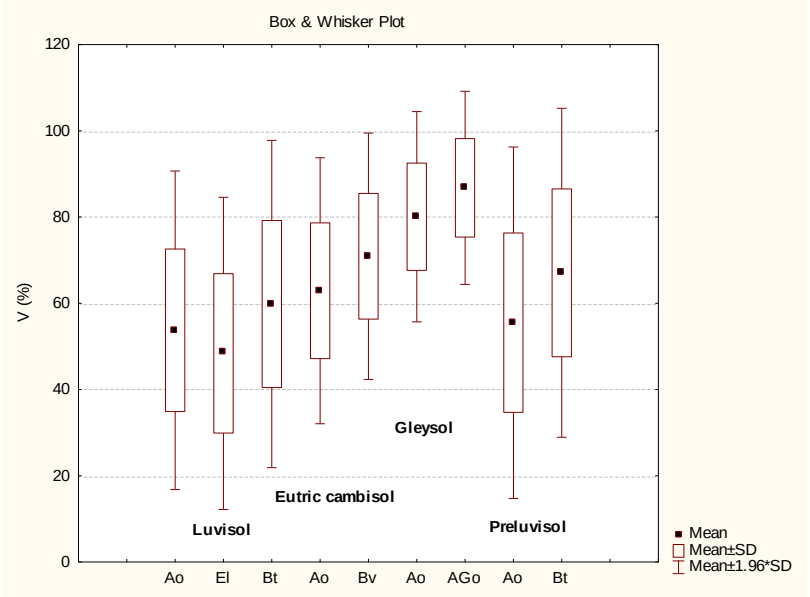


Figure 3. Base saturation degree variation for the most widespread soils from Arad County

Table 1

Average content of humus, nitrogen and total cationic exchange capacity for forest soils from Arad county

Eutric cambisol	Dystric cambisol	Preluvisol	Luvisol	Gleysol	Fluvisol
Total average cationic exchange capacity per soil type (T-me 100 g^{-1} sol)					
22.75	21.74	22.50	22.17	26.06	24.65
Average humus content in the A horizon per soil type (H-%)					
5.21	8.05	5.04	6.10	3.86	4.11
Average nitrogen content in the A horizon per soil types (%)					
0.27	0.43	0.25	0.31	0.20	0.24

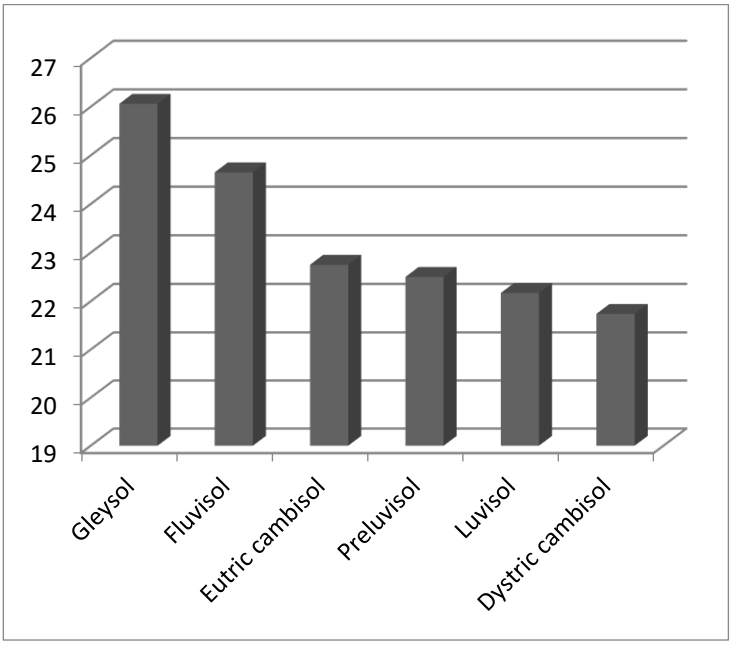


Figure 4. The variation of total cationic exchange capacity for the most widespread forest soils from Arad county

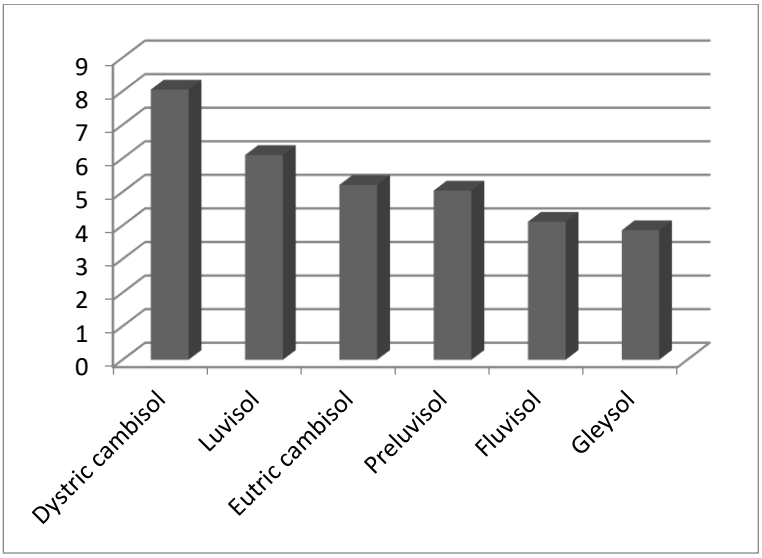


Figure 5. The variation of humus content for the most widespread forest soils from Arad county

Nitrogen

In regard with the nitrogen supply, fluvisols, preluvisols and eutric cambisols are very well supplied soils with this element, while dystric cambisols and luvisols are well supllied with nitrogen.

CONCLUSIONS

In Arad, a similar number of soils (12) with the ones from Maramureş County is found, but larger than the ones from Giurgiu County, which has only 7 types of soils (Crişan et al., 2017). Unlike other counties, gleysols are well represented in Arad.

Luvisol is a moderately acid soil, mezobasic in Ao and Bt and oligomezobasic in El, with a high total cationic exchange capacity, well supplied with nitrogen and intensely humiferous. Eutric cambisol is a moderately acid soil, mezobasic, with a high total cationic exchange capacity, very well supplied with nitrogen and intensely humiferous. Preluvisol is a moderately acid soil, mezobasic, with a high total cationic exchange capacity, very well supplied with nitrogen and moderately humiferous. Gleysol is a eubasic soil, with a very large total cationic exchange capacity, very well supplied with nitrogen and moderately humiferous. Dystric cambisolul is a strongly acid soil, oligomesobasic, with a high total cationic exchange capacity, well supplied with nitrogen and intensely humiferous. Phaeozem is a weak alkaline soil, with a high total cationic exchange capacity. Fluvisol is a weak alkaline soil, with a high total cationic exchange capacity, very well supplied with nitrogen and moderately humiferous.

REFERENCES

Balaşcău D., Borza I., 2011, *Soil quality in Gurahonţ depression,* JOURNAL of Horticulture, Forestry and Biotechnology, Volume 15(2), 157- 161.

Borza I., Ţărău D., Sala F., Ţărău I., Iordache M., 2007 *Quality state of soils from West of Romania and measures for their fertility restoration,* Research Journal of Agricultural Science, 39 (2), 161-166.

Chisăliţă I., Dincă L., Spârchez Gh., Crăciunescu A., Vişoiu D., 2015, *The influence of some stagnoluvisols characteristics on the productivity of Quercus cerris and Qurecus frainetto stand from O.S. Făget, D.S. Timiş*, Research Journal of Agricultural Science, 47 (3), 23-28.

Crişan V.E., Enescu R., Dincă M., 2017, *Descrierea solurilor din cadrul Direcţiilor Silvice Giurgiu şi Maramureş*, Revista de Silvicultură şi Cinegetică Braşov nr. 39, pag. 85-89.

Dincă L., Dincă M., Băcăinţan N., 2006, *Utilizarea programelor de modelare în Pedologia forestieră*, Analele ICAS, Seria I, Vol. 49, Editura Tehnică Silvică, 45-53.

Dincă L., Lucaci D., Iacoban C., Ionescu M., 2012, *Metode de analiză a proprietăţilor şi soluţiei solurilor*, Editura Tehnică Silvică, 173 p.

Dincă L., Spârchez G., Dincă M., Blujdea V., 2012, *Organic carbon concentrations and stocks in Romanian mineral forest soils*, Annals of Forest Research, 55 (2), 229-241.

Dincă L., Spârchez G., Dincă M., 2014, *Romanian's forest soil GIS map and database and their ecological implications*, Carpathian Journal of Earth and Environmental Sciences, 9 (2), 133-142.

Dincă L., 2015, *Describing an own calculation program for the organic carbon from soils (STOCS) and its main applications*, Research Journal of Agricultural Science, Timisoara, 47 (3), 37-43.

Iliuţă A., Ţărău D., Beşti B., 2012, *Yield capacity limitative factors in Arad Plain soils,* Research Journal of Agricultural Science, 44 (4), 77-81.

Iliuţă A., Ţărău D., 2013, *Fertility limitative pedological factors approach and soil yield capacity recovery actions in Arad county,* Research Journal of Agricultural Science, 45 (4), 83-89.

Mihuţ C., Niţă L., 2014, *Research on some degraded soils in Arad and mitigation measures to impose,* Research Journal of Agricultural Science, 46 (3), 3-7.

Spârchez Gh., Târziu D., Dincă L., 2011, *Pedologie*, Editura Lux Libris, Braşov, 293 p.

Şohrenţ M., Rusu I., 2009, *The main types of soils in perimeter vineyards Miniş-Măderat, Arad county,* Research Journal Of Agricultural Science, No. 41 (3), 152-155.

Târziu D., Spârchez Gh., Dincă L., 2004, *Pedologie cu elemente de Geologie*, Editura Silvodel, Braşov, 2004, 343 p.

Toth A., Turi Şt., Turi P., Duma-Copcea A., 2012, *Characterization of soils pedo Pecica near the village, Arad,* Research Journal of Agricultural Science, 44 (4), 144-148.

Vlad H., Borza I., Ţărău D., Dologa D., Iliuţă A., Bâc C., Florea D., 2007, *Pedological factors, component of Arad county rural area,* Research Journal of Agricultural Science, 39 (2), 155-160

*** Amenajamentele Ocoalelor Silvice: Beliu (1995, 2006, 2015); Bârzava (2007); Ceala (1992, 2002, 2012); Chişinău Criş (2002, 2012); Gurahonţ (1994, 2005, 2014); Lipova (2007); Radna (2006, 2015); Săvârşin (1985, 1996, 2006); Sebiş Moneasa (2005, 2014); Valea Mare (2009, 2012).

www.insse.ro

www.rosilva.ro

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

PLANTS CONSERVED IN "ALEXANDRU BELDIE" HERBARIUM – *ALYSSUM* GENUS

Cântar Ilie-Cosmin[1*], Vechiu Emilia[2], Dincă Lucian[2]

[1] „Marin Drăcea", National Institute for Research and Development in Forestry, Timisoara
[2] „Marin Drăcea", National Institute for Research and Development in Forestry, Braşov
* *Correspondence author. E-mail*:* cantar.cosmin@yahoo.com

Key words: *Alyssum, herbarium, species, botanists*

ABSTRACT

The purpose of the present paper is to describe the Alyssum Genus species present in Al. Beldie Herbarium from I.N.C.D.S. Bucharest. A data base was created for the species of this genus, containing data regarding their gathering place and date, the specialists who has collected them and the conservation degree of each exemplar, noted from 1 to 4. The Genus was divided in six sections, with species gathered from different parts of Europe, preponderantly from Romania. All the 29 species present in the Herbarium were gathered between 1833 and 1993 by Romanian and foreign specialists who have kept them in a very good conservation state. Furthermore, different diagrams were realized regarding the number of species encountered and their gathering periods.

INTRODUCTION

Brassicaceae Family contains 321 Genera and approximately 3700 species (Al-Shehbaz 1987). Alyssum Genus belongs to the Brassicales Order and contains 195 species distributed all around Europe, Asia, North Africa and North America (Li et al 2014). The Genus is represented by annual, biennial or perennial herbaceous plants, with oval elongated leaves and yellow or white (pink or purple at some species) hermaphrodite stellar flowers. The stem is sessile or ramified, while the fruit is a silica or silica (Baskin et al 1974). Dudley (1964) has divided the Genus in six sections, namely Meniocus (Desv.) Hook, Psilonema (C. A. Meyer) Hook, Alyssum and Gamosepalum (Hausskn.) Dudley, Tetradenia (Spach) Dudley, and Odontarrhena (C. A. Meyer) Koch. where all species are perennial and hyper accumulating Ni (Broadhurst Catherine et al 2016).

Recent phytogenetic analyses show that the Alyssum Genus is polyphyletic (Al-Shehbaz 1987).

The Alyssum name originates from Greek, where "a" means "no" and "lyssa" relates to madness, anger. As such, the name ascertains to the plant's reputation in medicinal purposes. It is considered that an infusion created from its leaves and flowers can be administered as antidote against madness or the bites of a rabid dog. The tea can also be used as sedative against anger (Dudley 1966).

MATERIALS AND METHODS

Marin Drăcea National Institute for Forestry Research-Development (INCDS) from Bucharest holds a Herbarium named after Alexandru Beldie, an important Romanian botanist. The Herbarium contains over 40.000 plates of some plant species

kept in their original maps and organized in almost 600 drawers (Vasile Diana et al 2017). The plant collection is registered in INDEX HERBARIORUM and is composed of plants that come from privately donated collections as well as from foreign collections obtained through exchanges. Amongst them we mention the 32 *Arabis* genus species (Dincă et al 2017a), the 33 *Orobanche* genus species (Scărlătescu et al 2017), 9 *Melica* species and 11 *Eragrostis* genus species (Cântar et al 2017), 19 *Androsace* genus species (Dincă Maria et al 2017), 15 *Veronica* genus species (Dincă et al 2017b), 69 *Potentilla* genus species (Crişan et al 2017), or 17 *Amaranthus* genus species (Dincă et al 2018).

The study material was thus composed of 83 plates belonging to the *Alyssum* Genus and present in Al. Beldie Herbarium. All 29 species representative of the *Alyssum* Genus and found within the Herbarium were introduced in a data base where they were grouped based on the species, gathering place and date, specialist who has collected them and their degree of conservation. Table number 1 presents an excerpt of the *Alyssum* Genus data base.

Furthermore, based on the investigations from the specialty literature, some *Alyssum* species present in the Herbarium were also described.

RESULTS AND DISCUSSIONS

The species found in the Herbarium were the following: *Alyssum alyssoides* L., *Alyssum arduini* Frits., *Alyssum argenteum*, *Alyssum borzaeanum*, *Alyssum caliacre*, *Alyssum campestre* L., *Alyssum corsicum* Duby, *Alyssum desertorum*, *Alyssum diffusum*, *Alyssum edentulum* W. et K., *Alyssum eximium* Nyár., *Alyssum halmifolium* L., *Alyssum hirsutum*, *Alyssum hispidum* L & P., *Alyssum leucadaeum* Guss., *Alyssum linifolium* Steph., *Alyssum macrocarpum* D.C., *Alyssum maritimum* Lam., *Alyssum minitum* Schl., *Alyssum murale* Waldst. & Kit., *Alyssum petraeum* Ard., *Alyssum repens* Baumg., *Alyssum rostratum* Stev., *Alyssum rupestre* Ten, *Alyssum saxatile* L., *Alyssum sinuatum*, *Alyssum tortuosum*, *Alyssum wierzbickii* Heuff. and *Alyssum wulfenianum* Bernh.. The most numerous *Alyssum* species present in the Herbarium are: *A. repens* Baumg (17 plates), *A. alyssoides* L.(11 plates), *A. arduini* Frits. and *A. borzaeanum* (6 plates) (Fig. 1).

Table 1

The inventory of *Alyssum* Genus (excerpt from the data base)

Drawer number	Plate number	Herbarium/ Botanic collection/ Institution	Name of species	Gathering date	Gathering place	Collected/ Determined by:	Conservation Degree (1..4)
51	1	Al. Beldie Herbarium, Bucharest	Alyssum alyssoides L.	1947.08.02	Poiana Țapului	Al. Beldie	1
51	36	Dr. C.Baenitz/ Herbarium Europaeum	Alyssum minutum Schl	1993.05.26	Bunardzik, pr. Filipopel	V. Střibrnỳ	1
51	68	Museum Botanicum Universitatis, Cluj / Flora Romaniae exsiccata	Alyssum arduini Fritsch	1936.04.06	Oltenia, distr. Gorj 470 m	E. Pop	1
51	15	Museum Botanicum Universitatis, Cluj / Flora Romaniae exsiccata	Alyssum borzaeanum	1925.05.25	Transsilvania, distr Cluj 410 m alt	E.L. Nyárády	1

51	48	Bucharest's Polytechnics Herbarium, Silviculture Faculty/ Botanic Laboratory	Alyssum repens Baumg.	1943.08.01	Bucegi: Bucşoiu 2400 m	Al. Beldie	1
51	66	Museum Botanicum Universitatis, Cluj / Flora Romaniae exsiccata	Alyssum rostratum Stev.	1922.06.13	Dobrogea, distr. Tulcea 100 m	Al. Borza	1

Alyssum alyssoides L. (Fig. 2) is an annual plant original from Europe and Asia but that was also introduced in the United States, Canada and Argentina (Dudley 1964). It can grow up to 35 cm, with a stern and erect stern, linear-obceolante leaves and obovate leaves that can reach 4 mm in length and are usually milky. The fruits are orbicular, emarginated or truncated, reaching 2,5-3,5 mm. The plant blooms between March-August and can also grow at altitudes of up to 2000 m (Akyol et al 2017). The seeds germinate during summer and early autumn, but only the seedlings that germinate during autumn survive (Baskin et al 1974). The plant is spread in dry, steppe and mountain areas.

Alyssum borzaeanum Nyár. (Fig. 3) is an endemic species spread out along the Black Sea's shore, Ukraine, Turkey, North Greece and Bulgaria. In Bulgaria it can be found on a surface of approximately 100 km² and is inscribed in the Red List as endangered species. The plant is perennial and can reach 10-30 cm in height. The base leaves are covered with stellar, oblanceolate leaves, while the flowers are numerous and yellow. It usually grows in steppe pastures, sometimes even on rocky areas or on shores (http://www.iucnredlist.org). In Romania the plant was first mentioned by Nyárády in 1926 (Păunescu Anca 2008).

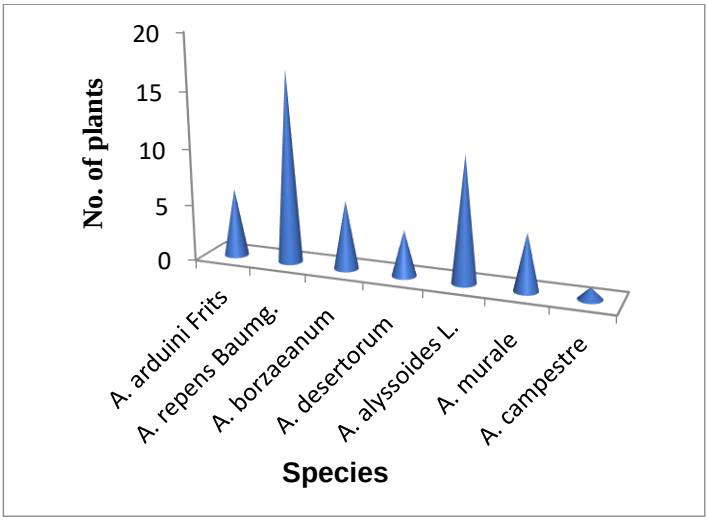


Figure 1. *Alyssum* Genus species present in the herbarium

Alyssum desertorum originates from Central and South-East Europe, as well as from Central and West Asia (Dudley 1964). The plant is annual and can grow up tp 25 cm in height. The stem is covered with stellar hairs, while the leaves are oblanceolate, sessile and 0,5 up to 3 cm. The flowers range from pale yellow to white and can grow

up to 2 mm (http://www.efloras.org/). The plant blooms from April until June (Dudley 1964). It can be found in perturbed areas, arid or rocky and on slopes with altitudes between 700 and 1200 meters. It usually grows together with *A. simplex* and *A. alyssoides*.

Alyssum repens Baumg. (Fig. 4) preponderantely found in South-East and Central Europe, Turkey and Caucasus. The leaves are oblong-obovate up to lanceolate, while the flowers are yellow-orange in color and with a diameter of 4-5 mm. The plant blooms during summer, from June until September. In Romania the plant can be found in the Carpathians or Apuseni Mountains (Dudley 1966).

Alyssum murale Waldst. & Kit (Fig. 5) is a species with a long blooming period, from June until September. It is a perennial plant, with linear-oblic green leaves, while the flowers are small and yellow. It usually grows on poor, rocky and well drained soils. The plant reproduces easily, through seeds. It is usually found in South-East and Central Europe (Dudley 1966).

Alyssum murale is a species that hyper accumulates Nickel (Ni), and as such used for the phytoremediation of soils rich in heavy metals (Broadhurst Catherine et al 2016).

Figure 2 *Alyssum alyssoides*

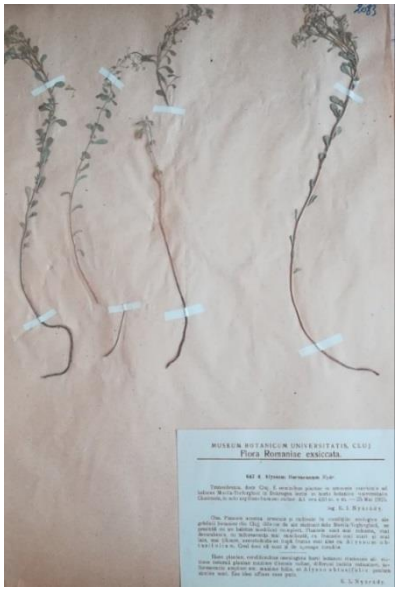


Figure 3 *Alyssum borzaeanum* Nyár.

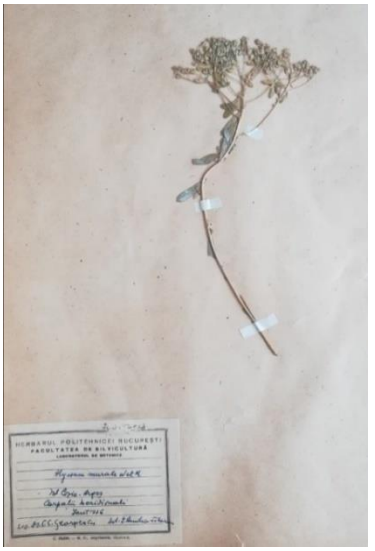


Figure 4 *Alyssum repens* *Figure 5 Alyssum murale* Waldst. & Kit.

The plant's gathering year. The *Alyssum* plants present in Al. Beldie Herbarium were collected between 1883 and 1993, namely on a time period of 110 years. The first plant that was collected was *Alyssum edentulum* W.K. in 1883 in Cernei Mountains. The periods in which most plants were gathered were 1920-1929 and 1930-1939, while the least plants were harvested during 1940-1980.

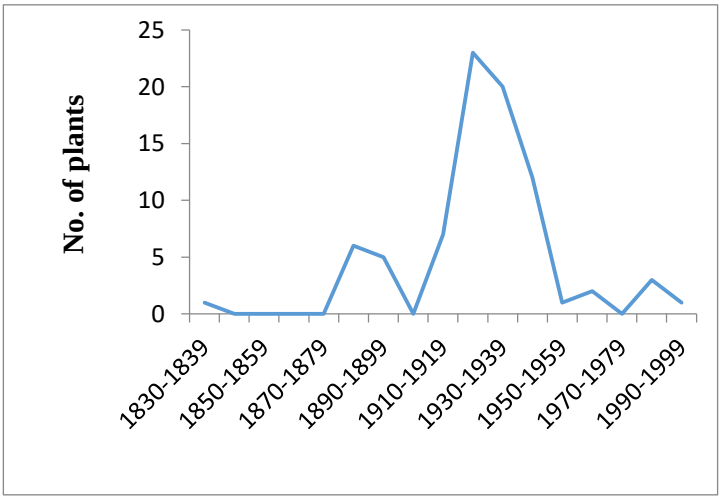


Figure 6. Harvesting periods of *Alyssum* Genus plants

The *Alyssum* plants were mainly gathered from Romania, namely from Banat, Bucegi Mountains, Mureş, Ilfov, Cluj, Buzău, Oltenia, Prahova etc (Fig. 7). Few plants were gathered from outside Romania, from countries such as Italy and France. Most plants were collected from Dobrogea.

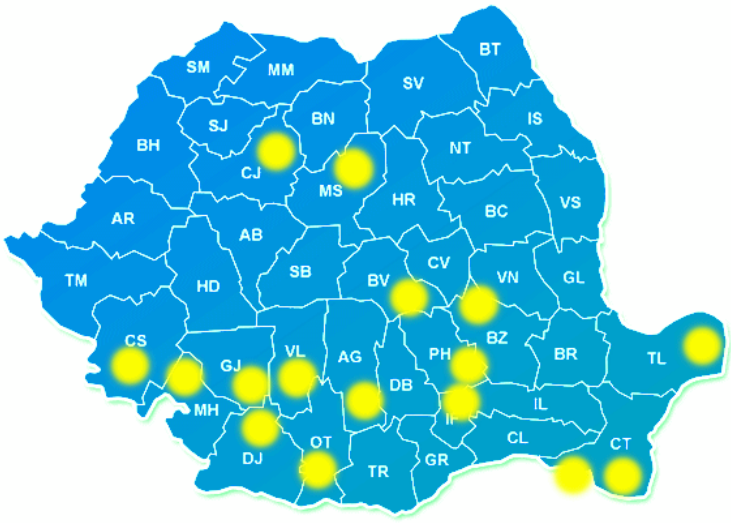


Figure 7. Place of harvest for Alyssum Genus in Romania

The plants were collected by Romanian and foreign specialist. Most plants were determined by Al. Borza and E.L. Nyárády. Amongst the renowned Romanian botanists who have collected plants from this Genus we mention Al. Beldie, C.C. Georgescu, E. Pop, I. Morariu, S. Paşcovschi, M. Ciucă, M. Haret, Şt. Purceleanu and T. Bunea. Amongst the foreign botanists we mention E. Reverchon, G.A. Poscharsky, H. Groves, J. Neuwirth, K. Richter, P. Ascherson etc.

CONCLUSIONS

From amongst the 195 *Alyssum* Genus species that can be found in Europe, Asia, North Africa and North America, 29 species were identified in "Al. Beldie" Herbarium. The plants were collected between 1833-1993, with a focus during 1920-1939. The oldest plant is *Alyssum edentulum W.K* harvested in 1833 from Cernei Mountains.

Most of the species were collected from Romania, especially from Dobrogea. The plants were kept in a very good conservation state. Within the species we can also find species from the Red List, such as *Alyssum borzaeanum* Nyár.

The most numerous species found in the Herbarium are *Alyssum repens* Baumg (17 plates), followed by *Alyssum alyssoides* L. (11 plates). They were gathered by renowned specialists such as Al. Beldie, E.L. Nyárády, S. Paşcovschi, C.C. Georgescu, M. Haret or T. Bunea.

REFERENCES

Akyol, Y., Kocabaş, O., Bozdağ, B., Minareci, E., Özdemir, C., 2017, Vascular anatomy of Alyssum alyssoides and A. desertorum (Brassicaceae) from Eastern Anatolia, Turkey. Phytologia Balcanica: International Journal of Balkan Flora and Vegetation, Vol. 23, No. 1, pp. 3-6.

Al-Shehbaz, I.A., 1987, The genera of Alysseae (Cruciferae;Brassicaceae) in the Southeastern United States. Journal of the Arnold Arboretum Vol. 68, No. 2, pp. 185-240.

Baskin, J. M., Baskin, C. C., 1974, Effect of vernalization on flowering of the winter annual Alyssum alyssoides. Bulletin of the Torrey Botanical Club. Vol. 101, No. 4, pp. 210-213.

Broadhurst Catherine L., Rufus L.C., 2016, Growth and Metal Accumulation of an Alyssum murale Nickel Hyperaccumulator Ecotype Co-cropped with Alyssum montanum and Perennial Ryegrass in Serpentine Soil. Frontiers in Plant Science, No. 7, pp. 451.

Cântar I.C., Dincă Maria., 2017, Doua genuri de plante din familia Poaceae (Melica si Eragrostis) existente in Herbarul Al. Beldie al INCDS Bucuresti. JOURNAL of Horticulture, Forestry and Biotechnology, Vol. 21, No. 3, pp. 68-76.

Crişan V., Dincă L., Oneț C., Oneț Aurelia, 2017, Collection species from Potentilla genus. Natural Resources and Sustainable Development, pp. 27-34.

Dincă L., Cântar I.C., Dincă Maria., 2017a, The characteristics of plant species from Arabis type present in Al. Beldie Herbariun from I.N.C.D.S. Bucharest. Annals of West University of Timişoara, ser. Biology, Vol. 20, No. 2, pp. 115-122.

Dincă L., Enescu Raluca., Oneț Aurelia., 2017b, Plant species from "Al. Beldie" Herbarium - Veronica genus - short description. Natural Resources and Sustainable Development, Vol. 9, pp. 43-50.

Dincă L., Dincă Maria, Pantea S., Timiş-Gânsac Voichița, Oneț C., 2018, Amaranthus plant - between myth and usage. Natural Resources and Soustainable Development, Vol. 8, No. 1, pp. 9-16.

Dincă Maria, Dincă L., Vasile Diana, 2017, A short description of Androsace genre plants present in Alexandru Beldie Herbarium from I.N.C.D.S. Bucharest. Currents Trends in Natural Sciences, Vol. 6, No. 12, pp. 16-24.

Dudley T.R., 1964, Synopsis of the genus Alyssum. Journal of the Arnold Arbor. Vol. 45, No. 3, pp 358–373.

Dudley T.R., 1966, Ornamental madworts (Alyssum) and the correct name of the goldentuft Alyssum. Arnoldia Vol. 26, No. 6-7, pp. 33-45.

Li, Y., Kong, Y., Zhang, Z., Yin, Y., Liu, B., Lv, G., Wang, X., 2014, Phylogeny and biogeography of Alyssum (Brassicaceae) based on nuclear ribosomal ITS DNA sequences. Journal of genetics, Vol. 93, No. 2, pp. 313-323.

Păunescu Anca, 2008, Histological investigation of the secondary somatic embryogenesis of Alyssum borzaeanum (Brassicaceae). PHYTOLOGIA BALCANICA, Vol. 14, No. 1, pp. 111 –117.

Scărlătescu V., Vasile Diana, Dincă L., 2017, Plant species from "Al. Beldie" Herbarium - Orobanche genre - short description. ProEnvironment Promediu, Vol. 10, No. 31, pp. 191-198.

Vasile Diana, Dincă L., Indreica A., Voiculescu I., 2017, Herbarul Alexandru Beldie - o colecție de plante şi o importantă bază de date pentru specialişti. Revista de Silvicultură şi Cinegetică, 39, pp. 114-119

http://www.efloras.org

http://www.iucnredlist.org

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE FLORISTIC AND VEGETATION STUDY IN THE BANU MARACINE VITICULTURAL CENTER

Cocoloş (Firică) Marcela Alina[1*], Giugea Nicolae[1], Mărăcineanu Liviu[1]

[1*] University of Craiova, Craiova Faculty of Horticulture
* *Correspondence author. E-mail*: alinamfirica@yahoo.com

Keywords*:* weeds, plantation, vine, viticulture, areal

ABSTRACT

This paper presents an analysis of the seedlings found in the Banu Mărăcine viticultural center, the degree of spreading, as well as some aspects related to their biology and ecology. It was used the method of comparative observation on the evolution of weeds and the changes which appear due to climatic factors.

INTRODUCTION

The floral and vegetation study is a theoretical analysis in order to know the main seedlings of the central viticulture Banu Mărăcine. Demonstration of the connection between plants and living conditions is reflected in the area of spreading of different species and in the way of grouping of different species on different territories. To assess the climatic and edaphic conditions typical of a habitat, we use indicator plants, which can offer rigorous information and with much lower costs compared to chemical analyzes or meteorological measurements. It has been used to identify plantlets and mature plants "Determination of weeds in agricultural crops"

MATERIAL AND METHODS

The research method that led to the realization of this work was to prepare a work plan, the selection of the required bibliography, field trips to identify the species, collecting material for the determination and classification. By studying the weeds in the area we have compiled systematic files with information on the characteristics of plant recognition and their influence on vine culture. We determined the systemic classification based on the sampling of specimens in the mentioned area, assessing the degree of development of the plant according to the pedological factors and the performance of the agricultural works.

To write the paper we used bibliographic material regarding the researched area, botanical, systematic and geobotanic works with zonal character. To this we applied information accumulated by field observations and data taken from the trader and specialists. We considered a number of specialized works with relevant content for the topic, applied to the data from the study of the plants found in different areas of the Banu Mărăcine wine-growing center. In the assessment of the soil condition it was used the geobotanic survey method promoted by Chirilă C.and Micu I., 1971.

RESULTS AND DISCUSSIONS

In the vineyard plantations, the weeds presented are numerous both in diversity and in the relations of abundance and domination that are established between them. According to studies conducted to date, from the point of view of vegetation "the territory falls within the Quercinese forest vegetation area. The whole area has been covered in the past by forests, but by expanding agricultural areas, only isolated forests meet today, especially on the slopes of the valleys." (Popa A., Giugea N., Genoiu T.C., 2015) It should be noted that the primary grass vegetation does not imply a monotonous aspect, according to the above mentioned work, complex variety of species: *Festuca rupicola*, *Achillea mellifolium*, *Hordeum murinum*, *Lolium perenne*, *Cynodon dactylon*, *Trifolium repens* and others.

In the vineyard plantations, the weeds presented are numerous both in diversity and in the relations of abundance and domination that are established among them. It has been found that in well-grown plots of land, the weed impregnation is poor, while in those with poor quality works there is a high degree of weed enrichment. In the vineyards of Banu Mărăcine prevail the annual summer weeds, and from the perennial ones predominate those with rhizomes. Among the species identified by the research of each plot, the more numerous are the following: *Sorghum halepense*), *Convolvulus arvensis*, *Elymus repens*, *Cynodon dactylon*, *Cardaria draba* (Urda vacii), *Polygonum aviculare*, *Rumex crispus* and *Sonchus arvensis*. (Popescu Gh., Costache. I., Răduţoiu D., 2003).

In the weed species encountered in the Banu Maracine vineyard, the following characteristics are presented:

*Sorghum hale*pense - The Poaceae family (Gramineae). Stony-planter plant with salty rhizome, which can reach 1.5 meters. Leaves linear-lanceolate, acuminate. It is multiplied by seeds, a plant producing 1200-6000 seeds. It prefers all types of soil, especially alluvial, thermophilic, found in the continental plain of the plain. (Andrei M., 1997).

Elymus repens - Poaceae Family (Gramineae). The plantula has a linear narrow leaf of 80-100 mm in length and one mm in width with stiff, short bristles. The mature plant has rhizomes in the upper layer of the soil, mostly between 2 and 12 cm deep. The adventives roots reach up to one meter deep underground. The rizomes are renewed annually and their activity lasts for 12-15 months after which they die. In one square meter can be found up to 3.000 grams of rhizomes, the total length of which ranges from 4 to 6 meters, and which have together over 25,000 buds (Chirilă C., 2001). The stem is one meter high, and the lower leaves have hairy patent vagina. The ligula is short and the auricules are narrow, long and surround the stem, especially on the last leaf. The inflorescence is a compound spice. It blooms from June to August. One plant produces about ten thousand kernels.

Convolvulus arvensis (Fig. 1) Convolvulaceae Family. The plant has epigenous cotyledons, long petiolate, with a pointed tip, slightly longer than wide. The hypocotyl is dirty-reddish. The mature plant has a highly developed root system. From this, radicular buds can form many suckers. The stem is volubilous when it has support, or creeping when it has no support. The leaves are hatched or sagitt. The fruit is a capsule. One plant produces 500-600 piriform seeds. It is frequently met and often abundant on all soil types and in all cultures. It is frequently multiplied and vegetative by stolons. (Crăciun I., 1989).

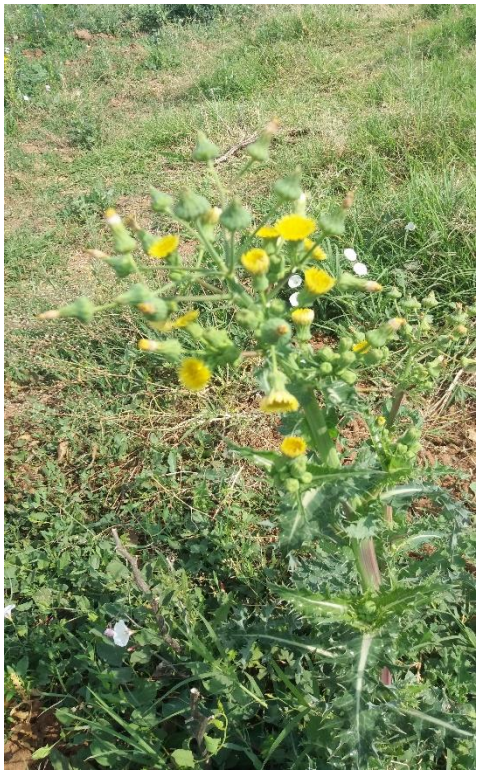


Fig. 1: *Convolvulus arvensis* with *Rumex pulcher* Fig. 2: *Sonchus arvensis*

Sonchus arvensis (Fig. 2) is a perennial, polycarpical weed, with suckers of the Asteraceae family. It is multiplied by radicular shoots and seeds. The first leaves have a wide elliptical tongue, the edge being toothed and the following are narrower. The leaves are runny, glabrous, thorny on the edges (Ciocârlan V, Chirilă C., 1982, Determinatorul buruienilor din culturile agricole, Ed. Ceres, Bucureşti). The root penetrates into the soil up to 50 cm deep and produce horizontal branches up to a meter long that are kept at a shallow depth (6-15 cm from the surface of the soil). The germination is done in late spring, when the soil is worm. It blooms and capitulates from June - July until September.

Cirsium arvense a species with a high generative multiplication capacity but also with highly active vegetative propagation through suckers, is spread in all vineyards in the country. The stem can often exceed 1.5 meters in height. The fruit is an anchen. It blooms from June to August. (Sîrbu C., 2003)

CONCLUSIONS

It can be concluded that not all plant species meeting in the Banu Mărăcine viticultural center are harmful, as it results from the comparative analysis of the degree of soil enrichment on different surfaces. As it emerges from the study by Şarpe N. 1987, weed species are framed in two sections: weed species common in almost all vineyards in the country and uncommon weed species. In the plantation there is a multiplication of a gradual multiplication of weeds with very high harmful potential, such as Sorghum halepense and Dragon Cardia. The floral inventory drawn up after the verdict can serve as a basis for further studies showing the dynamics of flora under the influence of edafoclimatic and anthropogenic factors on the researched field.

REFERENCES

Andrei M., 1997. Morfologia generală a plantelor, Ed. Enciclopedică, Bucureşti

Ciocârlan V, Chirilă C., 1982. Determinatorul buruienilor din culturile agricole, Ed. Ceres, Bucureşti

Chirilă C., 2001. Biologia buruienilor. Organografie, Corologie, Dinamică, Importanţă., Ed. Ceres, Bucureşti, pag. 303

Chirilă C. şi Micu I., 1971. Contribuţii la cunoaştere buruienilor din podgoria Dealu Mare

Crăciun I., 1989. Dicţionar de biologie, Ed. Albatros, Bucureşti

Popa A., Giugea N., Genoiu T.C., 2015. Oltenia, mica Românie viticolă, Ed. Aius, Craiova

Popescu Gh., Costache. I., Răduţoiu D., 2003. Buruienile din plantaţiile pomi-viticole şi grădinile de legume de la Ferma Tâmbureşti a SDE Banu-Mărăcine. Aplicaţii tehnologice „Ghid de practică". Tipografia Universităţii din Craiova

Sîrbu C., 2003. Podgoriile Cotnari, Iaşi şi Huşi, Edit. Ion Ionescu de la Brad, Iaşi.

Şarpe N., 1987. Combaterea integrată a buruienilor din culturile agricole, Edit. Ceres, Bucureşti.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE BIODEGRADATION OF RESIDUE GREEN ROBUSTA AND ARABICA COFFEE IN SOIL DURING INCUBATION, AND THEIR EFFECTS ON SOIL CHEMICAL PROPERTIES

Gougoulias Nikolaos[1]*, Wogiatzi Eleni[1], Giannoulis Kyriakos[1], Chounta Stamatina[1], Salonikioti Afroditi[1], Chouliara Adamandia[2]

[1]Department of Agronomy Technology, Technological Educational Institute of Thessaly, 41110 Larissa, Greece
[2]Informatics' Department, Informatics' Scientist, data exploration, Macedonia University of Thessaloniki, Greece
*Correspondence author. email: ngougoulias@teilar.gr

Keywords*: Green coffee; soil chemical properties; waste*

ABSTRACT

The present work was carried out in vitro (incubation experiment), and 1.25 and 2.5 g of air dried and well milled residue green Arabica coffee or residue green Robusta coffee, were applied to 50 g of soil, respectively. All treatments were incubated for 15 weeks at a constant temperature of 28 ^{0}C and after the incubation period, suitable chemical analyses were performed. The results of the experiment showed that the residue Arabica added in soil, are subjected to same degradation, in comparison to the residue Robusta, after a long incubation period. The residue Arabica as compared with of residue Robusta, increased the content of the available forms P, Cu and Zn, while and both materials increased the content of samples in available forms K, Fe and Mn, in comparison to the control (soil). These results, confirm the role of residue green coffee (Arabica or Robusta) as organic soil amendment.

INTRODUCTION

In modern alternative forms of agriculture is mandatory to replace chemicals with natural additives. The addition of various materials in the soil, affects the composition and biological activity of microflora, which determines the biochemical status of soil fertility (Gougoulias et al. 2014). When applying of organic fertilizers in the soil, dominate microbial nutrition (Gougoulias et al. 2013, Riber et al. 2014). Furthermore, by using composts prepared with agricultural wastes improves soil fertility and protect environment (Poulsen et al. 2013).

Literature on coffee waste as a soil amendment is limited, however studies have shown that coffee waste is a valuable organic fertilizer, particularly for sandy soils (Zake et al. 2000; Kasongo et al. 2011).

Green coffee beans contain phenolic compounds, and tocopherols, which exert strong antioxidant effect (Farah and Donangelo, 2006).

The objectives of this research were to study in vitro, the biodegradation in soil of the green Robusta and Arabica coffee solid residue, obtained after the removal of the extract with hot water, and the consequences of that biodegradation on chemical properties of soil.

MATERIAL AND METHODS

Commercial green Robusta and Arabica coffee beans from the local market in Larisa, were dried in a dark place at room temperature, finely ground, shaken at 150 rpm for 30 min using boiling water. The extraction of the green Robusta coffee with boiling water solvent results in the extraction of the polyphenols, where can find applications either in the form of powder or as extracts highly concentrated at polyphenols. The green coffee solid residue, which remained after the removal of the extract, was air dried and was used for the incubation experiment.

Incubation experiment: In this study, 1.25 g and 2.5 g air-dried and milled residue green Robusta coffee or Arabica were applied to 50g of soil respectively, (Table 1) and their effects on the chemical properties of soil, after 15 weeks of incubation at 28 ^{o}C were studied. Thus an experimental unit is constituted by 50 g of soil, and a variable amount of residue green Robusta coffee or Arabica. The experimental design was completely randomized with four replications. During the first three weeks of the incubation period, the moisture was maintained at two-thirds of field capacity, but for the next three weeks the soils were left to dry. This process was repeated until the end of the incubation period according to (Wu and Brookes, 2005) they reported that the alternation of drying and rewetting soil samples enhances mineralization of both soil biomass organic matter and non-biomass organic matter. At the end of the incubation period, soil samples were analyzed.

Methods of analyses: Samples were analyzed using the following methods which are referred by (Page et al. 1982).

Organic matter was analyzed by chemical oxidation with 1 mol/l $K_2Cr_2O_7$ and titration of the remaining reagent with 0.5 mol/l $FeSO_4$.

Both ammonium and nitrate nitrogen were extracted with 0.5 mol/l $CaCl_2$ and estimated by distillation in the presence of MgO and Devarda's alloy, respectively. Available P forms (Olsen P) was extracted with 0.5 mol/l $NaHCO_3$ and measured by spectroscopy. Exchangeable forms of potassium and sodium ware extracted with 1 mol/l CH_3COONH_4 and measured by flame photometer.

Organic phosphorus was measured after mineralization by combustion of the sample and subtraction of the mineral phosphorus amounts, which had previously been estimated in the laboratory. The mineral amounts were extracted with 1 mol/l H_2SO_4 and all forms were measured by spectroscopy.

Available forms of Mn, Zn, and Cu were extracted with DTPA (diethylene triamine pentaacetic acid 0.005 mol/l + $CaCl_2$ 0.01 mol/l + triethanolamine 0.1 mol/l) and measured by atomic absorption.

For the determination of total metals Mn, Cu and Zn, 1 g of material, digestion at 350 ^{0}C + 10 ml HNO_3 + 5 ml $HCLO_4$. According to the method described by (Varian, 1989), the samples were analyzed by Atomic Absorption (Spectroscopy Varian Spectra AA 10 plus), with the use of flame and air-acetylene mixture.

Statistical analysis: Data analysis was made using the MINITAB (Ryan et al. 2005) statistical package. Analysis of variance was used to assess treatments effect. Mean separation was made using Tukey's test when significant differences (P=0.05) between treatments were found.

Table 1
Chemical properties of soil samples, residue green Robusta or Arabica coffee used in the experiment

Property	Soil	Residue green Arabica coffee	Residue green Robusta coffee
Texture	Sandy Loam		
pH	7.84 ± 0.3		
* EC, dS/m	0.48 ± 0.06		
Organic matter (%)	0.87 ± 0.06		
$CaCO_3$ (%)	8.48 ± 0.5		
N -Total (g/kg)	1.28 ± 0.12	19.98 ± 0.6	20.79 ± 0.9
$N\text{-}NH_4^+$ (mg/kg)	49.4 ± 9.8		
$N\text{-}NO_3^-$ (mg/kg)	118.2 ± 15.2		
K-exchangeable (mg/kg)	229.6 ± 7.7		
K-Total (g/kg)	4.75 ± 0.26	0.36 ± 0.02	0.43 ±0.02
Na-exchangeable (mg/kg)	232.3 ±9.6		
Na-Total (g/kg)	0.38 ± 0.05	0.172 ± 0.09	0.17 ±0.02
CEC (cmol/kg)	19.8 ± 1.3		
P -Olsen (mg/kg)	13.5 ± 3.8		
P -Total (g/kg)	0.34 ± 0.06	1.183 ± 0.06	1.51± 0.09
Cu –DTPA (mg/kg)	0.81 ± 0.05		
Zn -DTPA (mg/kg)	1.01 ± 0.09		
Mn -DTPA (mg/kg)	2.75 ± 0.19		
Cu –Total (mg/kg)	10.33 ± 1.11	9.27 ± 0.56	3.97 ± 0.22
Zn -Total (mg/kg)	39.45 ± 1.72	5.49 ± 0.28	0.12 ± 0.01
Mn -Total (mg/kg)	532 ± 31.3	2.90 ± 0.16	2.02 ± 0.14
Fe-Total (mg/kg)		62.61 ± 3.13	99.18 ± 5.22
Mg-Total (mg/kg)		1586.9 ± 75.6	1351.5 ± 61.4

*Electrical conductivity, (EC) and soil pH is determined in (1:5) soil/water extract; Data represent average means and SE deviation. (n)=4.

RESULTS AND DISCUSSIONS

The results of the laboratory experiment at the end of the incubation period, they showed a high rate of biodegradation of organic matter from the application of the two rates of residue green Arabica or Robusta coffee compared with control (soil). The biodegradation of organic matter of residue green Arabica and Robusta coffee ranged from 67.9 to 70.6 %, while the control they showed a biodegradation of the organic matter by 22.9 % (Figure 1). The increased biodegradation of soil organic carbon probably was due to increased microbial activity. In similar laboratory studies, it was found that incorporation of coir residue on soil, after his use as substrate, they showed the lower rate of biodegradation of organic matter, about 35 % (Gougoulias et al. 2017).

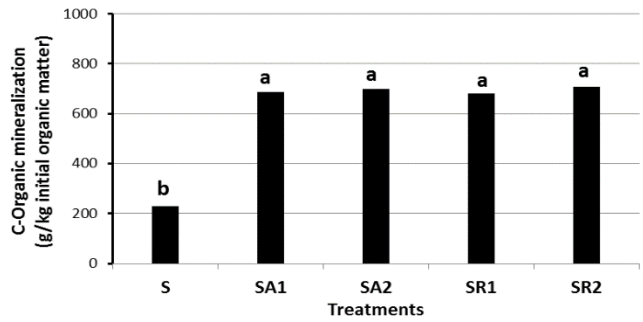


Figure 1. Effect of residue green Arabica and Robusta coffee on soil content in organic matter. (Bar values with the same letter on the top are not significantly different according to Tukey's test (P > 0.05)); S, control (soil); SA1, Arabica 1.25 g per 50 g of soil; SA2, Arabica 2.5 g per 50 g of soil; SR1, Robusta 1.25 g per 50 g of soil; SR2, Robusta 2.5 g per 50 g of soil.

The available forms of P were increased by Arabica or Robusta treatments, the greatest increase was observed when residue green Arabica coffee were added (Table 2). Nitrate forms increased by the addition of residue Arabica or Robusta, the greatest increase was observed when green Arabica coffee were added, at the higher dose. Moreover, ammonium content increased by the addition of residue Arabica or Robusta treatments (Table 2). The exchangeable Na content either by the addition of residue green Arabica coffee or by the addition of residue green Robusta coffee, was not showed significantly differences. The exchangeable K content were increased by residue green Arabica coffee or Robusta, the greatest increase was observed when residue at the higher doses were added (Table 2). The addition of residue green Arabica coffee or Robusta increased electrical conductivity where residue at the highest dose was added. Contrary, the addition of residue green Arabica coffee or Robusta reduced the pH of the soil compared to control. The decrease of soil pH at the end of the incubation period, probably is due to the stronger decomposition of soil organic matter, and in the oxidation of the $N\text{-}NH_4+$ to $N\text{-}NO_3$- (Table 2).

Table 2

Chemical properties of soil mixtures at the end of the incubation period

Treatments	Property						
	Available forms			Exchangeable forms		Extract 1: 5 in H_2O	
	(mg kg^{-1} soil)			(mg kg^{-1} soil)		(dS m^{-1})	
	P-Olsen	$N\text{-}NH_4^+$	$N\text{-}NO_3^-$	Na	K	EC	pH
S	14.1c	25.9b	82.5c	184.2a	282.8c	0.51c	7.71a
SR1	35.1b	110.3a	337.9b	185.0a	430.8b	0.53c	7.00b
SR2	37.4b	130.5a	680.0a	185.3a	657.3a	0.82a	7.10b
SA1	82.83a	134.0a	353.4b	187.4a	429.0b	0.54c	7.31b
SA2	75.07a	138.1a	314.7b	191.2a	631.8a	0.65b	7.23b

S, control (soil); SA1, Arabica 1.25 g per 50 g of soil; SA2, Arabica 2.5 g per 50 g of soil; SR1, Robusta 1.25 g per 50 g of soil; SR2, Robusta 2.5 g per 50 g of soil; Columns with the same letter do not differ significantly according to the Tukey's test (P=0.05).

The addition of residue green Arabica coffee increased both the Cu-available and Zn-available forms at the end of the incubation period compared to the control (Table 3). The addition of residue green Arabica coffee or Robusta increased Mn-available forms and Fe-available forms, the greatest increase was observed where the higher doses was added (Table 3).

Table 3

Chemical properties of soil mixtures at the end of the incubation period

Treatments	Property			
	DTPA - (mg kg^{-1} soil)			
	Cu	Zn	Mn	Fe
S	1.20b	1.03b	2.09c	0.62c
SR1	1.27b	1.17b	4.97b	0.99b
SR2	1.27b	1.21b	5.97ab	1.58a
SA1	1.67a	1.79a	5.70b	1.02b
SA2	1.67a	1.58a	6.60a	1.31a

S, control (soil); SA1, Arabica 1.25 g per 50 g of soil; SA2, Arabica 2.5 g per 50 g of soil; SR1, Robusta 1.25 g per 50 g of soil; SR2, Robusta 2.5 g per 50 g of soil; Columns with the same letter do not differ significantly according to the Tukey's test (P=0.05).

Total forms of Na and Mn increased by the addition of residue green Arabica coffee or Robusta compared to the control at the end of the incubation period (Table 4). Also, the addition of residue green Arabica coffee or Robusta increased both the total K and total P, the greatest increase was observed where the higher doses were applied. The addition of residue green Arabica coffee or Robusta increased both the Cu-total and Zn-total forms at the end of the incubation period compared to the control. The greatest increase was observed where the residue green Arabica coffee was added (Table 4).

Table 4

Total forms of elements of the soil mixtures at the end of the incubation period

Treatments	Property						
	Total forms - (mg kg^{-1} soil)						
	Na	K	P	Cu	Zn	Mn	P-organic
S	389.6b	4760.4c	362.1c	11.20d	41.20d	556.8b	87.40d
SR1	413.7a	5448.1b	482.9b	14.83c	47.67c	628.7a	374.8a
SR2	413.7a	6226.4a	582.9a	14.49c	55.09b	673.5a	149.9b
SA1	413.1a	5752.3b	487.3b	18.10b	59.88ab	646.2a	149.8b
SA2	430.8a	5940.4ab	515.9a	29.41a	64.39a	660.4a	100.0c

S, control (soil); SA1, Arabica 1.25 g per 50 g of soil; SA2, Arabica 2.5 g per 50 g of soil; SR1, Robusta 1.25 g per 50 g of soil; SR2, Robusta 2.5 g per 50 g of soil; Columns with the same letter do not differ significantly according to the Tukey's test (P=0.05).

CONCLUSIONS

The results of the experiment showed that the residue Arabica added in soil, are subjected to same degradation, in comparison with the residue Robusta, after a long incubation period. The residue Arabica compared with of residue Robusta, increased the content of the samples at the available forms P, Cu and Zn. However, exchangeable forms of Na, available forms of K, Fe and Mn was not significantly affected by of residue Robusta and Arabica addition. These results, confirm the role of residue green Arabica coffee or Robusta as organic soil amendment, and very possibly is important components for composting products, while that recycling constitutes a useful practice for environment protection.

REFERENCES

Farah A., Donangelo C.M., 2006, Phenolic compounds in coffee. Brazilian Journal of Plant Physiology, 18(1), 23-36.

Gougoulias N., Vagelas I., Papachatzis A., Stergiou E., Chouliaras N., Chouliara, A., 2013, Chemical and biological properties of a sandy loam soil amended with olive mill waste, solid or liquid form, in vitro. International journal of Recycling of Organic waste in Agriculture, 2(1),13.

Gougoulias N., Vagelas I., Papachatzis A., Kalfountzos D., Giurgiulescu L., Chouliara A., 2014, Mixture of solid with water soluble, olive oil mill waste application, as soil amendment in greenhouse cultivation of vegetables (Case study). Carpathian Journal of Food Science and Technology, 6(2), 63-68.

Gougoulias N., Vagelas I., Giurgiulescu L., Touliou E., Kostoulis V., Chouliara A. (2017). The coir substrate for soilless cultures, reused as soil amendment (study in vitro and in vivo). Carpathian Journal of Food Science and Technology, 9(4), 61-70.

Kasongo R.K., Verdoodt A., Kanyankagote P., Baert G., Ranst E.V., 2011, Coffee waste as an alternative fertilizer with soil improving properties for sandy soils in humid tropical environments. Soil use and Management, 27(1), 94-102.

Page A.L, Miller R.H., Keeney D.R.,1982, Methods of Soil Analysis. Part 2, Chemical and Microbiological properties. Agronomy (9), ASSSA, Mad. Wisc. USA.

Poulsen P.H.B., Magid J., Luxhøi J., de Neergaard A., 2013, Effects of fertilization with urban and agricultural organic wastes in a field trial–waste imprint on soil microbial activity. Soil Biology and Biochemistry, 57, 794-802.

Riber L., Poulsen P.H., Al-Soud W.A., Hansen L.B.S., Bergmark L., Brejnrod A. and Sørensen S.J., 2014, Exploring the immediate and long-term impact on bacterial communities in soil amended with animal and urban organic waste fertilizers using pyrosequencing and screening for horizontal transfer of antibiotic resistance. FEMS microbiology ecology, 90(1): 206-224.

Ryan B.F., Joiner B.L., Cryer J.D., 2005, MINITAB Handbook: Updated for release 14, 5th edition. Brooks/Cole-Thomson Learning Inc., Kentaky, KY.

Varian M., 1989, Flama Atomic Absorption Spectroscopy. Analytical Methods. Varian Australia. Publ. N0: 85-100009-00.

Wu J. and Brookes P.C., 2005, The proportional Mineralisation of Microbial Biomass and Organic Matter caused by air-drying and rewetting of a grassland soil. Soil Biology & Biochemistry, 37: 507-515.

Zake Y.K., Bwamiki D.P., Nkwiine C., 2000, Soil management requirements for banana production on heavy soils around Lake Victoria in Uganda. Acta Horticulturae (ISHS), 540, 285– 292.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

DESCRIBING FOREST SOILS FROM GALATI COUNTY

Deleanu Elena[1*], Ionescu Monica[1], Lucaci Dora[2]

[1] „Marin Dracea" National Institute for Research and Development in Forestry,Bucuresti
[2] „Marin Dracea" National Institute for Research and Development in Forestry, Braşov
**Correspondence author. e-mail: mdeleanuelena@gmail.com*

Keywords: *soil properties, forest soil description, Galați County*

ABSTRACT

The aim of this paper is to describe forest soils from Galati County, on the basis of the soil analysis data from forest management plans made in the period 1985-2013, namely 134 soil profiles and 423 pedo-genetic horizons.The data is part of a huge national database created by "Marin Dracea" National Institute for Research and Development in Forestry.The most widespread types of soils are phaeozem (24 %) and fluvisols (20 %), followed by preluvols (19 %), arenosols (13 %) and chernozem (11 %). Other types of soils identified in this County are: luvosols, regosols, erodosols and vertisols.

INTRODUCTION

For the year 2015 the total surface occupied by forests in Galați County is of 37157 ha (www.insse.ro). Galați Forest Administration has in its management 4 Forest Districts: Galați, Grivița, Hanul Conachi and Tecuci. As such, this Administration manages a total forest surface of 20552 ha, divided as it follows: rasinuous 1 %, common beech 1 %, oak 16 %, diverse hard species 65 % and diverse soft species 18 % (www.romsilva.ro).

Knowing these characteristics is extremely important in order to adopt adequate silvicultural measures (Târziu et al., 2004, Spârchez et al., 2011).

As such, the purpose of the present paper is to describe the soils belonging to the forest fund from this County.

MATERIAL AND METHOD

The present paper intends to monitor the physical-chemical properties of forest soils from Galati, starting with the year 1985 up to present days.

The analysed properties were: pH, carbonates content, humus content, nitrogen content, the basis exchange capacity, hydrogen exchange capacity, total cationic exchange capacity, base saturation degree and texture. All these analysis are centralized in the analysis bulletins and are part of an extended national database realized by INCDS ''Marin Dracea'', based on forest management plans. The accredited national and international methodologies were used as methods in the analysis of soil samples (Dincă L. *et al.,* 2012, Edu *et al.*, 2013). For the present paper, soil samples gathered in the period 1985-2013 from 4 forest districts belonging to Galati Forest District were analysed. As a total, 134 soil profiles and 423 pedo-genetical horizons were analysed (Amenajamentele Ocoalelor Galati, Grivița, Hanul Conachi, Tecuci).

RESULTS AND DISCUSSIONS

Types of soils from Galati County. First and foremost, the existent soil types and their predominance were taken into account. With this purpose in mind, the following diagram was realized in order to emphasize the predominance of each encountered type of soil (Figure 1).

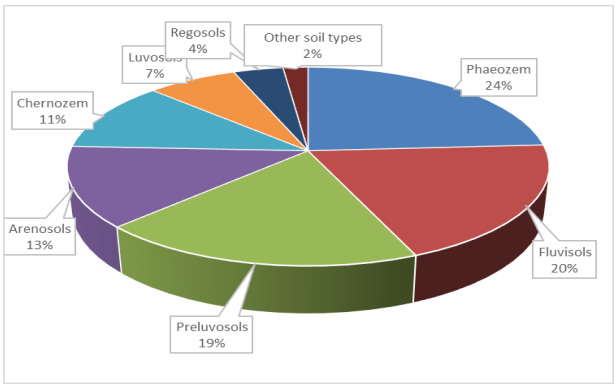


Figure 1. The predominance of forest soils identified in Galati County

As such, the most widespread soil types are the ones from Protisols class that occupy 37 % of the soils from this County, followed by Cernisols class with 35 % and Luvisols class with 26 %. The most widespread types of soils are phaeozem (24 %) and fluvisols (20 %), followed by preluvosols (19 %), arenosols (13 %) and chernozem (11 %). Other types of soils identified in this County are: luvosols, regosols, erodosols and vertisols.

At a national level, luvosols occupies the second place as spreading in forest soils (1.440.052 ha), preluvosols the fifth place (335.050 ha,) and phaeozem the sixth place (235.282 ha) (Dincă L. et al., 2014).

A diagram for the soil reaction was realized for the most widespread soils (phaeozem, fluvisols, preluvosols, chernozem), differentiated on genetic horizons (Fig. 2).

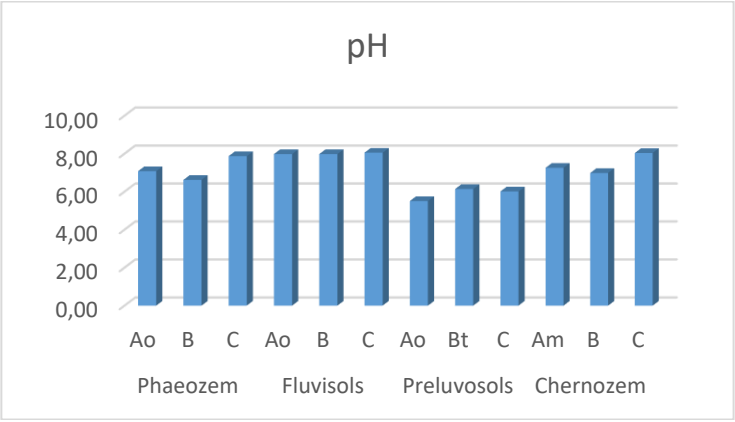


Figure 2. pH variations for the most widespread forest soils from Galati County

The lowest pH average values for the horizons are found for preluvosols (5,51 in the Ao horizon, 6,14 in Bt, 6,01 in C), while the highest values were identified for

fluvisols, recording a value of 8. Phaeozem and chernozem have very close values. By interpreting the average pH values, the reaction is neutral towards alkaline.

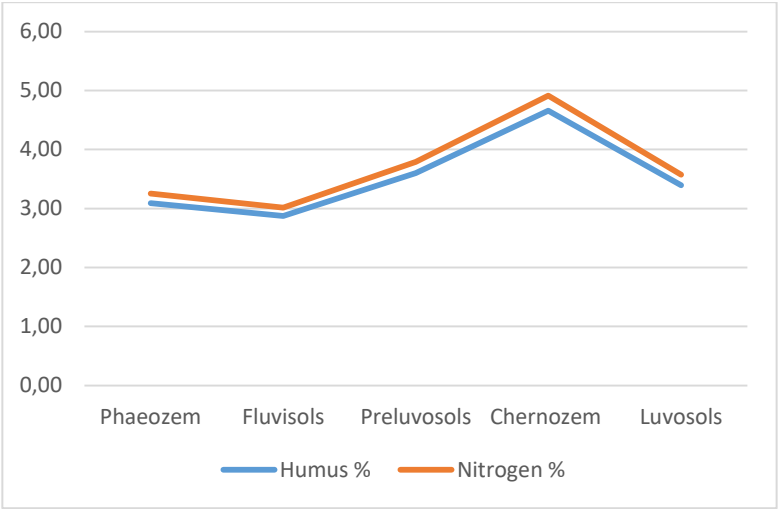


Figure 3. The variation of humus and nitrogen for the most widespread forest soils from Galati County

Average values per profile were calculated in order to obtain the total cationic exchange capacity. The results are then rendered per soil type (Table 1). Chernozem has a very high total cationic exchange capacity, followed by phaeozem, luvosols, preluvosols and fluvisols, whose cationic exchange capacity is also high.

A very important soil parameter is the humus content. As such, for each soil type identified in Galati County, an average value of humus content in the A horizon was calculated (Table 1).

Table 1.

Total cationic exchange capacity and average humus and nitrogen content for forest soils from Galati County

Phaeozem	Fluvisols	Preluvosols	Chernozem	Luvosols
Total average cationic exchange capacity per type of soil (T-me 100 g^{-1} soil)				
25,68	17,90	19,72	27,09	19,85
Average humus content in A horizon (H-%)				
3,09	2,87	3,60	4,66	3,39
Average nitrogen content in A horizon (%)				
0,16	0,14	0,19	0,25	0,18

The highest content of humus is registered for chernozem, followed by preluvosols and luvosols, being moderately humiferous soils (Dănescu et al. 1996). The humus values for the first horizon in forest soils from Olt County was of 4,20 % for preluvosols (Deleanu et al., 2017). As a conclusion, the average humus content for soils from Galati County is generally registered within the limits established at a national level in other investigations regarding forest soils: preluvosol = 31,5 g/kg, phaeozem = 30,2 g/kg, luvosol = 27,5 g/kg (Dinca et al. 2012).Similar with humus, nitrogen was only

calculated in the first horizon, as both elements are accumulated through the decomposition of organic matter at the surface and in the first centimetres of the soil's profile (fig. 3). The lowest quantity of nitrogen is accumulated by fluvisols, which is in this case a well-supplied soil with this element, while all the other soils are very well supplied with nitrogen. A graphic was created for the degree of saturation in basis (V), for the most widespread types of soils (Figure 4).

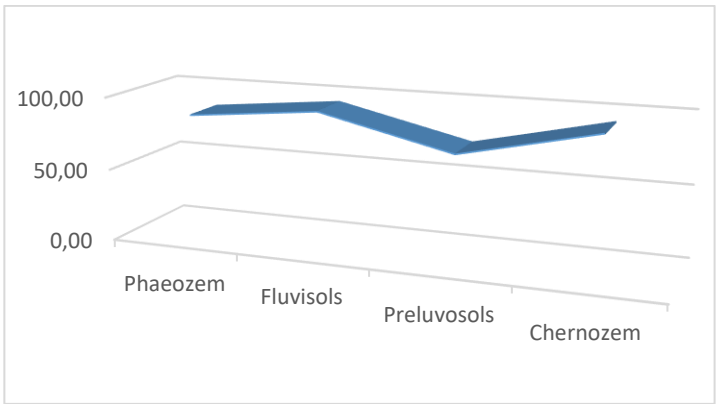


Figure 4. The variation of the base saturation degree for the most widespread forest soils from Galați County

As such, it can be observed that the largest variation amplitude is found in the case of fluvisols and chernozem, while the lowest is recorded for preluvosols. For phaeozem, V registers average values of 85,81 %.

CONCLUSIONS

Forest soils from Galați County belong preponderantly to the Protisols, Cernisols and Luvisol classes. The most widespread types of soils are phaeozem (24 %) and fluvisols (20 %), followed by preluvosols (19 %), arenosols (13 %) and chernozem (11 %). Other types of soils identified in this County are: luvosols, regosols, erodosols and vertisols.

Chernozem has a very high total cationic exchange capacity, followed by phaeozem, luvosol, preluvosol and fluvisol, whose cationic exchange capacity is recorded in the high category.

The highest content of humus is recorded for chernozem, followed by preluvosols and luvososl, situated in the moderately humiferous category.

The lowest quantity of nitrogen is accumulated by fluvisols, which is in this case a well-supplied soil with this element, while all the other soils are very well supplied with nitrogen.

REFERENCES

Dănescu F., Surdu A., Preda I., Bicu C., Păun R., 1996, Modificările positive înregistrate de însușirile fizice și hidrofizice ale solului în UP I Letca – OS Ghimpați, ca urmare a aplicării tehnologiei de refacere a arboretelor ce include afânarea adâncă a solului, Revista Pădurilor, 1.

Deleanu E., Ionescu M., Lucaci D., 2017, Data regarding forest soils from Olt county, Analele Universităţii din Craiova, seria Agricultură – Montanologie – Cadastru Vol. XLVII 2017, p. 284-290.

Dincă L., Lucaci D., Iacoban C., Ionescu M**.,** 2012, Metode de analiză a proprietăţilor şi soluţiei solurilor. Editura Tehnică Silvică, p. 173.

Dincă L., Spârchez, Gh., Dincă, M., Blujdea, V**.,** 2012, Organic carbon concentrations and stocks in Romanian mineral forest soils. Annals of Forest Research, *55* (2), p. 229-241.

Dincă L., Spârchez G., Dincă M., 2014, Romanian's forest soil GIS map and database and their ecological implications. Carpathian Journal of Earth and Environmental Sciences, 9 (2): p. 133-142.

Edu (Deleanu) E.M., Mihalache M., Ionescu M**.,** 2013, Determination of organic carbon in forest soils by comparative analysis of methods: Walkley Black method with the Gogoasa modification versus dry combustion dumars method, Research Journal of Agricultural Science, Timişoara, Vol 45, nr 1, p. 13-19.

Spârchez G., Târziu D.R., Dincă L., 2011, Pedologie. Editura Lux Libris, Braşov, p. 293.

Târziu D., Spârchez G., Dincă L., 2004, Pedologie cu elemente de Geologie. Editura Silvodel, Braşov, p. 343.

***Amenajamentele Ocoalelor Galati (1987, 1994, 2013), Grivița (1996, 2006), Hanul Conachi (1994, 2004), Tecuci (1985, 1996, 2006).

*** www.insse.ro

*** www.romsilva.ro

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

PLANTAGO GENUS COLLECTION SPECIES PRESENT IN ALEXANDRU BELDIE HERBARIUM

Deleanu Elena[1], Ionescu Monica[1] Dinca Maria[2]*

[1]„Marin Dracea" National Institute for Research and Development in Forestry,Bucuresti
[2]„Marin Dracea" National Institute for Research and Development in Forestry, Brașov,
**Correspondence author. e-mail: mdeleanuelena@gmail.com*

Keywords: *Plantango, botanists, plants, leaves***.**

ABSTRACT

The present paper describes morphologically and ecologically the Plantago species persent in ''Alexandru Beldie'' Herbarium from ''Marin Drăcea'' National Institute for Research and Development in Forestry (INCDS) from Bucharest. The Herbarium contains 231 plates of this genre that belong to 48 species. Some representative species of this genre are then described (Plantago lanceolata L., Plantago media L., Plantago major L, Plantago maritima L, Plantago coronopos L.). Furthermore, statistics and diagrams concerning the place and year of harvest are also present, together with annotations made by the botanists that have gathered them.

INTRODUCTION

The Alexandru Beldie Herbarium from *Marin Drăcea* National Institute for Research and Development in Forestry (INCDS) located in Bucharest, contains an impressive collection (40 000 plates) of certain plants, especially from mountain areas. As such, some of the mountain plants present in the Herbarium are the 32 *Arabis* genre species (Dincă et al., 2017), 15 *Ornithogalum* species (Enescu R. *et al.,* 2017), 15 *Veronica* species (Dincă et al., 2017), 69 *Potentilla* species (Crișan et al., 2017), 19 *Androsace* species (Dincă et al., 2017), 11 species of *Eragrostis* genus (Cântar C. et al., 2017) or the 112 *Hieracium* species (Dincă et al., 2017).

The plants from the collection are kept in their original folders and are arranged in 600 drawers (Vasile *et al*., 2017). The herbarium has been inscribed in INDEX HERBARIUM and includes a huge number of plants coming from private donations and from foreign collections.

The aim of this article is to present the state of this collection, to describe the species, the total number of Plantago specimens (48 species), together with the date when they were collected, their location, the botanist who gathered each exemplar and their conservation degree.

MATERIALS AND METHODS

The study material was represented by the 231 plates present in the above mentioned Herbarium and belonging to the *Plantago* genus.

The plates were grouped by species, harvest year, the place where they were harvested and by the specialist who gathered them. Table number 1 renders a small part from the database.

Table 1

The inventory of *Plantago* genus from INCDS Bucharest's Al. Beldie Herbarium (excerpt)

Plate no.	Drawer no.	Herbarium/ Botanic collection/ Institution	Species	Harvest date	Harvest place	Collected/ Determined by:	Conservation degree (1..4)
48	17	Bucharest Polytechnics Herbarium, Silviculture Faculty, Botanics Laboratory	Plantago montana L.	1942.06.21	Bucegi, V. Jepilor	Beldie Alexandru	1
48	55	ICEF Forestry Research and Experimentation Institute	Plantago lanceolata L.	1938.06.06	Mures	S. Pascovschi	1
48	59	ICEF Forestry Research and Experimentation Institute	Plantago lanceolata L.	1936.08.09	Tulcea, Nisipuri	Haralamb P. Cretzoiu	1
48	105	Bucharest Polytechnics School Herbarium, Botanics Laboratory	Plantago arenaria	1931.07.12	Dobrogea	C. C. Georgescu	2
48	112	Bucharest Polytechnics School Herbarium, Botanics Laboratory	Plantago indica L.	1935.06.28	Tecuci	C. C. Georgescu si P. Cretzoiu	1
70	13	Herbarium Normale editum ab I. Dorfler	Plantago ramosa (Gilib.) Asch.	1909.07.01	Austria Stadlau	L. Keller	1
70	33	Bucharest Polytechnics Herbarium, Silviculture Faculty	Plantago media L.	1943.07.01	Bucegi, Poiana Costilei	Al. Beldie	1
70	48	ICEF	Plantago media L.	1935.05.26	Stoiceni	At. Haralamb	1
70	75	ICEF	Plantago media L.	1933.01.01	Parang	At. Haralamb, J. Neuwirth	1

RESULTS AND DISCUSSION

Plantago is a genus of the Plantaginaceae family, Lamiales order that has approximately 265 species. The small plants usually have a dense tuft of basal leaves and long, leafless stalks bearing a terminal spike of small flowers (Beldie, 1979).

The leaves are sessile but have a narrow part near the stem which is a pseudo-petiole. They have three or five parallel veins that diverge in the wider part of the leaf. Leaves are broad or narrow, depending on the species. The inflorescences are borne on stalks typically 5–40 cm tall and resemble a short cone or a long spike, with numerous tiny wind-pollinated flowers.

The species of this genus present in the above mentioned collection are as follows: *Plantago lanceolata* L., *Plantago media* L., *Plantago major* L., *Plantago montana* L., *Plantago indica* L., *Plantago maritima* L., *Plantago gentianoides*, *Plantago atrata*

Hoppe, *Plantago major* L. var. *intermedia* (Gilib) Beck., *Plantago gentianoides* Sm., *Plantago cornuti* Gouan, *Plantago tenuiflora* W.et K., *Plantago schwarzenbergiana* Schur., *Plantago serpentina* All., *Plantago psyllium* L. , *Plantago media* L. var.*urvilleana* Rapin, *Plantango columnae*, *Plantago arenaria*, *Plantago argentea* Chaix, *Plantago carinata* Schrad., *Plantago coronopos* L., *Plantago lagopus*, *Plantago maxima* Juss., *Plantago minor*, *Plantago alpina*, *Plantago altissima* L., *Plantago sulubata*.

The most widespread *Plantago* species present in this herbarium are: *Plantago lanceolata* L. (53), *Plantago media* L. (48), *Plantago major* L (22), *Plantago maritima* L (8) and *Plantago coronopos* L. (2).

Plantago lanceolata is a rosette-forming perennial plant, with leafless, silky, hairy flower stems (10–40 cm). The basal leaves are lanceolate, spreading or erect, scarcely toothed with 3-5 strong parallel veins narrowed to a short petiole. The flower stalk is deeply furrowed, ending in an ovoid inflorescence of many small flowers, each with a pointed bract. Each flower can produce up to two seeds. Flowers can reach 4 millimetres (calyx green, corolla brownish), with 4 bent back lobes with brown midribs and long white stamens (https://en.wikipedia.org/wiki/Plantago_lanceolata).

Plantago media grows in damp grassy meadows up to an altitudes of 2000 m. A slender stalk of between 5 and 50 cm develops from a basal rosette of finely-haired leaves. Delicate pink-white flowers are borne between May and September. *Plantago media* is hermaphrodite and is pollinated by wind or insects, particularly bees. (https://en.wikipedia.org/wiki/Plantago_media).

Plantago major is an herbaceous perennial plant with a rosette of leaves that can reach 15–30 cm in diameter. Each leaf is oval-shaped, 5–20 cm long and 4–9 cm broad, rarely growing up to 30 cm long and 17 cm broad, with an acute apex and a smooth margin; there are five to nine conspicuous veins. The flowers are small, greenish-brown with purple stamens, produced in a dense spike 5–15 cm long on top of a stem 13–15 cm tall (rarely to 70 cm tall) (https://en.wikipedia.org/wiki/Plantago_major).

Plantago maritima is a herbaceous perennial plant with a dense rosette of stemless leaves. Each leaf is linear, 2–22 cm long and under 1 cm broad, thick and fleshy-textured, with an acute apex and a smooth or distantly toothed margin; three to five veins can exist. The flowers are small, greenish-brown with brown stamens, produced in a dense spike 0.5–10 cm long on top of a 3–20 cm stem. (https://en.wikipedia.org/wiki/Plantago_maritima).

Plantago coronopus produces a basal rosette of narrowly lance-shaped leaves up to 25 centimeters long that are toothed or deeply divided. The inflorescences grow erect to about 4 to 7 cm in height. They have dense spikes of flowers which sometimes curve. Each flower has four whitish lobes each measuring about a millimeter long. *Plantago coronopus* mainly grows on sandy or gravelly soils close to the sea. https://en.wikipedia.org/wiki/Plantago_coronopus

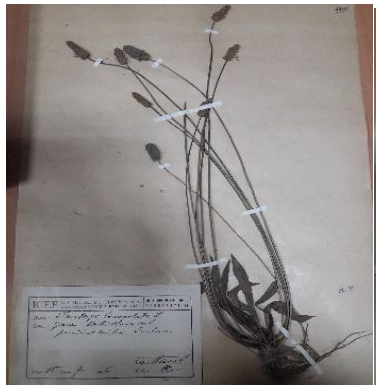


Figure 1. Plantago lanceolate

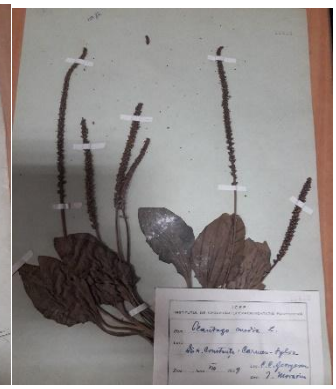


Figura 2. Plantago media

Figure 3. Plantago major

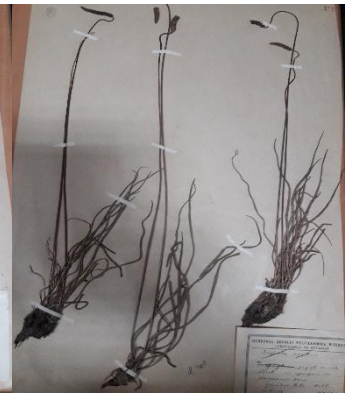


Figure 4. Plantago maritima

The plant's harvest year. The plants were gathered in a time period ranging between 1838 and 1963. The oldest plants of this genre are *Plantango major L.*, collected in 1838. The periods in which most plants were gathered were 1930-1949 (Figure 1).

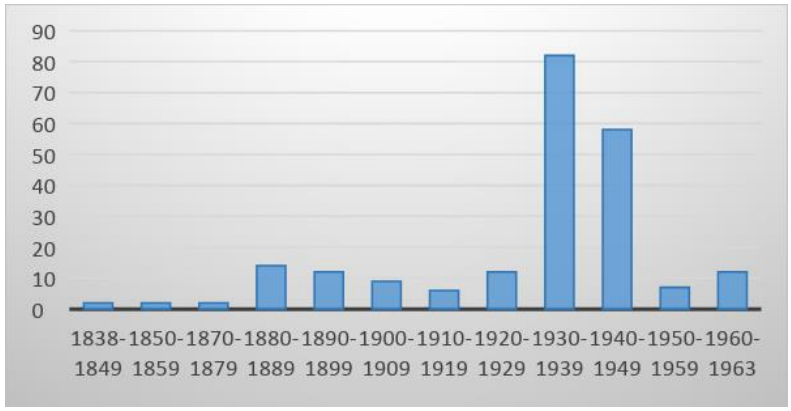


Figure 5. Harvesting periods of Plantago plants from INCDS Herbarium

The harvesting place of most species (P. lanceolata L., P. media L., P. major L., P. montana L., P. indica L., P. maritima L., P. gentianoides, P. altrata Hoppe) is generally represented by high mountain areas: Bucegi Mountains (Babele, Baba Mare, Valea Ialomitei, Varfu Omu, Valea Jepilor, Varfu Doamnei, Piatra Arsa), Parang Mountains, Retezat Mountains, or near cities from our country (Bucuresti, Borsa, Buzau, Braila, Cheia, ,Cluj, Constanta, Dolj, Sibiu, Hunedoara, Suceava, Tecuci, Tulcea, Valcea). Various species of this genus were also harvested from abroad: Austria, Italy, Switzerland, Russia, Sweden,Holland, France.

The people who gathered the plants are renowned Romanian specialists (Al. Beldie, P. Cretzoiu, C. Georgescu, A. Haralamb,M Ciuca, I Morariu, I. Prodan, Ov. Cosma)., M. Iacobescu), as well as foreign botanists (Wolff, Becker, Richter, Heuser, Keller, Guzzino, Rosenberg, Petta, Lojos).

CONCLUSIONS

"Alexandru Beldie" Herbarium, contains more than 40,000 plates, from which 231 plates belong to the *Plantago* genus.

In regard with the harvesting period, by analyzing Figure 5, it can be observed that they were gathered in a long period of time, almost 125 years, from 1838 until 1963. The maximum number of gathered plants from this long period of time is recorded during 1930-1949 and were gathered by renowned Romanian and foreign botanists (Al. Beldie, P. Cretzoiu, C. Georgescu, A. Haralamb, M Ciuca, I Morariu, I. Prodan, Ov. Cosma, M. Iacobescu). The plants were gathered from Romanian mountain areas (Bucegi, Parang, Retezat) or near cities from our country (Bucuresti, Borsa, Buzau, Braila, Cheia, Cluj, Constanta, Dolj, Sibiu, Hunedoara, Suceava, Tecuci, Tulcea, Valcea), as well as from some European areas (Austria, Italy, Switzerland, Russia, Sweden, Netherlands, France). The plants are in a good conservation degree and are essential in many research and science domains.

REFERENCES

Beldie A. 1979, Flora Romaniei - determinator ilustrat al plantelor vasculare. Editura Academiei RSR. vol. II, p. 125.

Cântar I.C., Dincă M**.**, 2017, The characteristics of plant species from Arabis type present in Al. Beldie Herbariun from I.N.C.D.S. Bucharest. Annals of West University of Timișoara, ser. Biology, vol. 20 (2), p.115-122.

Crișan V., Dincă L., Oneț C., Oneț A., 2017, Collection species from *Potentilla* genus. Natural Resources and Sustainable Development, pag. 27-34.

Dincă L., Vasile D., Voiculescu I**.,** 2017, The characteristics of plants from *Hieracium genre* present in Alexandru Beldie Herbarium from I.N.C.D.S. Bucharest". Lucrări ştiinţifice USAMV Iaşi, seria Horticultură 60 (1), p. 39-48.

Dincă L., Enescu R., Oneț A., Laslo V., Oneț C., 2017, Plant species from Al. Beldie herbarium - *Veronica* genre - short description. Natural Resources and Sustainable Development, pag. 43-50.

Dincă M., Dincă L., Vasile D**.**, 2017, A short description *of Androsace genre* plants present in Alexandru Beldie Herbarium from I.N.C.D.S. Bucharest. Currents Trends in Natural Sciences, 6 (12), p.16-24.

Enescu R., Dincă L., 2017, Description of plant species of *Ornithoghalum* genus present in Al. Beldie Herbarium from ``Marin Drăcea`` Bucharest N.I.R.D.F. Journal of Horticulture, Forestry and Biotechnology, Volume 21(3), p. 89-95.

Vasile D., Dincă L., Indreica A., Voiculescu I., 2016, Herbarul Alexandru Beldie - o colecție de plante și o importantă bază de date pentru specialiști. Revista de Silvicultură și Cinegetică, nr. 39, p.114-119.

*** https://en.wikipedia.org/wiki/Plantago_lanceolata.
*** https://en.wikipedia.org/wiki/Plantago_media.
*** https://en.wikipedia.org/wiki/Plantago_major.
*** https://en.wikipedia.org/wiki/Plantago_maritima.
*** https://en.wikipedia.org/wiki/Plantago_coronopus

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE INFLUENCE OF RISK ELEMENTS TO THE SOIL QUALITY AT THE FORMER MINING AREAS IN SLOVAKIA

Demková Lenka[1]*, Bobuľská Lenka, Árvay Július[2]

[*]University of Prešov, Departmet of Ecology, 17. november 1, 081 16, Prešov, Slovakia
[2] Slovak Agricultural University in Nitra, Department of Chemistry, Tr. A. Hlinku 2, 949 76 Nitra
**Correspondence author. E-mail*: lenka.demkova@unipo.sk

Keywords*: soil pollution, nutrients, soil enzymes, former mining area*

ABSTRACT

Among human activities, mining is responsible for environment contamination in huge areas of the globe. Soils polluted by risk elements lose their fertility and the toxicity effects are manifested in plants, animals, and micro fauna. Nutrients content (Ca, Na, K, Mg) and the activity of soil enzymes (urease, acid and alkaline phosphatase, FDA and ß-glucosidase) was determined in soil samples from two types of mining bodies – heaps of waste material and the open mines. Nutrient content analysis was carried out on an Agilent ICP-OES spectrometer 725 and the soil enzyme activity was determined according to valid methodologies under laboratory conditions. The aim of the study was to determine the content of the nutrients as well the activity of soil enzymes at different mining bodies and evaluate the influence of soil pollution to the soil characteristics. Soil quality has been different in terms of soil enzyme activity in the evaluated sampling sites because different enzymes react differently to environmental stress. The values of Ca, Na and K were higher at the heaps of the waste material comparing open mines.

INTRODUCTION

Bad soil quality at the former mining areas, especially near mining bodies, is a long-term serious environmental problem (Guo et al. 2017). The high content of the risk elements reduces soil fertility and ultimately endangers the health of the ecosystem and the humans (Xiao et al. 2017). The area of Slanske vrchy hills, near the Zlata Bana village (ZB) is characterized by a high number of mining bodies, especially open mining pits and the heaps of mining waste material. It poses a threat to the surrounding environment, due to the release of hazardous elements - heavy metals, into the soil, water and air. Nizna Slana village is under the constant influence of the risk elements coming from the tailing pond situated above the village. The sludge of a dusty consistency is transmitted by a wind to the big distances and interferes whole slope under the tailing pond and the village laying below. It has been repeatedly shown that soils with the high volume of the risk elements has low values of nutrients and are not valuable for agricultural purposes (Fazekašová and Bobuľská 2012). Additionally, it has been shown that enzyme activity responds very quickly to the environmental stress (Hinjosa et al. 2008), that's why it is used as relative stable, very sensible biochemical indicator of soil pollution. According to Šarapatka (2002), enzymatic activity is closely related to important soil characteristics, making it an ideal indicator of soil quality. In addition, soil enzymes response to the presence of the risk elements in soils much faster than other chemical or physical soil parameters (Nannipieri et al. 2002). Urease belongs to the group of hydrolases enzymes that catalyze hydrolysis of urea to carbon dioxide

and ammonia (Hasan 2000). Soil phosphatases catalyse the decomposition of organic phosphorus and play a key role in mineralization processes. Phosphatases are divided into acidic and alkaline, and their occurrence is influenced by the soil reaction (Kumar et al. 2011). FDA is conducted with a wide range of enzymes such as lipases, esterase and proteases (Gaspar et al., 2001). β-glucosidase enters the carbon pathway as a hydrolase. The high content of toxic elements in the soil has an inhibitory effect on its activity (Wang et al., 2008). The aim of the study was to compare the nutrient content (Na, Mg, Ca, K) in the soils of two former mining villages (Zlata Bana, Nizná Slana) to determine and compare soil enzyme activity among villages and to determine the relation between nutrients, soil enzymes and risk elements.

MATERIAL AND METHODS

Two former mining areas were selected for research activities. In Zlata Bana village (ZB), the mining activities focused to the gold mining started in the 16th century. Subsequently were stopped and the attempts to the restoration during the years 1730-1861, and again in 1989 were not successful. Nizna Slana (NS) is and old mining village focused to the iron and precious metals mining. Mining activities were developed during the 12th and 13th century, when mining specialists from Germany were invited to the village. Iron mining was stopped in 2008.

Soil samples (0-10 cm) were sampled during the summer in 2017 from 11 sampling sites in the Nizna Slana (NS), and 11 sampling sites in the Zlata Bana (ZB) village. Soil samples (500 g) were stored in the plastic bags, transported to the laboratory conditions and air-dried. Subsequently, the soil samples were sieved (<2mm), homogenized and stored to the analyses (-20°C). The soil reaction (pH) was measured by InoLab pH 720-WTW in the solution of 5g and 25mL of a 0.01M $CaCl_2$. The activity of acid (KF) and alkaline phosphatase (ZF) was determined according to Grejtovski (1991), urease activity (URE) according to Khaziev (1976), soil ß-glucosidase activity (BG) according to Eivazi and Tabatabai (1988) and FDA according to Green et al. (2006). The nutrient content as well as the content of the risk elements was determined with an axial plasma configuration of Agilent ICP-OES 725 (Agilent Technologies Inc., Santa Clara, CA, USA. All statistical operations were performed in STATISTICA 12 (© TIBCO Statistica™).

RESULTS AND DISCUSSIONS

A total content of the risk elements determined at the sampling sites from two former mining villages and the limit values for each element set by Act. No. 220/2004 Coll. of Laws are listed in Figure 1. Average values of Cd, Fe, Pb and As exceed the limit value in both villages. The limit value of Cu was exceeded only in the case of NS. Serious pollution by As and Fe was determined in the sediments (Brehuv et al. 2007) and atmospheric deposition (Hančulák et al. 2011) in Nizna Slana.

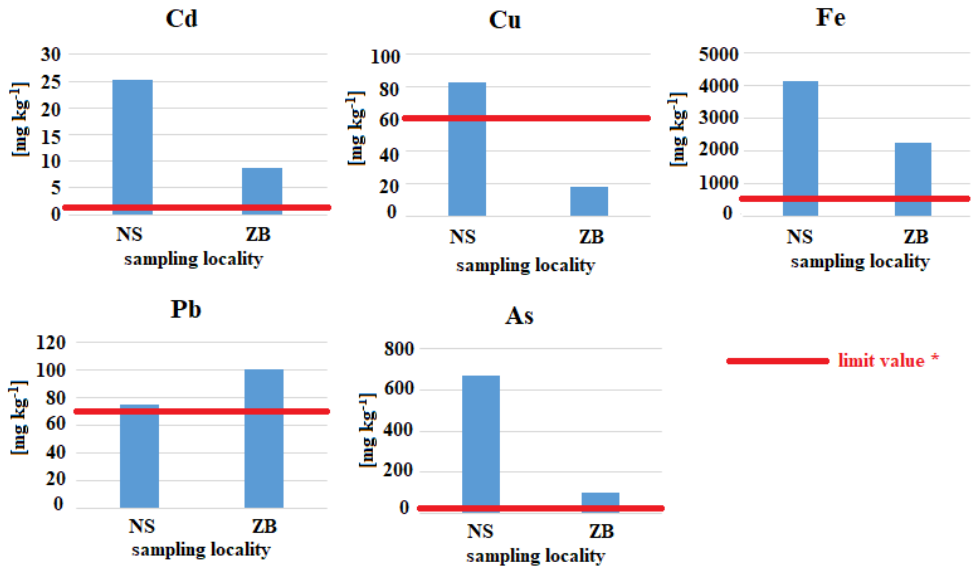


Figure 1 Average values of the risk elements determined in the Nizna Slana (NS) and Zlata Bana (ZB) village, and the limit value set by the *Act No. 220/2004 Coll of Laws.

The values of soil enzymes and soil pH are listed in Table 1.

Table 1

Values of the nutrients, soil enzymes and pH determined in the sampling sites in Nizna Slana (NS) and Zlata Bana (ZB) villages.

Soil properties		NS Min-max (average±st.deviation	ZB
Ca	mg kg $^{-1}$	308-3605 (1304±1142)	1069-79973 (20520±21267)
Na		211-736 (398±182)	120-436 (219±102)
K		1012-9534 (3224±2658)	3211-7517 (4863±1215)
Mg		631-4191 (1631±1146)	2414-24514 (9638±6233)
URE	(mg NH_4^+-Ng^{-1} 24^{-1})	0.07-0.73 (0.36±0.23)	0.06-0.83 (0.49±0.21)
ACP	(mg P g^{-1} $3h^{-1}$)	29.1-241 (99.5±66.1)	9.95-248 (106±79.1)
ALP	(mg P g^{-1} $3h^{-1}$)	28-169 (68.3±46.3)	18.1-213 (100±63.2)
FDA	(µg FS / g soil h)	0-57.4 (12.6±18.8)	0.00-51.6 (12.6±18.8)
BG	(µg p NP / g soil h)	11.7-158 (91.5±53.4)	6.56-364 (114±103)
pH	-	3.3-7.42 (114±103)	4.72-7.54 (6.73±0.99)

Soil pH values ranged between 3.30 – 7.42 and 4.72-7.54 in NS and ZB, repeatedly. According to the Čurlik and Šefčik (1990) classification, soil samples in NS and ZB were determined as extremely acid to alkaline. It has been repeatedly demonstrated that soils with high levels of toxic elements use to reach low pH values (Alloway 2010).

In the study of Franc et al. (2016), who determined the content of the nutrients in the sludge of the tailing pond, the average values of Ca, Mg and K varied between 4110-4560 mg kg^{-1}, 6610-6900 mg kg^{-1}, 10310-12510 mg kg^{-1}, repeatedly. Comparing our results, only values of Ca in ZB village reached a higher value. It has been

demonstrated several times that a high degree of contamination of the natural environment uses to negatively affected by the activity of soil enzymes (Wang et al., 2008). Comparing villages, the lowest values of soil enzymes were determined in ZB, which was (as it is shown in the Figure 1) higher polluted.

Spearman's correlation relationship (Table 2) shows a significant positive correlation between soil pH and Ca, and soil pH and Mg. Ca and Mg also gave significant positive correlation between themselves. Taylor et al (2002) determined a negative correlation between soil pH and soil enzymes. In our case, pH gave negative correlation only with ACP and ALP. In the study focused on the assessment of the soil properties in the metal bordered region (Angelovičová et al. 2014), positive correlation between K and soil urease activity was determined, what wasn't confirmed in our study.

Correlation relationships between risk elements and soil properties are listed in Table 3. Soil pH gave significant positive correlation with Cd, Cu and Fe. High values of Cd, Cu, Fe, and As significantly positively influenced the level of Mg. Potassium (K) gave a significant positive correlation with Cu and Fe. As and Pb gave a negative correlation with all evaluated soil enzymes. The level of URE and ACP was negatively influenced by the risk elements. It has been repeatedly shown, that accumulation of the risk elements in soils reduce the content of microbial biomass, limiting the functional diversity of ecosystem (Wang et al., 2008).

Table 2

Correlation relationships between nutrients, soil enzymes and soil pH.

	Ca	Na	K	Mg	URE	ACP	ALP	FDA	BG
pH	0.59*	-0.39	0.02	0.66*	0.23	-0.34	-0.03	0.05	0.25
Ca		-0.33	0.02	0.88**	-0.32	-0.46	-0.27	-0.27	0.64**
Na			0.32	-0.38	-0.48*	-0.16	-0.12	-0.20	-0.07
K				0.08	-0.18	0.07	0.27	0.13	-0.08
Mg					-0.19	-0.35	-0.19	-0.14	0.56*
URE						0.28	0.11	0.27	-0.38
ACP							0.78**	0.77**	-0.08
ALP								0.82**	-0.16
FDA									0.04

*p<0.05; **p<0.01

Students t-test (Table 4) was used to determine significant differences in soil pH and soil enzymes between sampling villages. Significantly highest values of Ca and Mg were determined in ZB. In the soil samples from NS significantly highest values of Na were assessed. There were found no differences between soil enzyme activity between villages. Soil pH reached significantly highest values in ZB comparing NS.

Table 3

Correlation relationship between soil enzymes, soil pH and risk elements.

	Cd	Cu	Fe	Pb	As
pH	0.53*	0.55*	0.49*	-0.15	0.37
Ca	0.48*	0.21	0.41	-0.02	0.34
Na	-0.28	-0.36	-0.21	0.20	-0.23
K	0.36	0.52*	0.49*	-0.03	0.12
Mg	0.77**	0.45*	0.67**	0.27	0.53*
URE	-0.05	-0.08	-0.21	-0.36	-0.13
ACP	-0.29	-0.01	-0.21	-0.27	-0.38
ALP	-0.07	0.09	0.09	-016	-0.26
FDA	-0.04	0.12	0.09	-0.17	-0.16
BG	0.14	0.07	0.11	-0.12	-0.08

*p<0.05; **p<0.01

Table 4

The results of t-test expressing statistically significant differences in nutrient, soil enzyme activity and pH between the evaluated former mining villages.

	factor	**df**	**f**	**p**
Ca	Between villages	1	5.07	0.039*
Na		1	6.24	0.023*
K		1	2.79	0.114
Mg		1	10.1	0.005**
URE		1	1.20	0.289
KF		1	0.03	0.856
AF		1	1.18	0.293
FDA		1	1.29	0.272
GLUK		1	0.26	0.616
pH		1	17.8	$2.e{\cdot}10^{-5**}$

*p<0.05; **p<0.01

CONCLUSIONS

High values of the risk elements in the soils of the former mining area negatively affected soil quality and health. Serious pollution by As, Cd, and Fe was confirmed in both villages. An activity of soil enzymes was negatively influenced by the risk elements. Comparing villages, higher values of the risk elements in NS have been proven by lower soil enzyme levels and lower values of soil pH. The level of Ca and Mg significantly positively correlated with soil pH, additionally, Mg significantly correlated with all evaluated risk elements except Pb.

ACKNOWLEDGMENT

The research was supported by the project of Ministry of the Education, Science, Research and Sport of the Slovak republic VEGA 1/3026/2018.

REFERENCES

Act. No. 220/2004 Coll of Laws. On the protection and use of agricultural land. National Council of the Slovak Republic, Bratislava.

Alloway J. B., 2010, Heavy Metals in Soils: Trace Metals and Metalloids in Soils and their Bioavailability. Springer, Dordrecht, Heidelberg and New York, pp. 368.

Angelovičová L., Bobuľská L., Fazekašová D., 2014. Chemical and biological soil properties as the indicators of the soil environment influenced by heavy metals. Acta universitatis Prešoviensis Folia Oecologica, 11, 11-19. (in Slovak).

Brehuv J., Špaldon T., Šestinová O., Slančo P., Hančuľák J., Bobro M., 2007, Contamination of the water and sediment load from the drainage basin of the Slaná river by influence of former and present mining activities. Acta Facultatis Ecologiae, 16(1), 91-100.

Čurlik **J.,** Šefčik P., 1990, Geochemical atlas of Slovak republic, part V. Soils, MŢP, Bratislava, pp. 99.

Eivazi F., Tabatabai M. A., 1988, Glucosidases and galactosidases in soils. Soil Biology and Biochemistry, 2, 601-606.

Fazekašová D., Bobuľská L., 2012, Soil Organisms as an Indicator of Quality and Environmental Stress in the Soil Ecosystem. Životné prostredie, 46, 103 – 106.

Gaspar M. L., Cabello M. N., Pollero R., 2001, Fluorescein diacetate hydrolysis as a measure of fungal biomass in soil. Current microbiology, 42(5), 339-344.

Green V. S., Stott D. E., Diack M., 2006, Assay for fluorescein diacetate hydrolytic activity: optimization for soil samples. Soil Biology and Biochemistry, 38, 693-701.

Grejtovski A., 1991, Influence of soil improvers on enzymatic activity of heavy alluvial soil Plant Soil Environment, 37, 289-295. (in Slovak).

Guo L., Zhao W., Gu X., Zhao X., Chen J., Cheng S., 2017, Risk assessment and source identification of 17 metals and metalloids on Soils from the Half-Century Old Tungsten Mining Areas in Lianhuashan, Souhtern China. International Journal of Environmental Research and Public Health, 14(12), 1475.

Hančulák J., Fedorová E., Šestinová O., Špaldon T., Matik M., 2011, Influence of iron ore works in Nižná Slaná on the atmospheric deposition of heavy metals. Acta Montanifstica Slovaca, 16(3), 220-228.

Hasan H. A. H., 2000, Ureolytic microorganisms and soil fertility: A review. Communication in Soil Science and Plant Analysis, 31(15-16), 2569-2589.

Hinjosa M. B., Carreira J. A., Rodrigues-Moroto J. M., Garcia-Riuz R., 2008, Effects of pyrite sludge pollution on soil enzyme activities: ecological dose-response model. Science of Total Environment, 396, 89-99.

Khaziev F. K., 1976. Soil enzyme activity (in Russian). Nauka, Moskva, pp. 180.

Kumar S., Chaudhuri S., Maiti S. K., 2011, Phosphate activity in natural and mined soil – A review. Indian Journal of Environmental Protection, 31(11), 955-962.

Nannipieri P., Kandeler E., Reggiero P., 2002, Enzyme activities and microbiological and biochemical processes in soil. In Burns R. G. & al. (eds.) Enzymes in the Environment, Activity, Ecology and Applications. New York, Marcel Dekker, pp. 1-33.

Šarapatka B., 2002, Possibilities of utilization of enzyme activity as an indicator of the productivity and quality of the system. Biological indicators of soil quality. Brno, MZLU, pp. 62-71.

Taylor J. P., Wilson B., Mills M. S., Burns R. G., 2002. Comparison of microbial numbers and enzymatic activities in surface soil and subsoils using various techniques. Soil Biology and Biochemistry, 34(3), 387-401

Wang Y. P., Li Q. B., Shi J. Y., Lin Q., Chen X. C., Wu W., Chen Y. X., 2008, Assessment of microbial activity and bacterial community composition in the rhizosphere of a copper accumulator and a non-accumulator Soil Biology and Biochemistry, 40(5), 1167-1177.

Xiao R., Wang S., Li R., Wang J. J., Zengquiang Z., 2017, Soil heavy metal contamination and health risks associated with artisanal gold mining in Tongguan, Shaanxi, China. Ecotoxicology and environmental Safety, 141, 17-24.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

RESEARCH ON THE EVOLUTION OF SOME RISK FACTORS AND STRESS IN THE DEALU BUJORULUI VINEYARD IN THE CONTEXT OF THE LIKELY CLIMATE CHANGE

Enache Viorica[1*], Donici Alina[1], Tabaranu Gabriel[1]

[1*]Research and Development Station for Viticultural and Winemaking Bujoru
**Correspondence author E-mail* enacheviorica57@gmail.com

Keywords: *climate risk, vine, air temperature, precipitation*

ABSTRACT

The research was carried out between 1980 and 2016 and its objective is to establish the trend of risk and stress factors in the Bujoru vineyard ecosystem. Viticulture is sensitive to climate change, therefore depending on the evolution of the weather the most efficient technological measures that minimize the effect of climate change must be established in the future. For the Bujoru vineyard ecosystem, drought is a frequent phenomenon, with long periods of time without quality rainfall followed by short periods of torrential rain, over the average quantity, not entirely able to be harnessed. Evolution of precipitation marks a cyclical trend of about 7-8 years during which rainy years alternate with droughty years. The precipitation deficit is especially occurring during the winter and at the beginning of the vegetation period (April to May). The air temperature during the vegetation period shows a trend of growth until 2003, followed by a decrease until 2014, followed by a growth trend. The frequency of tropical days (days with Tmax> 30 ° C) shows a rising trend during the vegetative period and the number of days during winter (Tmax <0 ° C) shows a decreasing trend.

INTRODUCTION

Since the beginning, agriculture has enjoyed a remarkably stable climate, but now, since the 1980, we are facing with a global warming trend. Expansion and intensity of extreme weather phenomena reduces the production annually, and for the sustainable conservation of natural resources in agriculture it is necessary to provide a scientific basis for all actions and measures to prevent and mitigate the consequences. Global climate change associated with increased pollution, deforestation, etc. have led to an increase in the dry and aridity process. Global climate change is one of the major concerns of our century - a complex area where it is necessary to improve knowledge and understanding to take immediate and accurate action. Analysis of climatic data over long periods has shown a climate change trend. Simulations with complex global climate models have shown that the phenomenon is determined by both natural and anthropogenic factors (IPCC, 2007). The climate risk, by acting outside normal limits according to the bioclimatic requirements of the vine, causes violent destruction, eventually leading to "partial or total loss of biological capacity". In determining climatic risk, the climate risk threshold of the vine is also considered. Any significant climatic change has repercussions on the vineyard ecosystem (Alexandrescu I.C., 1994). The wine-growing plants in Moldova and especially in the South are increasingly affected by the climate changes that have occurred in the last decade. A changing climate is one of

the major environmental and socio-economic problems facing sustainable wine-growing and production in the next century.

MATERIAL AND METHODS

The research was carried out in the experimental field of the Statiunea de Cercetare Dezvoltare pentru Viticultură şi Vinificaţie Bujoru between 1980 and 2016. Data were analyzed and processed on:

- average air temperature over the vegetation period, minimum and maximum annual temperature;
- number of days in the winter with maximum air temperature < 0 ° C;
- number of days with maximum air temperature > 30 ° C (tropical days);
- the annual and vegetative season;
- number of days with rainfall during the vegetation period;
- number of days with rainfall during the vegetation period;
- the global thermal heat balance, active and useful/actual.

RESULTS AND DISCUSSIONS

During the vegetation period, the mobile average indicates a tendency of increase in the air temperature by the year 2003, followed by a tendency of decreasing in the air temperature until 2014, followed by a growth trend (fig. 1). In general, the average air temperature shows an increasing trend from 1980 to 2016.

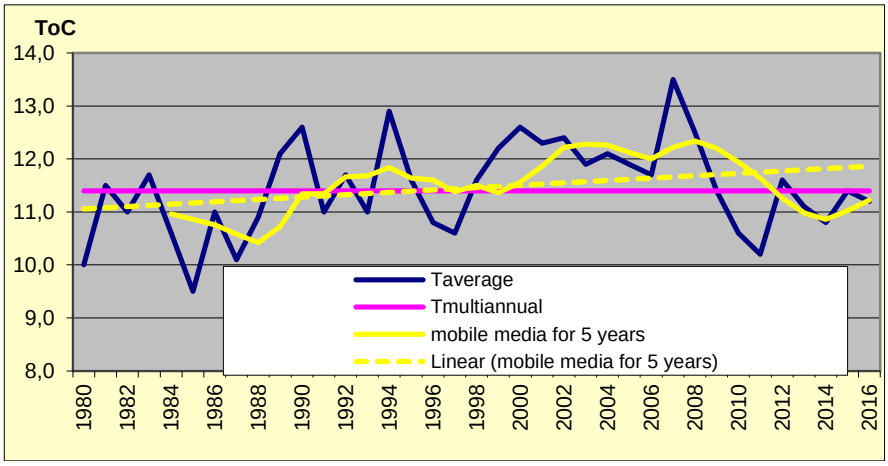


Figure 1 Air average temperature during the vegetation period at RDSVW Bujoru

In terms of minimum air temperatures, over the 27-year period minimum temperatures below -16,0 ° C and only 10 years with Tmin higher than -16,0 ° C (Figure 2) have been recorded. The maximum air temperature above 40 °C was recorded in 2007 and 2012, the remainder of the period is generally above 35 °C excluding 1982, 1984, 1991 and 1997. In 29 years out of 37 were recorded temperatures below freezing (<0,0 °C) during the vegetation period (Figure 3). The year 1988 (-1,5 °C), 2014 (-0,2 °C) and 2000 with the minimum temperature of -10,0 °C on May 1 and Tmax of 28,0 °C (daily amplitude of 38,0 °C) were highlighted.

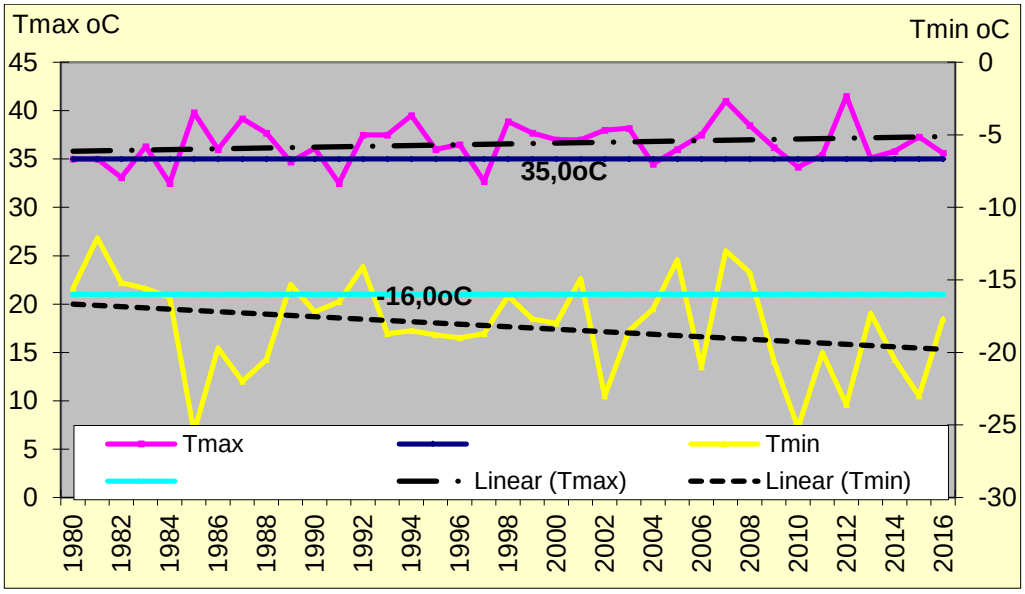


Figure 2 Minimum temperatures and annual maximum temperatures evolution at the Dealu Bujorului vineyard

In the Dealu Bujorului vineyard, the multiannual average rainfall (1980-2016) is 462,1 mm, with 293,8 mm during the vegetation period (with a minimum of 103,1 mm in 1986 and a maximum of 484,3 mm in 1991). Evolution of precipitation marks a cyclic tendency of approximately 7-8 years in which the rainy interval alternates with the dry interval (Figure 5).

Relative to the number of days with Tmax> 30 ° C, all the years analyzed were favorable to the vine culture. The trend shows an increase in the number of tropical days, from 1980 to 2016 (Figure 4).

The five-year moving average which is consistently expressing the climate trend suggests that there has been an increasing trend in annual rainfall over the last period (Enache Viorica et al., 2017).

There is an uneven distribution of rainfall over the year, with periods of drought framed by short periods of abundant rainfall and often torrential. Rainfall deficiency occurs especially during the winter and early vegetation period (April to May) with repercussions on the occurrence of vegetation phenophases. Frequently, in June-July there are torrential rains that are not fully exploited, leading to an increase of the rainfall deficit. In 7 years out of the 10 with precipitations lower than 250 mm during the vegetation period, Tmax> 35ºC was recorded and in 17 years out of 37 annual precipitation of less than 450 mm and Tmax > 35ºC were recorded.

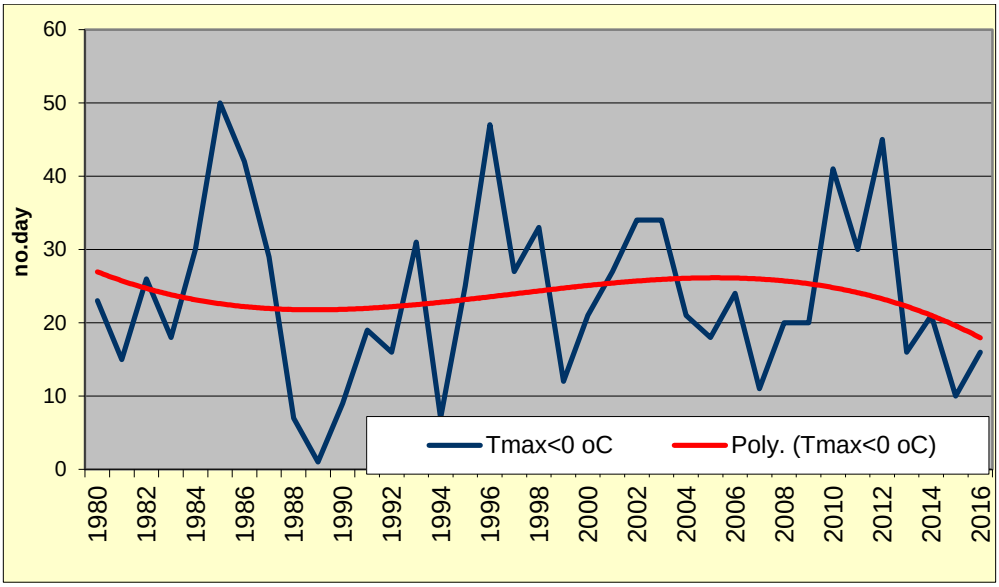


Figure 3 Number of winter days with the minimum air temperature < 0 ºC

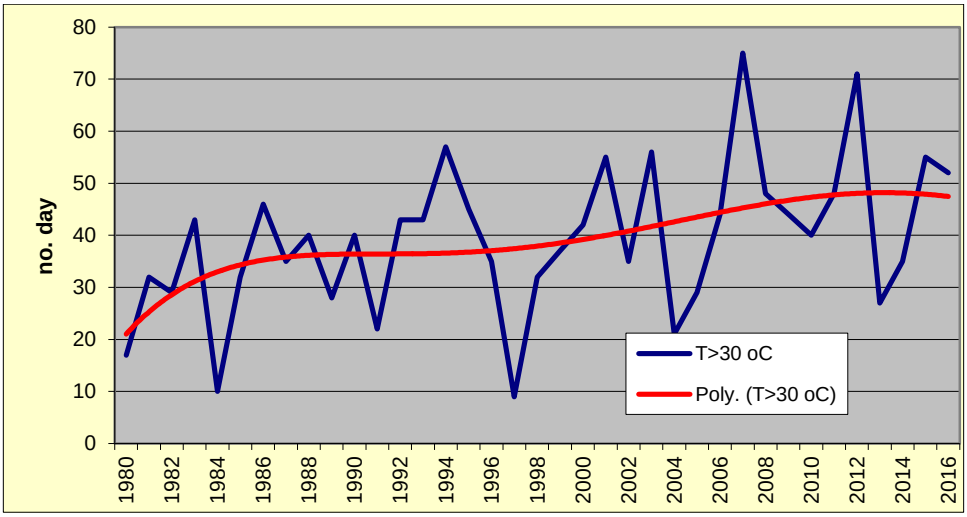


Figure 4 Number of days with the air minimum temperature >30 ºC (tropical days)

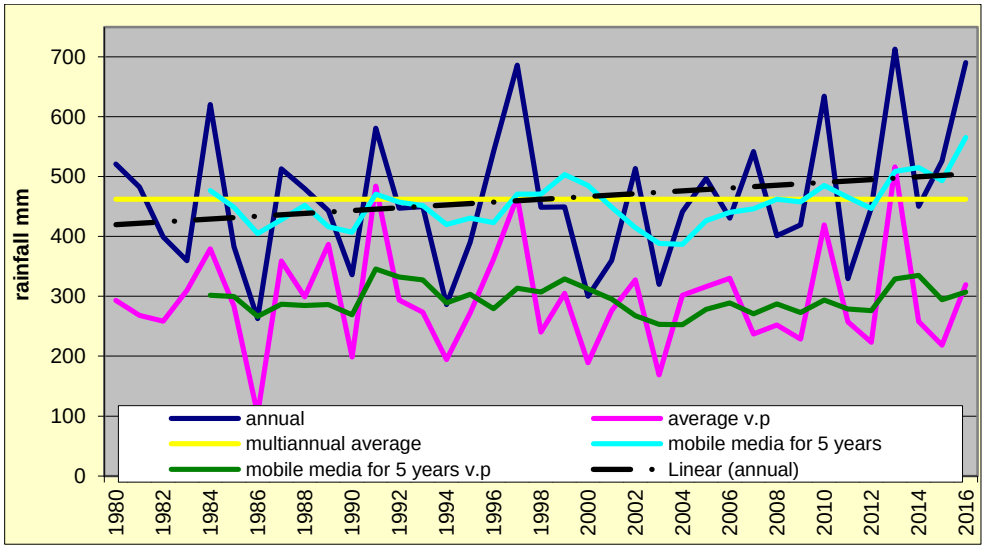


Figure 5 Multiannual average rainfall during the vegetation period

The number of days with rainfall of less than 5 mm predominates over the vegetation period, followed by precipitation between 5-10 mm and over 10 mm (Figure 6). In recent years the number of days with precipitation < 5 mm is increasing.

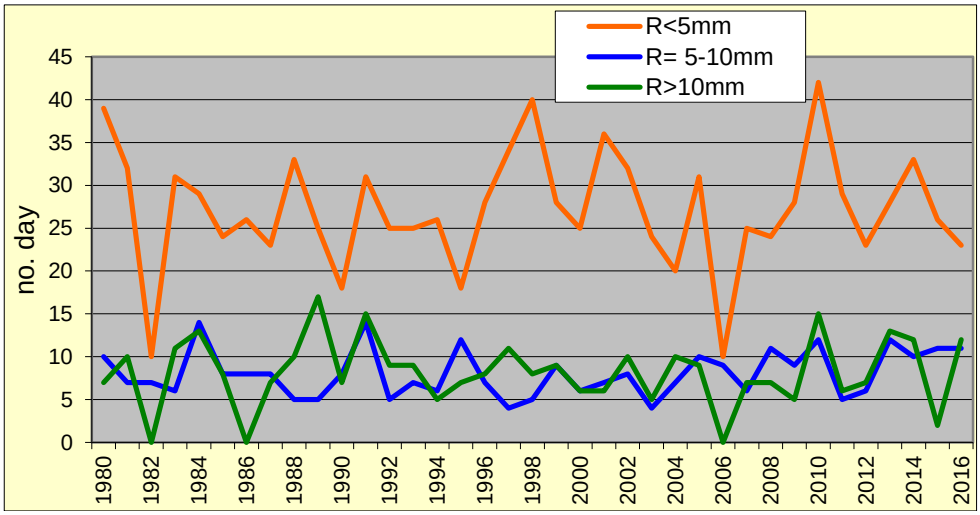


Figure 6 Days with rainfall during the vegetation period

Drought is a frequent phenomenon for the Bujoru Vineyard ecosystem. In order to clarify this phenomenon, it is necessary to know not only the annual rainfall, but the interval of the year in which the precipitations were absent or in insufficient quantities. Between 1980 and 2016 there were long periods without useful rainfall followed by short periods of surplus precipitation, which were totally untapped. In July and August 2001, 10,0 mm and 0,8 mm precipitations were recorded, followed by torrential rains in September 2001. The same aspect is recorded in 2007 in July, when in 30 days there

were only 1,0 mm and in August there were extreme rain events (torrential rains). Insufficient precipitations were also recorded in 2011 (5,2mm / September), 2002 (4,2mm / May), 1994 (9,3 / May), 1988 (7,0 / July), 1986 (7,4 mm / May), 1985 (0,1mm / April) and 1982 (0,2mm / July). During the rest of the time there are months when the rainfall is recorded in small quantities, well below the multiannual average of the respective month. The global heat thermal balance, active and useful heat balance have been calculated for the 1980-2016 vegetation period to measure the caloric resources of the wine-growing zone. We observe a random evolution of the amount of global temperature, active and useful, with an increasing trend from 1980 to 2016. Significant deviations of the active and useful temperatures were recorded in 1994, 2007 and 2012 (Figure 7).

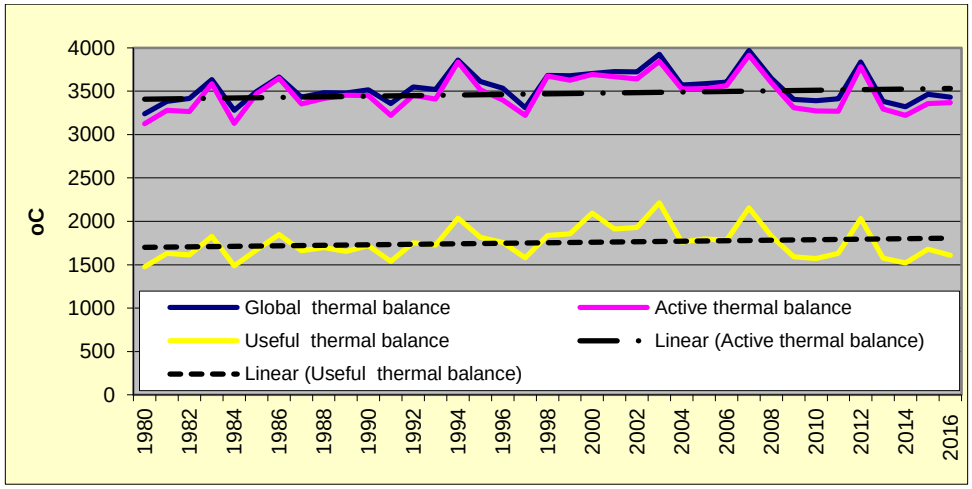


Figure 7 Global heat thermal balances, active and useful

CONCLUSIONS

Analyzing the evolution of some risk and stress factors between 1980 and 2016 in the Dealu Bujorului vineyard, it can be observed that:

• average air temperature has a growth trend from 1980 to 2003, then a slight decrease until 2014, followed by a growth trend;

• Maximum air temperature above 40 °C has been recorded in 2007 and 2012;

• Temperatures below the freezing threshold (<0,0 ° C) during the vegetation period have been recorded in 29 years out of 37 analysed, with 2000 being recorded when -10 ° C on May 1 and Tmax of 28,0 ° C (daily amplitude of 38 ºC).

• The number of tropical days is increasing from 1980 to 2016;

• The five-year rolling average that consistently expresses the climate trend suggests that lately there has been a tendency of increasedannual precipitation but with uneven distribution over the year, with periods of drought fraught with short periods of heavy rain and often torrential;

• In recent years the number of days with precipitation <5 mm is increasing;

• Global, active and useful heat balance/thermal balance is showing an increasing trend from 1980 to 2016.

REFERENCES

Alexandrescu I.C., Oslobeanu M., Jianu L., Pituc P., 1994 - Mică enciclopedie de viticultură, Editura Glasul Bucovinei, Iasi, pp 712

Enache Viorica, Donici Alina, Tabaranu Gabriel, 2017 **-** Trend of the evolution of daily precipitation in the condition of probable climatic changes in the Dealul Bujorului vineyard, Lucrări ştiinţifice, Anul L, vol. 60(1), Seria Horticultura, Editura Ion Ionescu de la Brad, 97-102

IPCC, 2007 - Climate change, 2007 - The physical science basis. Contribution of working Grup I., the fourth assessment rapport of the IPCC, Cambridge UP.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

ASPECTS REGARDING THE DESERTIFICATION PROCESS IN OLTENIA REGION, ROMANIA

Gavrilescu Elena[1], Marinică Ion[2], Popescu Simona Mariana[1*], Ghermec Cristian[3],Ghermec Olimpia[3]

University of Craiova, Faculty of Horticulture, Craiova
[2]University of Craiova, Faculty of Science, Craiova
[3]University of Craiova, Faculty of Mechanical Engineering, Dr. Tr. Severin
** Correspondence author. E-mail*: popescu_simona83@yahoo.com

Keywords*: drought, desertification, heat waves, anthropogenic impact*

ABSTRACT

The climate warming process has progressed from one year to the next, not only in Oltenia or Romania but on the whole planet, which has led to the increase of droughts, their extension and their duration. As a result, desertification processes in vulnerable areas have widened and expanded. The summer of 2017 was excessively warm with long drought intervals and excessively high temperatures. The summer heat peaked at the beginning of August when absolute thermal peaks were reached and exceeded at many weather stations in the country, and in Oltenia there were 10 meteorological stations that recorded temperature records. The paper examines the climatic conditions and desertification processes in Oltenia, which have occurred in this part of the country and the impact on the environment.

INTRODUCTION

The anthropic impact on the climate, especially in the last century, was particularly great that it is considered to be a global, regional and local modifying factor, and human action on the environment has become a climatogenic factor. The climate data of the last century have revealed, in addition to a progressive general warming of the atmosphere (highlighted at a planetary level) a reduction in rainfall which have become limiting factors for the growth, development and productivity of agricultural crops in certain geographical regions and at the same time very restrictive factors for the allocation and use of water resources. The year 2015 was the first year in which the global average temperature exceeded by 1 ° C, the average of the last century, followed by 2016 with a higher exceedance than in 2015, and 2017 is expected to be the hottest on our planet in the first three years, with extreme weather phenomena (climatic extremes), according to the WMO Provisional Statement of Climate Status.

The United Nations Conference on Environment and Development – UNCED has defined desertification as a land degradation in arid, semiarid and dry sub-wet areas resulting from the action of several factors, including climatic variations and human activity. Droughts are complex risk climatic processes with slow manifestations that affect and engage (depending on their duration and intensity) a diverse number of components of the geographical environment.

For this study we chose the time span between 2007-2017, during which the dry summer periods in the region of Oltenia, Romania had a large spatio-temporal expansion and in some years they began even in the spring or occurred after dry winters. During

droughts, the flow of the rivers and the Danube decreases, the level of groundwater decreases considerably and many fountains dry. Therefore, serious problems arise from the water supply of the localities, the crops dry in some areas and suffer static forces which cause premature rupture, and the grains become shabby, with little content of pungent substances or become unfit for consumption. This paper is part of an extensive series of studies on climate change in Oltenia and its impact on the environment (Marinică, 2006; Marinică and Marinică 2014).

MATERIAL AND METHODS

The phenomena of desertification and land degradation are closely related to drought and drought phenomena. For the study of drought phenomena, the following criteria and methods can be used: analysis of non-periodic variations of precipitation and deviations of precipitation quantities (monthly, seasonal and annual); the frequency of the dry rainfall type and its spatio-temporal expansion, according to the Hellman criterion applied to the monthly and annual quantities (the criterion also sets the percentage deviations of the annual and half-yearly amounts from normal), use of Walter Lieth climates, use of standardized rainfall index (ISP). In this paper we mainly used the Hellman criterion, and as a database we used the records from the meteorological stations in Oltenia with long strata of meteorological observations (some over 120 years). We have compiled a series of graphs necessary for comparative analysis in the study of these complex phenomena and we have used the published statistical data to assess the effects of drought periods.

RESULTS AND DISCUSSIONS

Aspects of increasing summer air temperature. Of many aspects, we will analyze the increase in temperature during summer. In June, due to the Earth-Sun geometry, the day's duration reaches the maximum of 15 hours and 32 minutes at 20.VI, and the summer solstice takes place at 21.VI. Day length reaches 15 hours and 1 minute on May 22nd and therefore at 30.VI there are a total of 40 days where the duration of the day is ≥ 15 hours (at 1.VI the day's duration is 15 hours and 18 minutes, and at 30.VI, 15 hours and 28 minutes). As a result of the long daylight and sunshine angle of nearly 90 °, the sunstroke is maximum and causes the air temperature to rise. The general circulation of the atmosphere over this period of time determines the frequent occurrence of tropical warm air adventures in North Africa and the intensification of air heating. Heat waves occur in June more frequently after the 15th, but generally during the hot season, the waves of heat can occur even from the first decade of April. The analysis of the maximum monthly temperature values recorded in June in the studied range shows that they were between 32.5 °C at Polovragi and 41.3 °C at Calafat with the average for the entire Oltenia region of 36.4 °C, being the highest overall average of monthly temperature peaks in June of all history of climate observations for a period of 11 years (Tabel 1). There were 8 absolute temperature climates for June: Calafat 41.3 °C, 41.1 °C at Bechet and Baileşti, 39.7 °C at Caracal, 39.1 °C at Dr. Tr. Severin, 38.9 °C at Slatina, 38.8 °C in Craiova and 25.9 °C at Parâng Peak in the mountain area.

Table 1

Maximum temperature values recorded in the summer months in Oltenia in the period 2007-2017 (Tmax (°C), date = AAAA/ZZ, Hm = altitude of the weather station (m), the values marked with * are absolute thermal absolutes for those meteorological stations)

Meteorological Station		June		July		August	
	Hm	Tmax	data	Tmax	data	Tmax	data
Dr. Tr. Severin	77	39.1*	2007/26	42.2	2007/24	41.3*	2017/5
Calafat	66	**41.3***	2007/26	**44.3***	2007/24	**42.2***	2017/5
Bechet	65	41.1*	2007/26	44.2*	2007/24	41.2*	2012/24;26
Băileşti	56	41.1*	2007/26	44.0*	2007/24	40.5	2012/24
Caracal	112	39.7*	2007/26	41.9	2007/24	40.5	2012/24
Craiova	190	38.8*	2017/29	42.6*	2007/24	40.8	2017/5
Slatina	165	38.9*	2017/29	41.4*	2007/24	39.6	2012/7;24
Bâcleş	309	38.6	2007/26	43.2*	2007/24	38.3	2017/5
Tg. Logreşti	262	35.4	2017/29	39.4	2007/24	38.3*	2017/5
Drăgăşani	280	37.1	2007/26	40.6	2007/24	38.7	2012/24;25; 2017/4;5
Apa Neagră	250	35.6	2013/19	40.6	2007/24	38.8*	2015/12
Tg. Jiu	210	36.6	2017/29	40.7*	2007/24	39.6*	2017/5
Polovragi	546	***32.5***	2017/29	36.5	2007/24	***36.5****	2012/25
Rm. Vâlcea	243	35.6	2007/26	39.8	2007/24	40.7*	2012/7
Voineasa	573	33.4	2016/22	***36.4***	2007/24	36.7*	2012/24
Parâng	1585	25.9*	2010/13	28.4*	2007/24	28.3*	2017/5
Media Oltenia		36.4	2007	40.4	2007	38.5	2012

Source: data from the ANM archive

At the pluviometric point Cujmir (Mehedinţi County) was recorded the maximum value of 42.0 °C on 26th of June 2007 (Marinică I., Marinică Andreea Floriana 2016), equaling the absolute climatic record of the last century recorded on 29.VI.1938 in Oraviţa. Most of the records were recorded in June 2007 during the most intense heat wave in June of all the history of the climate recorded between 18-27.VI.2007. ***June 2007 was the hottest summer beginning of the last 136 years.*** In June 2017, five maximum temperature values were recorded, two of which were absolute records for the respective meteorological stations in Craiova and Slatina (Tabel 1). Of the other years, we notice June 2013 with a maximum of 35.6 °C in the area of the sub-Carpathian depressions at Black Water and June 2010 with the absolute climatic record at Parâng Peak. In Romania, between 29.VI-1.VII.2017, there was an intense heat wave, with the peak of 1.VII.2017, when the highest temperatures were recorded in the history of the observations, at the date of 1 July. The Danube level at Bechet declined by 6 cm from the previous day on 1.VII.2017 and it was then decided that the Bechet-Oreahovo ferry would run only the day (07-21 hours).

Spatial-temporal expansion of dry time in June. As a result of high temperatures and low or no rainfall over long periods of time there has been intense drought that has caused major damage to agriculture and animal husbandry and not only in these economic areas. During this time, 79 months / dry weather at the meteorological station was recorded in June, according to Hellmann's criterion, a 44.9 %. Three months with spatial-temporal expansion over 90 % were registered: June 2007 and 2012 with 93.3 % and June 2017 expanding by 100 % (total drought) (Fig 1). The graph of the variation of the spatio-temporal expansion of dry time has an increasing trend with a significant growth rate of 0.5809. The driest month was June 2017 with the average for the entire region was 25.2 l/m^2, followed by June 2012 with an average of 38.0 l/m^2. The lowest monthly precipitation was in 2017: 2.2 l/m^2 in Craiova, 3.4 l / m2 at

Dr. Tr. Severin, 4.0 l/m^2 at Calafat, 4.2 l/m^2, 6.3 l/m^2 at Băileşti and 9.8 in Băcleş, and in 2012: 3.0 l/m^2 in Băileşti, 7.2 l/m^2 in Craiova and 9.2 l/m^2 in Calafat.

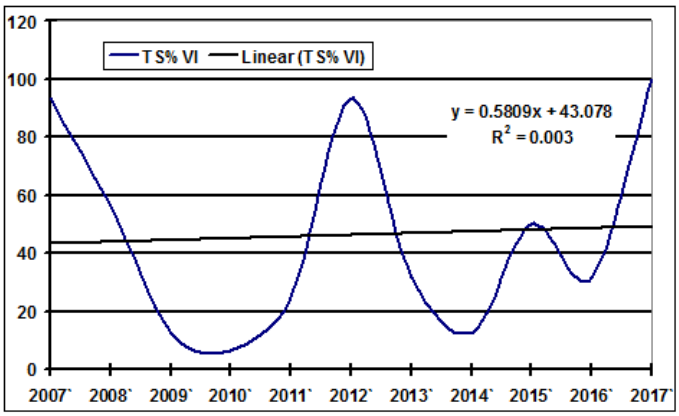


Figure 1. The variation of the space-time extension of drought in June. (Source: processed data from the ANM archive)

In July, the duration of the day is maintained ≥15 hours until 22.VII when the first decrease is recorded for 1 minute under 15 hours, and on 31.VII the duration of the day is 14 hours and 40 minutes, the decrease in the duration of the day the whole month is only 47 minutes. So in the last month of spring and in the first two months of summer, for 62 days, between 22.V-22.VII the duration of the day is ≥15 hours.

In the analyzed range, the maximum temperature values were between 36.4 °C at Voineasa and 44.3 °C at Calafat, and of those recorded at eight meteorological stations (50 % of the Oltenia meteorological stations) became absolute records for July being the largest of all weather observations: 28.4°C at Parâng Peak, 40.7°C at Tg. Jiu, 41.4°C at Slatina, 41.9°C at Caracal 42.6°C at Craiova, 43.2°C at Bâcleș, 44.0°C at Băilești, 44.2°C at Bechet and 44.3°C at Calafat. Their average for the whole region was 40.4 ° C being the largest of all summer but also in the history of the climate. All the monthly thermal peaks of the studied range were recorded in 2007 during the most intense heat wave in the Romanian climate history produced in the period 15-24.VII.2007, and the value of 44.3 °C from Calafat is the absolute thermal maximum for the entire country of July, 24.VII.2007 being the first day of July when in Romania the air temperature reached and exceeded 44.0 ° C (Tabel 1).

Spatial-temporal expansion of dry time in July.

In July, there was a 78-month / dry-time meteorological station, according to Hellmann's criterion, a 44.3 % temporal extension. The hottest month was July 2007 with the average for the entire region was 20.2 l/m^2, and the registered quantities were due to rainfall that came on 31.VII.2007, followed by July 2015 with the average of 26.2 l/m^2. The lowest monthly rainfall was in 2007: 3.2 l/m^2 la Caracal, 6.6 l/m^2 at Drăgășani, 8.5 l/m^2 at Băilești and 9.8 l/m^2 at Rm. Vâlcea; in 2010: 9.8 l/m^2 at Caracal; in 2015: 1.6 l/m^2 at Băilești, 6.8 l/m^2 at Calafat, l/m^2 at Bechet, 8.8 l/m^2 at Caracal and 9.0 l/m^2 at Rm. Vâlcea. Four months were recorded with a time-span extension of the drought: July 2012 with 73.3 % expansion, July 2013 with 81.3 % July 2007 expanding by 93.8 % and 2015 with 100 % expansion (total drought). The graph of the variation of the spatio-temporal expansion of dry time has a slightly decreasing trend with an insignificant coefficient of

decline of -0.2818, due to rainfall in 2017 recorded in the period 2-3.VII.2017 and followed by intense drought to 6. X.2017.

In August, the duration of the day lasts ≥ 14 hours until the 15th and on 16th, the night duration begins to exceed 10 hours and as a result the nights gradually cool down, allowing for a good enough rest, (tropical nights become uncommon) although the days are stagnant in some years until September 15 or even after, although the polar climate front migrates quite quickly southward, bringing behind him increasingly hot air masses. Decreasing the duration of the day in August is 1 hour and 20 minutes being the first decrease of the duration of the day> 1 hour, during the year. As a result, the monthly average air temperature for the entire region in Oltenia recorded the first decrease in the year, compared to July, with a modest value of 0.5 °C. However, the absolute absolute maximum temperature of air in Romania was recorded at 10.VIII.1951 in Râmnicelu commune at the Ion Sion agricultural farm (in Bărăganul Brăilei), at 44.5 °C, not surpassed until now. During the studied period, the monthly temperature peaks were between 36.5 °C at Polovragi and 42.2 °C at Calafat, and their average for the whole region was 38.5 °C, the second highest value in the summer. 10 absolute temperature records have been recorded at the meteorological stations: Parâng, Drăgășani, Polovragi, Voineasa, Tg. Logrești, Apa Neagră, Tg. Jiu, Rm. Vâlcea, Bechet and Dr. Tr. Severin, and at Craiova, Slatina and Dragasani meteorological stations were the highest in the last 72 years (Tabel 1). August 2017 being the hottest month of the last 72 years, and the most intense heat wave was recorded between 1-6.VIII.2017.

Spatial-temporal expansion of drought in August.

In August there were 96 months / weather station of dry weather, being the largest of all summer, according to Hellmann's criterion, a 54.5 % temporal extension. The driest months were August 2008 with the average for the whole region was of 9.7 l/m^2, august 2011 with the average of 16.5 l/m^2 and august 2012 with the average of 24.5 l/m^2. During this period (2007-2017), there were 30 months station / meteorological with precipitation values ≤ 10 l/m^2, which confirms that August is the driest month of the summer, in which the desertification processes are amplified. Four months of spatial-temporal expansion of the drought were recorded: August 2008 with 100 % expansion (total drought), August 2013 with expansion of 81.3 %, July 2007 expanding by 93.8 % and 2015 with 100 % expansion (total drought), August 2001 expanding by 93.8 %, August 2012 with 87.5 % and August 2016 expanding by 81.3 %.

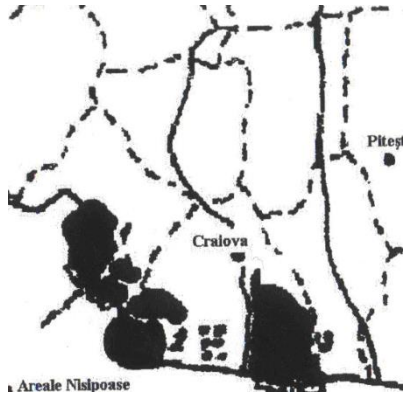


Figure 2. Sandy Areas in Oltenia (after Marinica and Marinica, 2016)

Monthly precipitation averages in August for the whole period considered (2007-20017) ≤ 30.0 l/m^2 were recorded in the area of Dr. Tr. Severin, Calafat, Bechet, Baileşti Caracal, that is where the temperatures were the highest and the sandy soils

very vulnerable to the desertification processes (Fig. 2). The processes of aridization and desertification were intense throughout the southern half of Oltenia and especially in the area called ,"***Oltenia' s Sahara"***.

CONCLUSIONS

During the studied period (2007-2017), the climatic heating in Oltenia continued and even intensified, recording 24 hot thermal temperatures with a local character and one for the whole country during the summer. The above shows the intensification of the heat and drought in the summer, and the field observations as well as our documentation have shown that the processes of desertification during the summer have been accentuated and extended in all counties. All of this is due primarily to the intensification of climatic warming but also to intensive land use. In the sandy area, in some years the "migratory" sand dunes occur due to the wind intensification. We report that among the most destructive actions is the use of herbicides in agriculture.

REFERENCES

Marinică, Ion. 2006. Fenomene climatice de risc în Oltenia, Editura Autograf MJM, Craiova, 386 p;

Marinică I., Marinică Andreea Floriana. 2014. Considerations on Desertification Phenomenon in Oltenia, Forum Geografic. Studii şi Cercetări de Geografie şi Protecţia Mediului. Vol. XIII, 2, Universitatea din Craiova, pp. 136-147.

Marinică I., Marinică Andreea Floriana. 2016. Variabilitatea climatică în Oltenia şi schimbările climatice, Edit. Universitaria, Craiova.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

FLOWERS AND FRUITS VARIABILITY OF *Convolvulus arvensis* L. WEED

Ionescu Nicolae[1*]

[1*]Agricultural Research and Development Station Pitești
Correspondence author. E-mail: nicolaeionescu50@gmail.com

Keywords*: Convolvulus arvensis, corolla, capsule, seeds, variability*

ABSTRACT

*The species is a perennial dicotyledonous that stifles serious crop plants. In the world is considered among the top of 10 weeds like importance. It's spread occurs both by seeds and by rhizomes. The morphological characteristics of the plant and specially the reproductive showed a trend continues, depending on the ecotype existing at a time. Corolla average diameter measured 27 mm, the capsule was 6.5 mm high, 4.4 mm wide and formed 3 seeds each. The seeds have a length of 3.1 mm and 2.0 mm width. Among the characters studied were established both positive and some negative correlations. Positive correlations were obtained between the capsule size (r = 0.421***) and between the seed size (r = 0.621***). An-significant negative correlations were between the corolla diameter and capsule length (r -0.068) and between the number of seeds/ capsule and seed length (r = -0.174). A very low positive correlation was found between the capsule diameter with capsules width (r 0.024). In these circumstances weed was adapted into agriculture field by forming larger dimensions of capsules and seeds, in contrary of flowers corolla diameter.*

INTRODUCTION

Weed control has entered in a new phase: on the one hand herbicides is restricted for environmental protection (Stone et al, 2005), and on the other hand existing species evolves (Parnell & Curtis, 2012). Adapting to new conditions (Gianoli, 2004) can be demonstrated by observing the variability trend as many morphological characters (Black et al, 1994). It was found that a weed with reproductive traits (Angiosperm Phylogeny Group 2003) as high variability, has managed to adapt better to the ecology of crop (Carine & Robba, 2010). The current trend requires control measures (Boldt & Sobhian, 1993), accepted (Wiese et al, 1996; Wiese et al, 1997), diversified and complex (Coombs et al, 2004).

A weed known in agricultural fields is *Convolvulus arvensis* L. (pro syn *C.minor* A.L. Juss., bindweed, field bindweed, lesser bindweed, field morning glory, CONAR code Bayer). The plant grows in different environmental conditions and blooms in midsummer ((Weaver & Riley, 1982). Flowers 1-3 in axillary cymes inflorescence, have short stems. Corolla funnel-shaped, pentamerous, with 5 radial pubescent bands but not divided into distinct lobes, with small bands. The color of the petals is white, sometimes pinkish and reddish. Bands of petals are pink or white. Corolla diameter is 10-25 mm. Five stamens are inserted to the base of the corolla tube, their filaments flattened at the base and rounded at the top, about 1 cm long. Style with 2 oblong stigmas and ovary 2-locular, both white (Weaver & Riley, 1982). The ovary is surrounded by a circle of yellow-orange

ring of nectar, for pollinator insects. Fruits are capsules 4-valve, hairless, brown- yellow, globular, peak with style rudiments. Capsule height surpasses customary width. In capsule form seed dark-brown to black, sub-ovate. The 1-4 pieces are rounder- thinner with rough surface and arched back side. The seeds were 2.5-4.5 mm long, 2.0-3.5 mm wide and 2.0-3.0 mm thick.

The aerial part of the plant is not recommended in animal feed (Austin, 2000; Meng et al, 2002). But in terms of medicinal, plant contains a number of promising compounds (Kaur & Kalia, 2012). Thus, the rhizome containing resin (*convolvulin*), alkaloids (*cuscohygrins* and *calystegins*), lipids (*butyric acid* forms) and flavonoids (*rutin*). The roots and the air parts have flavonoids (7) and *coumarin* (5). Green part of the plant contains steroids (3) and phenolic acid compounds (9) (Schultheiss et al, 1995; Todd et al, 1995). The seeds are rich in lipids (7 acids such as oleic, arachidic, lioleic, linolenic, stearic, palmitic and behenic) (Kaur & Kalia, 2012).

The weed is native to Europe and Asia and prefer both winter cereals and spring crops. System “convolve” felt like a weed cover the entire acreage, then climbs on crop plants. By performing measurements in different conditions of vegetation, it might bring some new elements to describe this species of weed. In the present study we analyzed the corolla diameter, length and width of capsule, number of grains per capsule, length and width of the grains formed.

MATERIAL AND METHODS

Measurements were performed in August on *Convolvulus arvensis* plants, last three years. They were chosen from more areas with winter wheat and maize crops. The areas were located in the resort region. 100 plants of *C.arvensis* were measured diameter of flowers corolla (the cups) completely open. The basal portion of the plant was harvested by a single capsule completely mature. Of 100 capsules were measured: height, width and the number of formed seed. Seeds were measured by length and width.

Morphological characters were analyzed by histograms (*polygons frequency*, %). In the method were used class intervals, and in the number of seeds per capsule, absolute values were used. Study has highlighted several aspect and namely: i)modal values with highest frequency, ii)variability within ranges of characters studied, iii)the specifics of each character of the ecotype of the plant analyzed.

Among the analyzed characters were established some correlations, by which they could observe and study their tendencies within ecotype. The expression values was used Excel.

In the statistical calculation of all the values obtained was used analysis of variance (ANOVA test) i.e. on the ranges of variation. Statistical parameters were calculated using formula: $\bar{a} = \frac{\Sigma x}{n}$, unde ā = media of determinations, iar x = values obtained, S^2 (variance) $= \frac{1}{n-1}\left[\Sigma x^2 - \frac{(\Sigma x)^2}{n}\right]$, S (standard error) = $\sqrt{S^2}$, S % (variation coefficient) = $\frac{S}{\bar{a}}100$. Finally it was developed a summary of the data from characters variability of *C.arvensis* flowers, fruits and seeds established by determinations.

RESULTS AND DISCUSSIONS

Variability of *C.arvensis* corolla diameter. Cime forming by plant with large flowers, are visible in the crops. Corolla diameter is accustomed 1.0- 2.0- 2.5- 3.0 cm. Determinations resulting were values between of 17 and 35 mm. Corolla average diameter was 27 mm- figure 1. The color of weed corolla is white- rose- Figure 2. Dominant between the diameter of *C.arvensis* were the corolla of 26-28 mm (33 %), followed by those with 29 to 31 mm (24 %). Corolla with lower values and with higher value were 3 % and 1 % respectively.

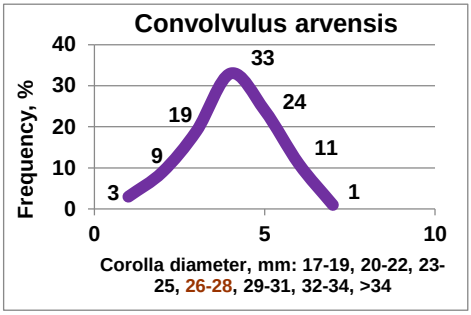


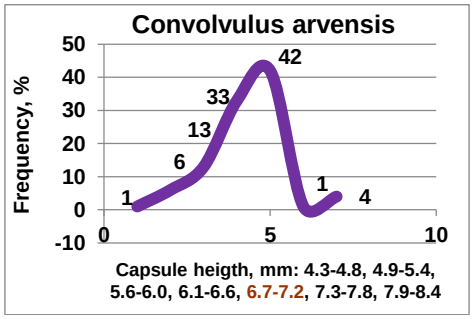
Figure 1. Evolution of corolla diameter

Figure 2. *C.arvensis* corolla aspect

Variability of capsules and seeds. After fecundation the capsules are formed. Data from literature shows values of dimensions of the capsule between 50-70 mm in height and 50-60 mm in width. By measuring the height of the capsule from bottom to the top were found some differences- Figure 3. Limit values ranged between 4.3 and 8.4 mm. The modal value ranged from a maximum length of 6.7-7.2 mm (42 %), followed by those with 6.1-6.6 mm (33 %). Capsules shorter of 4.3-4.8 mm had a frequency of 1 %, while the longest between 7.3-8.4 mm were a total of 5 %. Width capsules showed values between 3.6 and 6.6 mm. The modal value was 4.6-5.0 mm (33 %), followed by those with 4.1-4.5 mm (21 %) and 5.1-5.5 mm (21 %). Capsules with greater widths constiuted 6 % of total- Figure 4.

C.arvensis capsule form a variable number of seeds, between 1 and 4 (rarely found a higher number). In the case of capsules analysis found 1-4 seeds/ capsule. The highest frequency had 4 seeds/ capsule (37 %), followed by the 3 seeds (32 %), 2 seeds/ capsule were 29 % and 2 % with one seed/ capsule- Figure 5. Appearance and color of seeds are specific- Figure 6.

Seed size are different, the usual length is of 3-4 mm. In other determinations found seeds 2.5-4.5 mm long, 2.0-3.5 mm width and 2.0-3.0 thickness. Their overall shape is ellipsoid, with bush skin, dark brown to black. Measurements have demonstrated that *C.arvensis* seed are between 2.0 and 4.9 mm. The highest frequency had a seed of 3.0-3.4 mm (36 %), followed by those with 3.5-3.9 mm (23 %), and those with 2.5-2.9 mm (22 %). Seeds for long, 4.5-4.9 mm constituted only 1 % of total- Figure 7. Seed width was between 1.0 1nd 3.0 mm. The most frequent ones had 1.9-2.1 mm (32 %), followed by 16 % of those with 1.6-1.8 mm and 2.5-2.7 mm respectively. Variability of this character was quite high, with discontinue values- Figure 8.



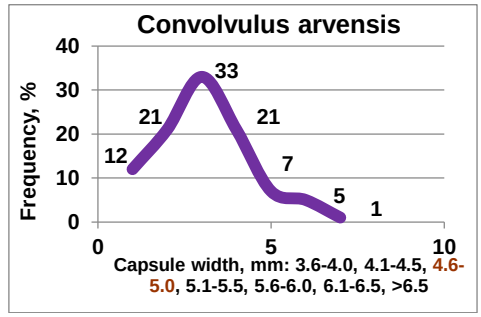


Figure 3. Evolution of capsula height

Figure 4. Evolution of capsula width

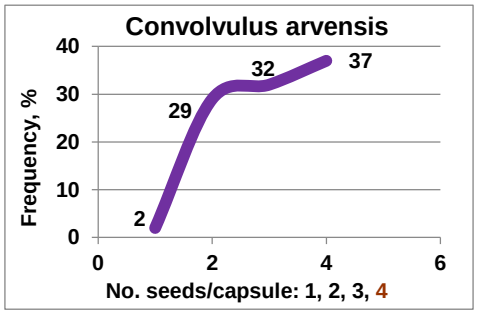
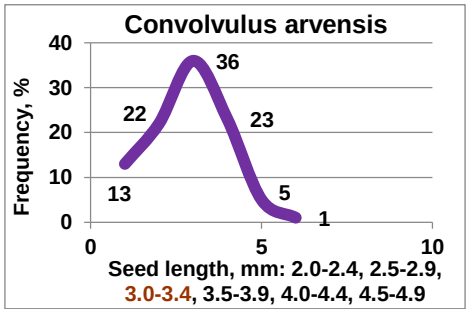


Figure 5. Evolution of seeds no. from capsula Figure 6. Seeds and capsules of *C.arvensis*

Correlations between the main characters. The correlation between the diameter of the corolla and capsule dimensions (length and width) were an-significant: negative for capsule length, r = -0.068, and positive for capsule width, r = 0.024. These links show that weed make capsules somewhat larger, indifferent of capsule diameter- Figure 9 and Figure 10.

Between length and thickness of the *C.arvensis* capsule was established a significant and positive correlation (r = 0.421***). Capsules, how they are longer, their thickness is much higher. The correlation is supported by the conditions that they encounter in the crops- Figure 11.



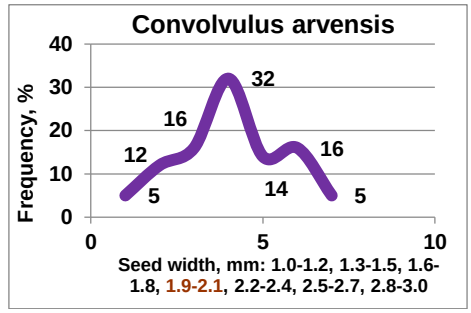
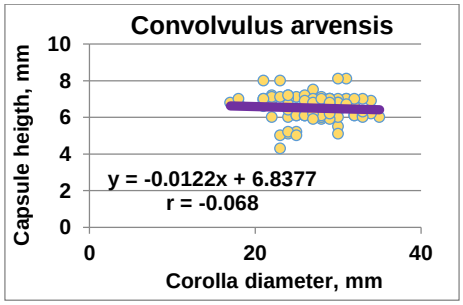


Figure 7. Frequency of seed length Figure 8. Frequency of seed width



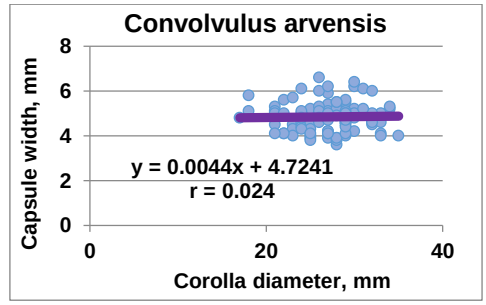


Figure 9. Correlation between corolla diameter and capsula height Figure 10. Correlation between corolla diameter and capsule width

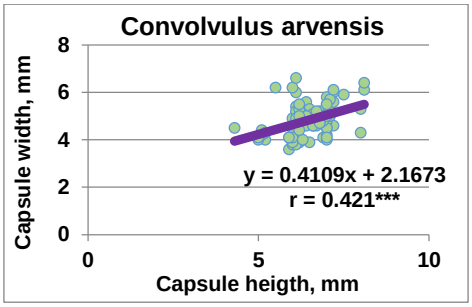


Figure 11. Correlation between height and width of capsula

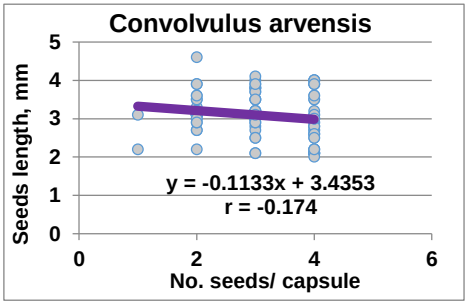


Figure 12. Correlation between no. seeds/ capsula and seeds length

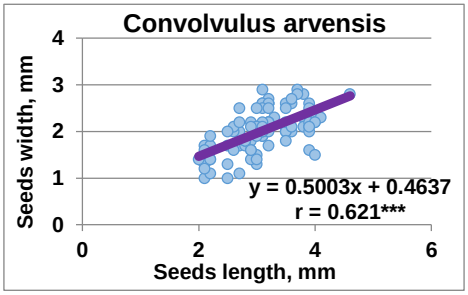


Figure 13. Correlation between lenght and width of weed seeds

Figure 14. Seeds of *C.arvensis* weed

Between the number of seeds per capsule and seed length achieved a negative relation, quite obvious: r = -0.174- Figure 12. This demonstrates that in capsules with a greater number of seeds, they have slightly less length. Between seed size (length and width) achieved a very favorable correlation (r = 0.621***), which shows that as the crop conditions are better, the plant forms better seed size- Figure 13. Appeareance and color of C.arvensis seeds are shown in Figure 14. Proportion of brown and black seeds was quite equal.

From a synthetic table of correlations between various characters emerged negative links between the number of seeds per capsule and size of seeds- Table 1. Positive correlations were obtained between the width of the capsule with the number of seeds per capsule (r = 0493 ***) and with the seeds length (r = 0.296 **).

Table 1

Correlations between differing characters of *C.arvensis* weed flowers and fruits

Character	Corolla diameter	Capsule height	Capsule width	No. seeds/ capsule	Seeds length	Seeds width
Corolla diameter	1	-0.068	-0.024	0.060	-0.067	-0.014
Capsule height		1	0.421***	0.033	0.378***	0.245*
Capsule width			1	**0.493*** **	**0.296** **	0.039
No. seeds/capsule				1	-0.174	-0.528^{000}
Seeds length					1	0.621***
Seeds width						1
DL 5 % = 0.19 DL 1 % = 0.25 DL 0.1 % = 0.32						

Statistical analysis of the corolla, capsule and seed variability. Were calculated for each character analyzed: the average (ā), the variance (s^2), the standard error of the mean (s) and the coefficient of variation (CV, %). Statistical estimates made have

highlighted the characteristic values of *Convolvulus arvensis* ecotype. The values obtained were characteristic. Thus flowers corolla measured on average 27.08 mm, capsule measured 6.503 mm in heigth and 4.369 mm wide. The capsules were formed 3.04 grains which measured 3.091 mm long and 2.008 mm width- Table 2.

Table 2

Statistical indices of *Convolvulus arvensis* flowers and fruits

Indices	Corolla diameter, mm	Capsule		No. seeds/ capsule	Seeds	
		Heigth, mm	Width, mm		Length, mm	Width, mm
Media, ā	**27.08**	**6.503**	**4.369**	**3.04**	**3.091**	**2.008**
Variance, s^2	13.43	0.366	4.824	0.6347	0.4708	0.2098
Standard error, s	3.6644	0.605	2.196	0.7967	0.6862	0.4581
Coef. of var., %	**13.53**	**9.30**	**50.26**	**26.21**	**22.20**	**22.81**

CONCLUSIONS

A common species that cause significant damage is *Convolvulus arvensis* L. weed. Plant is widespread in southern territory, because the existing cross-type is very well suited in wheat and maize. To control it through its management it is good to know as many morphological characters. It was found that a species that express variability broadest posiible help in finding the most suitable method of control. Morphological variability, especially reproductive being less known, may express existing cross-type in these conditions- Table 3.

The corolla of the flowers was something larger, formed capsules apparent with bigger heigth and width. The number of grains in a normal capsule was 1 to 4 pieces. The dimensions of the length and width of grain showed a lower than normal. Weight of a thousand kernels (WTK) of *C.arvensis* each 10 capsules ranged between 3.33 and 6.47 g.

Table 3

Values of corolla and fruits characters variability, CONAR weed

Characters		Literature	Research
Corolla diameter, mm		10 – 30	17 - 35
Capsule	Heigth, mm	5.0 – 7.0	4.3 – 8.1
	Width, mm	5.0 – 6.0	3.6 – 6.6
No. seeds/ capsule		2 - 4	1 - 4
Seeds	Length, mm	4.0 – 5.0	2.0 – 4.6
	Width, mm	2.0 – 3.0	1.0 – 2.9
Weight of a thousand kernels, WTK, g		-	3.33 – 6.47

REFERENCES

Angiosperm Phylogeny Group, 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnean Society, 141(4): 399-436.

Austin D.F., 2000. Bindweed (*Convolvulus arvensis, Convolvulaceae*) in North America- from medicine to menace. Bulletin of the Torrey Botanical Club, 127(2):172 -177.

Black I.D., Matic R., Dyson C.B., 1994. Competitive effects of field bindweed (*Convolvulus arvensis* L.) in wheat, barley and field peas. Plant Protection Quarterly, 9(1):12-14.

Boldt P.E., Sobhian R., 1993. Release and establishment of *Aceria malherbae* (Acari: *Eriophyidae*) for control of field bindweed in Texas. Environmental Entomology, 22(1):234-237.

Carine M. A. and Robba L., 2010. Taxonomy and evolution of the *Convolvulus* abatius complex (*Convolvulaceae*). Phytotaxa: 1- 14 1.

Coombs E. M., et al., Eds., 2004. Biological Control of Invasive Plants in the United States. Corvallis: Oregon State University Press: 1- 151.

Gianoli E., 2004. Plasticity of Traits and Correlations in Two Populations of *Convolvulus arvensis* (*Convolvulaceae*) Differing in Environmental Heterogeneity. International Journal of Plant Science, 165(5): 825-832.

Kaur M., Kalia A.N., 2012. *Convolvulus arvensis*- a useful weed. International Journal of Pharmacy and Pharmaceutical Sciences, 4(1): 38- 40 (ISSN 0975-1491).

Meng x.l., Riordan N.H., Casciari J.J., Zhu Y., Zhong J., Gonzales M.J., Miranda-Massari J.R., Riordan H.D., 2002. Effects of a high molecular mass *Convolvulus arvensis* extract on tumor growth and angiogenesis. Health Science Journal, 21: 323- 328.

Parnell J. and Curtis T., 2012. Webb's An Irish Flora. Cork University Press. ISBN 978-185918-4783.

Schultheiss P.C., Knight A.P., Traub-Dargatz J.L., Todd F.G., Stermitz F.R., 1995. Toxicity of field bindweed (*Convolvulus arvensis*) to mice. Vet Hum Toxicol, 37(5):452-454.

Stone A.E., Peeper T.F. and Kelley J.P., 2005. Efficacy and acceptance of herbicides applied for field bindweed (*Convulvulus arvensis*) control. Weed Technology, 19:148–153.

Todd F.G., Stermitz F.R., Schultheis P., Knight A.P., Traub-Dargatz J., 1995. Tropane alkaloids and toxicity of *Convolvulus arvensis*. Phytochemistry, 39: 301- 303.

Weaver S.A. & Riley W.R., 1982. The biology of Canadian weeds. 53. *Convolvulus arvensis* L. Canadian Journal of Plant Science, 62:461-472.

Wiese A.F., Salisbury C.D., Bean B.W., Schoenhals M.G., Amosson S. 1996. Economic evaluation of field bindweed (*Convolvulus arvensis*) control in a winter wheat-fallow rotation. Weed Science, 44:622-628.

Wiese A.F., Bean B.W., Salisbury C.D., Schoenhals M.G, Amosson S., 1997. Economic evaluation of field bindweed (*Convolvulus arvensis*) control. Weed Science, 45(2): 288-295.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

ASSESSMENT AND CHARACTERIZATION OF MICROBIAL COMMUNITIES IN SALT AFFECTED SOIL

Mihai Constanța[1], Crăcică Ana Gabriela[2], Paraschiv Maria[3, 4], Cîmpeanu Carmen[1], Constantin Carmen[1, 3*]

University of Agronomic Sciences and Veterinary Medicine of Bucharest
[2] OMV Petrom S.A., Upstream – Domestic Assets – Laboratory RO/ICPT Campina
[3] National Institute of Research and Development for Biological Sciences Bucharest
[4] Research Center for Advanced Materials, Products and Processes – University Politehnica of Bucharest, Romania
* *Correspondence author. E-mail*: manolecarmen2000@gmail.com

Keywords*: halophytes, microorganisms, saline*

ABSTRACT

This paper presents the population of micro-organisms found in the saline soil with a certain electrical conductivity.

The soil samples were dried, and ground. After this procedure, the soil was revitalized with peptone water, then incubated 12 hours (overnight) at 31 °C. The culture media used were: nutrient agar: yeast extract, peptone, agar; YPG agar: yeast extract, peptone, glucose, agar supplemented with chloramphenicol. For the identification of osmotolerant microorganisms, these media were also used with different NaCl concentrations ranging from 5 ÷ 15 %. The soil samples were inoculated in Petri dishes and incubated for 7 days at 35 °C for bacteria and 28 ºC for fungi. After incubation, the number of bacteria and fungi in each soil sample was calculated by the UFC determination technique (colony forming units).

INTRODUCTION

There are many studies that state that more than 5 % of agricultural land worldwide is affected by salinity (Etesami 2018, Almeida Machado & Serralheiro, 2017, Shrivastava & Kumar 2015, Pitman & Läuchli 2002). Along with salinity, the composition of the soil is modified. Within it, the microbial communities which are involved in processes and biogeochemical cycles (Lima do Nascimento et al. 2016, Stefanis et al. 2013). Microbial communities in the saline soils are an indicator to the functionality of ecosystem services. However, the literature about the microbial diversity and composition is scarce (Zhao et al. 2018). Playing an important role through mineralization of organic matter, it is recommended to maintain high microbial activity (Yan et al. 2015).

Thus, the aim of this study was to evaluate the microbial population of soils with known electrical conductivity. This study was needed for a broader research that involved the use of halophyte plant species in order to improve soil quality.

MATERIAL AND METHODS

For this experiment, six soil samples with different salinity was taken. The evaluation, identification and characterization of microbial diversity in three repetitions were performed using an adapted method (Shafkat et al. 2017).

Soil samples were taken from a depth of 40 cm, in southeastern Romania (Figure 1).

Figure 1. The soil sampling area

To revitalize and enrich the microorganisms, peptone water and NaCl solution in 1: 5 and 1:10 dilutions were added to soil samples and then incubated for 12 hours (overnight) at 31 °C.

After incubation, the samples of the soil were inoculated on culture media (nutrient agar - NA and YPG agar). Sowed Petri dishes were incubated for 7 days at 35 °C for bacteria and 28 °C for fungi.

After incubation, the number of bacteria and fungi in each soil sample was calculated by the CFU determination technique (colony forming units), which allows to determine the number of viable cells in a sample, in the form of colony-forming units, in Petri dishes on selective culture media, above mentioned.

CFU = N x c x 10, where

CFU = number of viable cells/1ml sample

N = average of the colonies counted from the same dilution

c = dilution reverse

10 = coefficient reference to 1ml.

In the experiments performed, the macroscopic examination was performed visually, considering the characteristics of the bacterial colonies developed on the culture medium. Also, the microbial culture characters the shape, the color, and the texture of the colony were analyzed.

The EC was realized using an adapted method (Rayment and Higginson, 1992).

RESULTS AND DISCUSSIONS

The soils selected for this study had different EC values, and contained different microbial composition and viability (Table 1).

Table 1

Results of growth in NA and YPG media containing 5 % (w/v), 10 % (w/v), and 15 % (w/v) NaCl

Sample-Dilution	Nutrient Agar (5 % NaCl) CFU	Nutrient Agar (10 % NaCl) CFU	Nutrient Agar (15 % NaCl) CFU	YPG (5 % NaCl) CFU	YPG (10% NaCl) CFU
P_{1a} – 1:5	395.6	90.5	x	31.5	x
P_{1b} – 1:10	730	69.5	x	10.5	x
P_{2a} – 1:5	199.5	20	x	44	x
P_{2b} – 1:10	9	x	x	21	x
P_{3a} – 1:5	353	142	x	69	x
P_{3b} – 1:10	59.5	52.5	x	21	x
P_{4a} – 1:5	146	27	x	47	x
P_{4b} – 1:10	135	x	x	19	x
P_{5a} – 1:5	590	x	x	5	x
P_{5b} – 1:10	439	x	x	7	x
P_{6a} – 1:5	522	x	x	3	x
P_{6b} – 1:10	327.5	236	x	x	x

x - the appearance of salt crystals

All the samples showed growth in NA and YPG media containing 5 % (w/v), NaCl. But failed to grow in media containing 10 % (w/v) and 15 % (w/v) NaCl. The results are similar who those obtained by Shafkat et al. (2017) in media containing 8 % (w/v) and 10 % (w/v) NaCl.

Bacterial growth in 10 % NaCl supplemented media reached the stationary phase at 24 hours incubation with fewer bacteria. Concentration of 5 % NaCl in the growth media contributes to a faster growth of bacteria and the cells have reached the stationary phase after 48 hours. This may be due to the fact that an increase in salt content restrains the growth and development of bacteria without affecting the composition (Zhang et al. 2015).

The negative control (medium without NaCl) showed the total absence of microorganisms.

Through macro and microscopic observations of colonies, several typea of bacteria and fungi have been identified.

Thus, the highest percetage in the microflora of the studied soil has *Bacillus* genus with a total of 4 species, followed by *Staphylococcus*, *Enterococcus* and *Micrococcus*.

Morphology and phenotypic characteristics suggest that the bacterial isolate is a moderately halotolerant member of the genus *Bacillus*. The isolated cells are thin, short strands, 0.3-0.5mm wide and 1.3-1.9 mm long. The colonies are creamy, smooth and circular. Strictly aerobic, non-flagellated, non-motile, long, straight or slightly curved in the middle, with rounded heads.

Bacterial colonies of the genera *Staphylococcus*, *Enterococcus* and *Micrococcus* dispersed on the culture medium formed rounded colonies, embossed with nearly round yellow and light creamy edges. There were creamy, smooth, low convex and circular / slightly irregular bacterial colonies on NA medium containing 10 % NaCl.

Microscopically, the cells appeared in the form of coils, diplococi, isolated or in pairs, short chains, immobile.

The microbial population increased in inverse proportion to the chloride concentration, salt crystals making their appearance (Figure 2).

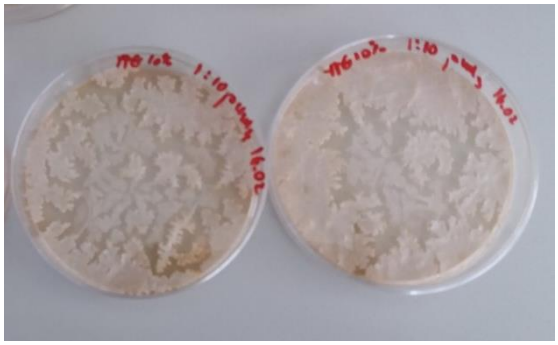


Figure 2. The occurrence of salt crystals on medium with 10-15 % NaCl

Also, different fungi species were isolated and identified at different concentrations of NaCl. Thus, the presence of *Aspergillus*, *Penicillium*, *Cladosporium*, *Alternaria*, *Mucor* genus has been revealed (Figure 3).

A **B** **C**

Figure 3. Colonies of *Cladosporium* sp. (A), *Penicillium* sp. (B), *Alternaria* sp. (C)

To assess the microbial population, soil samples with electrical conductivity between 4000 and 11000 mS cm^{-1} were used. According to the classification (Canfora et al. 2014), the soil is saline (the Electrical Conductivity is greater than 4 dS m^{-1}).

CONCLUSIONS

With regard to microbiological soil assessment, it can be concluded that most important bacteria and fungi groups can live in concentrations up to about 5 % salt and that many groups are physiologically active even at much higher concentrations. Also, due to the total absence of colonies in salt-free environments, isolated and identified bacteria and molds can be classified as moderately halotolerant. Different fungal species were isolated and identified at various concentrations of NaCl. These results indicate a significant presence of the strains of *Aspergillus* sp., *Penicillium* sp., *Cladosporium* sp., *Alternaria* sp., and *Mucor* sp.

The highest share in the soil microflora studied was *Bacillus* genus with a total of 4 species, followed by the genus *Staphylococcus* sp., *Enterococcus* and *Micrococcus* sp.

ACKNOWLEDGMENT

These researches were carried out under the financing contract no. 56 / 05.09.2016 Project ID P_40_308, Clean technologies for processing and / or capitalizing fuel-efficient materials – CleanTech.

REFERENCES

Almeida Machado R. M., and Serralheiro R. P., 2017, Soil salinity: effect on vegetable crop growth. Management practices to prevent and mitigate soil salinization, Horticulturae, vol. 3, 1-13.

Canfora L., Bacci G., Pinzari F., Lo Papa G., Carmelo Dazzi, and Benedetti A., 2014, Salinity and bacterial diversity: to what extent does the concentration of salt affect the bacterial community in a saline soil? PLoS One, vol. 9, 1-15.

Hassan Etesami, 2018, Using halotolerant bacteria for farming in salt affected soils, Acta Scientific Agriculture, vol. 2, 1-2.

Lima do Nascimento Paula Gracielly Morais, Beatriz Letícia Silva da Cruz, Andréa Mirne de Macêdo Dantas, Francisco Cláudio Lopes de Freitas, Márcia Michelle de Queiroz Ambrósio and Rui Sales Júnior, 2016, Microbial communities in soil cultivated with muskmelon under different management systems, Revista Brasileira de Ciencia Solo, vol. 40, 1-15.

Rayment G. E., Higginson F. R., 1992, Australian laboratory handbook of soil and water chemical methods, Melbourne, Inkata Press. (Australian Soil and Land Survey Handbooks, vol. 3.

Shafkat S. R., Romana S., Nafisa T., 2017, Isolation and identification of halotolerant soil bacteria from coastal Patenga area, BioMedCentral Research Notes, vol.10, 1-6.

Stefanis C., Alexopoulos A., Voidarou C., Vavias S., Bezirtzoglou E., 2013, Principal methods for isolation and identification of soil microbial communities, Folia Microbiol (Praha), vol. 58, 61-68.

Zhang Y., Cao C., Guo L., Wu Q., Cui Z., 2015, Soil properties, bacterial community composition, and metabolic diversity responses to soil salinization of a semiarid grassland in northeast China, Journal of Soil and Water Conservation, vol. 70, 110-120.

Pooja Shrivastava and Rajesh Kumar, 2015, Soil salinity: A serious environmental issue and plant growth promoting bacteria as one of the tools for its alleviation, Saudi J Biol Sci., vol. 22, 123–131.

Pitman M. G., and Läuchli A., 2002, Salinity: Environment - Plants - Molecules, olecules , Kluwer Academic Publishers, Printed in the Netherlands, 3–20.

Yan N., Marschner P., Cao W., Zuo C., Qina W., 2015, Influence of salinity and water content on soil microorganisms, International soil and water conservation research, vol. 3, 316-323.

Zhao S., Liu J. J., Banerjee S., Zhou N., Zhao Z. Y., Zhang K., Tian C. Y., 2018, Soil pH is equally important as salinity in shaping bacterial communities in saline soils under halophytic vegetation, Scientific Reports, vol. 8, 1-11.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE NEW PEST *CYDALIMA PERSPECTALIS* (WALKER, 1859) (LEPIDOPTERA: CRAMBIDAE) IN AREA OF CENTRAL OLTENIA.

Mitrea Ion[1]*, Stan Raluca[2]

University of Craiova, Faculty of Horticulture;
[2]PhD University of Craiova
*Correspondence author. E-mail: mitreion@gmail.com;

Keywords: *Cydalima perspectalis, monitoring, Buxus, Oltenia*.

ABSTRACT*:*

Cydalima perspectalis Walker, 1859 (Lepidoptera: Crambidae) is a dangerous pest for the Buxus sempervirens shrub, which gives it this status is the spread rate, being present on almost the entire European continent. In recent years, it has also spread to Romania in several parts of the country. In the Oltenia area it is observed both in the urban and rural areas, and the degree of defoliation is different from one area to another. A small defoliation rate was encountered in Craiova, Sărari area with a percentage of 20 %, and the highest in Dobrun village of 100 %, finally leading to the death of the host plant.

INTRODUCTION

Cydalima perspectalis (Walker, 1859), known as the hairy caterpillar of the buxus, is an invasive species originating in East Asia: China, Japan, Korea, India.

This pest is part of the Order: Lepidoptera, Family: Crambidae, accidentally introduced into Europe from China.

So far, the general view is that, the main route of introduction is the international trade of Buxus plants, and the rapid spread of *Cydalima perspectalis* is most likely caused by the repeated supply of infested plants (Leuthardt et al., 2010; Van der Straten & Muus 2010).

In Europe, it was first reported in 2007 in Germany (Krüger, 2008; Korycinska, & Eyre, 2009), then in the Netherlands (Muuś et al., 2009), Switzerland (EPPO, 2008); Käppeli, 2008), France (Feldtrauer et al., 2009), Great Britain (Mitchell, 2009), Austria (Rodeland, 2009), Liechtenstein (Slamka, 2010), Italy (FEI, 2010), Belgium (Castells et al. (2011), the Czech Republic (Šumpich, 2011) Hungary (Sáfián & Horváth, 2011), Slovenia (Matjaž Jež in Sáfián & Horváth, 2011), Turkey (Hizal et al., 2012) Croatia (Koren & Črne, 2012), Russia (CABI/EPPO, 2012, Matsiakh, 2014), Slovakia (Pastoralis et al., 2013), Denmark (Hobern,2013), Spain (Pérez-Otero et al., 2015), Bosnia-Herzegovina (Ostojic et al., 2015), Greece (Strachinis et al. 2015), Serbia (Konjević et al., 2015), Albania (Mariotti, 2017), quoted by Raineri et. al., 2017).

In Romania, this pest was first reported in 2010 in three different locations in Bucharest (Iamandei, 2010, quoted by Fora & Poşta, 2015). On the territory of Romania was also present: in the north-west part of Bucharest (Székely et al., 2011), Timişoara (Vîrteiu, 2014 and Fora & Poşta, 2015), in other localities in Timiş county (Gugea & Vîrteiu, 2017), Botosani (Balan & Corduneanu,2014), Constanța (Skolka & Zaharia,

2014), Cluj (Bunescu & Florian, 2015), Arad (Don et al., 2016), Satu Mare (Katonea et al., 2016) and Salaj (Katonea et al., 2016, qouted by Gugea & Virteiu, 2017.)

Because of the very high spreading rate, this species is likely to be present in other areas of the country in addition to the above mentioned, the data not yet published.

METHOD AND MATERIAL

The study on the attack and spread of the species *Cydalima perspectalis* Walker on the *Buxus sempervirens* was carried out between July and September 2018.

The first step was achieved by visual inspection and observation of attack on the host plant, then counting and collecting both larvae and adults.

Larvae were collected by hand, and an entomological mesh was used to collect the adults. (figure 1).

Figure 1. Collection of larvae (left) and entomological mesh (right) (original).

The collected biological material was transported to the Entomology Laboratory of the Faculty of Horticulture, the determined larvae belonging to the species *Cydalima perspectalis* (Figure 2).

Figure 2. Growth box (left) and insectarium (right) (original).

RESULTS AND DISCUSSIONS

Buxus sempervirens is one of the most cultivated ornamental species, but in recent years it faces a dangerous pest, *Cydalima perspectalis* Walker.

Infestation symptoms include feeding damage on the leaves of the shoot edges by the larvae, which can leave only leaf skeletons and the epidermis behind them. (Leuthardt and Baur, 2013, quoted by I. Strachinis et al., 2015). Larvae can completely defoliate the host plant and finally lead to its death.

In Craiova, the first attack was detected in July 2018 in the Botanical Garden due to the high defoliation degree of this shrub, and after visual inspection the first larvae were discovered, and attacks were also found in other public areas: in the Red Valley neighborhood in front of a block and on Ştirbei Vodă Boulevard in front of the Art Gallery, and in September in the Beethoven Special Technological High Court.

Other attacks being reported in Olt County in Dobrun commune, in a private yard and in Balş on Station Street.

In August it was also reported in Drănic commune, Dolj County.

The degree of attack on *Buxus sempervirens* shows the presence of the *Cydalima perspectalis* pest at least one year before being reported.

After the first stage of the study, reporting the presence of larvae and the identification of the attacked shrubs, were carried out the second step that of larval collection of different ages (young and mature).

After the species was reported, a number of observations were made regarding the degree of attack on the host plant in order to apply the control measures (Table 1).

Table 1

Spread of the species *Cydalima perspectalis* and the degree of attack on the species *Buxus sempervirens*.

Date	Location	Colletion point	Attack rate (%)
04.07.2018	Craiova, Dolj	Botanical garden	70 %
05.07.2018	Dobrun, Olt	Private yard	100 %
14.07.2018	Dobrun, Olt	Private yard	70 %
09.08.2018	Craiova, Dolj	Street Sărarilor, nr. 33	20 %
15.08.2018	Craiova, Dolj	Boulevard Știrbei Vodă	50 %
14.08.2018	Balș, Olt	Station street	80 %
17.08.2018	Drănic, Dolj	Private yard	50 %
04.09.2018	Craiova, Dolj	În the yard of Special Technological Beethoven high school	90 %

Percentages between 20-100 % indicate the degree of defoliation of the host plant, the lowest degree of attack of 20 % represents a minimal attack of this pest registered on Buxus plants from Sărari Street, no. 33, Craiova, and the one of 100 % was recorded on Buxus plants in a private yard in Dobrun, Olt, (Figure 3).

Figure 3. Total defoliation of *Buxus sempervirens (*original).

We mention that in this location besides the total defoliation, it has been observed that the larvae have also been fed with the bark, causing the death of the host plant (Figure 4).

Figure 4. *C. perspectalis* larvae feeding on bark (original).

We later found that the above mentioned percentages changed, the lack of chemical control increased the degree of attack and the spread of the species at several points, for example in the Botanical Garden, initially the attack was found near the lake, then on 04.09.2018 all existing Buxus bushes were attacked by *Cydalima perspectalis.*

Recognition of the species can be done taking into account the external morphology of the stages of development. Thus, adults can easily be identified with white iridescent wings, and their edges are dark brown with a discoidal spot on the front of the wings (Fora & Poşta, 2015).

Adults of *Cydalima perspectalis* have a wingspan of about 4 cm (Leuthardt and Baur, 2013, quoted by Fora & Poșta, 2015). The body is white with the exception of the head and the last segment of the abdomen, which are brown (Mally & Nuss, 2010), (Figure 5, left.)

Occasionally, melanic forms appear which are completely brown,with the exception of the white discoidal spot on the forewings (Korycinska & Eyre 2011, Sáfián & Horváth 2011, quoted by Szekely et al., 2011) (Figure 5, right).

After mating, the females laid eggs on the leaves of the host plant in groups of 5-20, coated with a translucent jelly (Leuthardt and Baur, 2013, quoted by Fora & Poşta, 2015), initially being pale yellow, but close hatching, the cephalic capsule of the larva can be observed (Fora & Poşta, 2015) .

Figure 5. Adult general appearance *Cydalima perspectalis* (left) and melanin adult general appearance (right) (original)

Larvae are light green, characterized by longitudinal black (thick) and white (thin) stripes and black dots outlined in white on the dorsal side of the body and a bright black head (Figure 6), and in the last larval stage they can reach a length of up to 4 cm. (Szekely et al., 2011, Bella, 2013).

Larvae feed mainly on leaves, but may also attack the bark of the host plant, and young larvae prefer leaves with high alkaloids (older leaves), under natural conditions, young larvae tend to feed on old leaves from the bottom of shrubs (Figure 7), on a strong attack the shrub dries. (Leuthardt and Baur, 2013, quoted by Fora & Poşta, 2015)

Figure. 6. Cydalima perspectalis – larva (original).

Figure 7. Attack produced by larvae on mature leaves (left) and on old leaves at the bottom of shrubs (right) (original).

Pupae are between 1.5 to 2.0 cm long, initially are green with dark stripes on the dorsal surface, towards the end of the growth period can be noticed a dark pattern corresponding to the marginal line of the adult wings (figure 8). They are concealed in a cocoon of white silk spun among the leaves and twigs (Korycinska and Eyre, 2009, quoted by Fora & Poşta, 2015).

Figure 8. Pupal stage of *Cydalima perspectalis* (original)

CONCLUSIONS

Results from research on Cydalima perspectalis and damage caused in the central area of Oltenia reveal that this pest spreads very rapidly, leading to the destruction of the Buxus sempervirens ornamental species of public or private gardens and gardens.

The degree of defoliation may be from a minimum of 100 %, leading to the death of the host plant in a short time, in the absence of control measures.

Particular importance should be attached to species monitoring, and biology must be further studied in order to observe the dynamics of the pest in terms of effective treatments to combat this species.

REFERENCES

Bunescu H., Florian Teodora, 2016, The Box Tree Moth, *Cydalima perspectalis* Walker (Lepidoptera: Crambidae: Spilomelinae) a New Invasive Species in Cluj Area (Romania), *University of Agricultural Sciences and Veterinary Medicine, Faculty of Agriculture, Cluj-Napoca, Romania: 62-65*.

Fora & Poșta, 2015, *Cydalima perspectalis* Walk. (Lepidoptera: Crambidae), a dangerous pest of *Buxus sempervirens* in Timis County, Romania, Journal of Horticulture, Forestry and Biotechnology, Vol. 19 (3), USAMVB Timişoara, 26-32.

Hizal et. al., 2012, The new pest Cydalima perspectalis (Walker, 1859) (Lepidoptera:Crambidae) în Turkey, Journal of Animal And Veterinary Advances 11 (3); 400-403.

Gugea I., Vîrteiu Ana–Maria, 2017, Remains *Cydalima perspectalis* (*Lepidoptera: Crambidae*) an invasive species dangerous for landscaping in western Romania?, Research Journal of Agricultural Science, 49 (4), 135-141.

Strachinis I., Kazilas C., Karamaouna F., Papinikolaou N.E., Partsinevelos G.K. and Milonas P.G., 2015 First record of Cydalima perspectalis (Walker, 1859) (Lepidoptera: Crambidae) in Greece, Hellenic Plant Protection Journal 8: 66-72.

Leuthardt F.L.G., Billen W., Baur B., 2010: Spread of the box-tree pyralid *Diaphania perspectalis* (Lepidoptera: Pyralidae) in the region of Basel - a pest species new for Switzerland. Entomo Helvetica 3:51- 57.

Székely L., Dincă V. & Cristian M. ,2011 Cydalima perspectalis (Walker, 1859), a new species for the Romanian fauna (Lepidoptera: Crambidae: Spilomelinae), Bul.inf. Entomol., 22: 73-78.

Mally R. & Nuss M. (2010) Phylogeny and nomenclature of the box tree moth, *Cydalima perspectalis* (Walker, 1859) comb. n., which was recently introduced into Europe (Lepidoptera: Pyraloidea: Crambidae: Spilomelinae). *European Journal of Entomology* 107: 393-400.

Van der Straten Marja J. & Muus Tymo S.T., 2010, The box tree pyralid, Glyphodes perspectalis (Lepidoptera: Crambidae), an invasive alien moth ruining box trees, *Proc. Neth. Entomol. Soc. Meet.* - VOLUME 21, 107-111.

Raineri et. al., 2017*, Cydalima perspectalis* (Walker, 1859) (Lepidoptera, Crambidae) and the threats for the Nature 2000 Habitat 5110 in Liguaria (NW-ITALY), *Boll. Mus. Ist. Biol. Univ. Genova*, 79, 215-236.

Pérez-Otero R. et. al., 2014, Cydalima perspectalis Walker, 1859 (Lepidoptera, Crambidae): una nueva amenaza para Buxus spp. en la Península Ibérica, Arquivos Eentomolóxicos, 10: 225-228.

Salvatore Bella, 2013, The Box Tree Moth Cydalima perspectalis (WALKER, 1859) Continues to spread in southern Europe: New records for Italy (Lepidoptera Pyraloidea Crambidae), Redia, XCVI, 51-55.

Skolka M., R. Zaharia, 2014, *Cydalima perspectalis* (Lepidoptera: Crambidae) – new invasive species in Constanţa, International Zoological Congress of "Grigore Antipa" Museum 19-22 November 2014, Book of Abstracts, Bucharest, Ed. Medialux, Bucureşti, 181-182.

Koren Toni & Črne Mitja, 2012 The First Record of the box tree moth, Cydalima perspectalis (WALKER, 1859) (Lepidoptera, Crambidae) in Croatia, NAT. CROAT. VOL. 21 No 2 , 507–510.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

STUDIES ON THE MONITORING AND CONTROL OF THE SPECIES METCALFA PRUINOSA SAY (HOMOPTERA: FLATIDAE)

Mitrea Ion[1]*, Stan Raluca[2]

University of Craiova, Faculty of Horticulture;
[2]PhD University of Craiova
*Correspondence author. E-mail: mitreion@gmail.com;

Keywords: *Metcalfa pruinosa, chemical control, monitoring.*

ABSTRACT

Metcalfa pruinosa Say 1830, an invasive species of North American origin, has expanded its area to almost the entire European continent, being also a polyphagous species.

Over the years has been tried to combating the specie through biological control over the mass appearance of the populations of Metcalfa pruinosa, but also chemical combating.

The monitoring and control of this species was carried out in the Botanical Garden of Craiova.

Following the chemical control we performed, we found that the most effective treatment is Nurelle D 50/500 EC.

INTRODUCTION

Metcalfa pruinosa Say 1830, also known as melliferous cicada, belongs to the Flatidae family, being of North American origin, an invasive species extending from the southeast of Canada (Ontario - Quebec) to Florida (Mead, 2004, quoted by Preda & Skolka, 2009)

In Europe, it was first reported in 1979 (Zangheri & Donadini, 1980), France 1986 (Della Giustina, 1987), Spain 1988 (Pons et al., 2002), Slovenia 1990 (Sivic, 1991) (1994), Switzerland 1993 (Jermini et al., 1995), Croatia 1993 (Maceljski et al., 1995), Austria 1996 (Holzinger et al., 1996), Czech Republic 2001 (2004), 2003 (Karsavuran & Guclu, 2004), Hungary 2004 (Penzes et al. 2005), Bulgaria 2004 (Trenchev et al., 2007), Serbia 2006 (Mihajlović, (2009, quoted by Preda & Skolka, 2009).

In Romania it was first reported in Constanta in 2009 (Preda & Skolka, 2009), then in Timisoara (Gogan et al., 2010), Bucharest (Chireceanu & Gutue, 2011) Craiova (Mitrea, 2016).

MATERIAL AND METHOD

The study was conducted between July and September 2018, so we could identify the attacked plants by *Metcalfa pruinosa* in the area of green spaces in Craiova (Botanical Garden, Nicolae Romanescu Park, private gardens, on the streets and in front of the blocks).

In addition to identifying host plants, we made a series of observations and determinations to observe population densities and the degree of attack on plants.

To control the pest, chemical treatments were performed using four insecticides with different chemical bases (anthranilamides, ketoenols, chloronicotins, organophosphorus).

RESULTS AND DISCUSSIONS

Polyphagous species, *Metcalfa pruinosa*, hosts over two hundred species of plants, from spontaneous plants to fruit trees and especially ornamental plants (Pons et al., 2002).

Following the studies we have identified a number of 105 host plants from which 80 plants are identified in the botanical garden and 25 in Nicolae Romanescu Park. This pest is present in most of the green areas in Craiova, parks, private gardens or in front of blocks attacking ornamental plants isolated or cultivated as living fences.

Metcalfa pruinosa has a characteristic appearance, with gregarious behavior, it can easily be recognized by the specific layout of the bark, branches of trees or shrubs, stem, leaves and inflorescences (Figure 1).

Figure 1. The arrangement of branches and leaves of adults and larvae of Metcalfa pruinosa.(original)

This polyphagous planthopper species has become a serious pest in agriculture and public green space by forming dense populations which subsequently cause severe damage in orchards, vineyards, ornamentals and urban areas (Zangheri and Donadini 1980; Girolami and Camporese 1994, quoted by Strauss, 2009).

Large infestations of *M. pruinosa* may weaken the host plants by excessive phloem sucking and honeydew production which supports the growth of sooty moulds on affected plants, resulting in reduced fruit quality and leaf photosynthesis but also in quality damage in ornamentals (Strauss, 2009).

The secretion of sweet substances favors the development of various types of funguses, especially from Fam. Capnodiaceae (Della Giustina and Navarro, 1993, quoted by Preda & Skolka, 2009), named *Capnodium salicinum*, known as fumagin, being a black film, found on the leaves and inflorescences of several wood species such as **Forsythia x intermedia* Vahl, **Buxus sempervirens* L., **Berberis vulgaris* L., *Fraxinus excelsior* L., **Liriodendron tulipifera* L., **Magnolia tripetala* L., **Broussonetia papyrifera* L., **Philadelphus coronarius* L., (Figure 2).

Fig. 2. Leaves covered with *Capnodium salicinum* on *Fraxinus excelsior* L., **Philadelphus coronarius* L., **Magnolia tripetala* L., **Liriodendron tulipifera* L. (from left to right).(original)

This fungus is feding by colonizing the dew layer produced by the cicada and does not directly affect the plant tissues, their damage is indirect because the black layer prevents the light to reaching on leaves, thus diminishing the photosynthesis process.

Regarding the economic impact of this species, *Metcalfa* can cause debilitation of plants affected by various factors (for example, late frost) (Preda & Skolka, 2010), as well as the aesthetic, thus decreasing the ornamental value of the plants attacked.

The limitation of the species spreading in urban green spaces is difficult to achieve (Girolami and Mazzon, 1999, quoted by Preda & Skolka,2009). In the Czech Republic Sumithion used 0.1 % concentration to combat it (Lauterer, 2002, cited by Preda & Skolka, 2009).

Difficulties during chemical combat can be encountered due to three factors:

a) marked polyphagia leads the species to be almost omnipresent and able to pass easily, due to the remarkable mobility of nymphs and adults, from spontaneous vegetation to cultivated plants;

b) the pronounced scatter of egg hatching, which takes about two months and which causes a prolonged coexistence of different stages of development;

c) the substantial waxy layer covering and protecting the juvenile stages. (Pieri, 2007).

Based on these considerations, we proposed to test the biological efficacy of four insecticides (Coragen 20 SC 1.5 ml / 1 liter of water, Movento 100SC 0.05 ml / 0.5 water, Calypso 480 SC 0.5 ml / 5 l water and Nurelle D 50/500 EC 3 ml / 0.5 l water) used against mobile forms (adult and larvae) of the species *Metcalfa pruinosa* found on various host plants in the Botanical Garden.

Insecticides have a systemic effect on mobile stages (adults and larvae) that are affected by contact and ingestion.

Application of insecticides was carried out on 17.07.2018 with a spray atomizer. Observations on the number of adults and live larvae/plant were performed both before treatment and at 24, 48, 72 hours, 7 days and 14 days after treatment.

The results obtained after applying the treatments are presented in Table 1.

Following the treatments and the monitoring of their effect on the *Metcalfa pruinosa* pest, we found out that of the four insecticides used, the best results were recorded on the Nurelle D 50/500 EC product, the effect of which could be observed from 24 hours to its application and has been maintained so far.

The products of Coragen 20 SC, Movento 100 SC and Calypso 480 SC had a low effect in the first 72 hours, and promising results were recorded on the woody plants.

Figure 4. *Pyracantha coccinea* Roem. before and after treatment.(original)

For biological control worldwide, studies have been conducted on the introduction of parasitoid chimenopters from Fam. Drynidae, mainly the parasitic wasp *Neodrynus typhlocybae* (Strauss,2009).

Further releases have been undertaken in the canton of Ticino (Coldrerio and Carasso) in Switzerland (Jermini et al. 2000), in western Slovenia close to the Italian border (Nova Gorica and Volčja Draga) (Žežlina et al. 2001), in Istria in Croatia (Poreč) (Ciglar et al. 1998; B. Barić, pers. comm.), and in southern France (Malausa et al. 2003), as well as in Catalonia and Valencia in Spain (A. Soto Sanchez, pers. comm., quoted by Strauss,2009).

Promising results were obtained both in Italy, France and Slovenia (Girolami and Conte, 1999; Villani and Zandigiacomo, 1999; Malausa et al., 2000; Žežlina et al., 1998, quoted by Strauss, 2009).

Table 1.

Influence of application of insecticides on the number of mobile forms (adults and larvae) existing on the host plant

Nr. crt.	Host plant name	Number of mobile forms (adults and larvae) on the host plant before and after treatment					
		Before tratment	After 24 h	After 48 h	After 72 h	After 7 days	After 14 days
Nurelle D							
1	**Pyracantha coccinea* Roem.	37 A 80 L	1 A	0	0	0	0
2	*Iris* sp. L.	8 A 180 L	0	0	0	0	0
Coragen							
1.	*Acer platanoides* L.	75 A 80 L	67 A 80 L	50 A 80 L	45 A 75 L	55 A 70 L	40 A 28 L
2.	*Cephalaria uralensis* (Murray) Roem.&Schult	5 A 56 L	5 A 50 L	2 A 30 L	2 A 25 L	8 L	12 A 2 L
3.	*Amorpha fruticosa* L.	15 A 45 L	15 A 45 L	8 A 25 L	1 A 20 L	1 A 10 L	8 A
4.	**Iris* sp. L.	45 A 130 L	45 A 80 L	25 A 65 L	20 A 40 L	30 A 45 L	15 A 20 L

Nr. crt.	Host plant name	Number of mobile forms (adults and larvae) on the host plant before and after treatment					
Movento							
1.	*Salvia* sp. L.	2 A 15 L	1 A 20 L	2 A 18 L	2 A 15 L	7 A 25 L	10 A 32 L
2.	**Hosta plantaginea* (Lamarck) Ascherson	40 L	1 A 45 L	4 A 50 L	2 A 50 L	7 A 50 L	8 A 25 L
3.	*Cephalaria uralensis* (Murray) Roem.&Schult	8 A 40 L	8 A 37 L	10 A 30 L	14 A 28 L	50 A 35 L	70 A 15 L
Calypso							
1	**Rudbeckia fulgida* Aiton	10 A 45 L	8 A 40 L	7 A 37 L	8 A 35 L	12 A 25 L	15 A 20 L
2	*Prunus cerasifera* Ehrh.	5 A 50 L	5 A 40 L	3 A 27 L	3 A 20 L	2 A 6 L	1 A
3	*Amorpha fruticosa* L.	15 A 40L	13 A 35 L	10 A 22 L	10 A 20 L	6 A	3 A

Legend: h- hours; A - Adults; L – Larvae.

Also in the literature are mentioned different natural enemies consuming M. pruinosa, especially from Fam. Coccinellidae (Coleoptera) e.g. Coccinella septempunctata (L., 1758), Miridae (Hemiptera) and Chrysopidae (Neuroptera), as well as various bird species (Barbattini et al., 1991, Greatti et al. 1994, quoted by Strauss, 2009).

CONCLUSIONS

Throughout the study, we met a total of 105 host species in the Craiova area.

In the chemical control, the best result was recorded at the Nurelle D 50/500 EC, the results still being maintained.

Because of the colonization of as many host species in the Oltenia area, it is necessary to carry out new treatments for the reduction of the *M. pruinosa* population and the damage caused.

Studies on chemical control of the species should be continued to find the best product so as to reduce the spread of this pest.

REFERINCES

Chireceanu Constantina, Gutue C., 2011 , Metcalfa pruinosa (Say) (Hemiptera: Flatidae) Identified in a new south eastern area of Romania (Bucharest area), Romanian Journal of Plant Protection Vol. 4, 28-34.

Preda Cristina, Skolka M., 2009, First record of a new alien invasive species in Constanţa -Metcalfa pruinosa (Homoptera: Fulgoroidea), Lucrările Simpozionului Mediul şi agricultura în regiunile aride, Prima ediţie, 141-146.

Pieri F., 2007, L'introduzione accidentale di insetti esotici: il caso del flatide neartico Metcalfa pruinosa (say) (Homoptera- Fulgoroidea), Università di Pisa, Facolta' di Agraria: 20- 35.

Gogan Alina, Grozea Ioana, Virteiu Ana Maria and Baghina N., 2013, Flatid plant hopper (Metcalfa pruinosa Say) a new dangerous insect pest of ornamental and agricultural plants in Romania, Journal of Food, Agriculture & Environment Vol.11 (3&4) : 2065 - 2070.

Strauss G., 2011, Environmental risk assessment for Neodryinus typhlocybae, biological control agent against Metcalfa pruinosa, for Austria, European Journal of Environmental Sciences, Vol. 2, No. 2, 102-109.

Grozea et al. 2011, Metcalfa pruinosa Say (insecta: homoptera: flatidae): A new pest in Romania, African Journal of Agricultural Research Vol. 6(27) , 5870-5877.

Mitrea I. 2016, *Metcalfa pruinosa* (Homoptera: Fulgoroidea), new and dangerous pest in lawn of Oltenia, Annals of Unifersity of Craiova, Vol:XXI (LVII), 573-578.

Pons X. et al. 2002, *Metcalfa pruinosa* (Say) (Homoptera: Flatidae), ¿una plaga potencial de plantas ornamentales en espacios verdes urbanos de Cataluña?, Bol. San. Veg. Plagas, 28: 217-222

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE COLLECTION OF ROSES FROM THE BUCHAREST "DIMITRIE BRÂNDZĂ" BOTANICAL GARDEN. PAST, PRESENT AND FUTURE.

Marius Negulici[1]*

[1]Bucharest Botanical Garden – Bucharest University
**Correspondence author e-mail:* marius.negulici@gmail.com

Keywords: *roses, botanical garden, Bucharest, Romania.*

ABSTRACT

The present paper aims to present some aspects from the Bucharest "Dimitrie Brandza" Botanical Garden rose collection history.

Throughout time, the rosary, much like the Botanical Garden, went through several radical changes. Data gathered showed that, before the second World War, the rose collection was located where today we find the Green Houses. There was also a significant change in variety and number of rosebushes, with the current collection hosting more than 4000 rosebushes and more than 200 varieties.

INTRODUCTION

Roses through the gentleness of the petals, but also through the scent of aromas, from fruits to spices, have always fascinated generations throughout time; it is common knowledge that when someone receives flowers, the primary reaction is to smell the perfume. Roses also occupy an important place in any landscaping design; there are almost no parks or gardens that do not have roses that, in combination with other plant species, especially in lawns, offer a wonderful painting, whether planted in singles, arches or massive. Roses have delighted and attracted visitors to enjoy their beauty and marvel at the atmosphere created by both color and perfume, for years and years.

The founding of the Botanical Garden is mainly due to the initiative of Dr. Carol Davila, former head of the School of Medicine and Pharmacy, which preceded the current Faculty of Medicine. Since 1855, when the school was known as the Mihai Vodă Surgery School, he insisted that Ştirbei Vodă would establish a Botanical Garden. With all the events of 1859 with the Unification of the Principalities under a single ruler, it was decided that the works to establish a botanical garden would begin in 1860, when the Cotroceni Botanical Garden was inaugurated on November 5th (Ionescu, 1902).

According to documents found in the Botanical Museum, the Rosary was founded in 1886 (Fig. 1.), after the return of the Botanical Garden in Cotroceni. Between 1874-1886 (Fig. 2.) the garden was relocated near Vasile Şuţu Palace (Diaconescu 1981).

Fig. 1. The period (1874-1886) when the garden was relocated
(The Museum of Botanical Garden)

Fig. 2. The Botanical Garden plan in 1886 (The Museum of Botanical Garden)

Fig. 3. Aspects from the Rosary before the Second World War
(The Museum of Botanical Garden)

The first data on the Botanical Garden rosary refers to the way it was organized and its location within the premise. The place where it was originally designed and setup is the place where today we find the Green Houses (Fig.3.); back then the rosary hosted 200 varieties of roses. The photos found in the Botanical Museum show that there was an

important collection of roses grafted in the trunk, but also important varieties of thea hybrids, floribunda, polyantha, etc. (Ionescu, 1902).

During the bombing of World War II in the Botanical Garden, 96 bombs were dropped destroying almost everything in their path. The holes resulting from the bombing were, unfortunately, filled especially with debris from the rubble of the Capital, causing a poor soil quality, a problem which still persists in certain areas. (Săvulescu, 1961; Tarnavschi, 1961).

With the construction of the new greenhouses between 1976-1978 (Fig.4.), the Rosary was moved and restored by planting over 100 new varieties on to the place where it is still stands today, with the help of Liuba Tipa, who was the coordinator (Diaconescu 1981).

Fig. 4. The Botanical Garden rosary in 1978
(Photo L. Ţipa)

An important step in the past few years happened in 2008 when the Botanical Garden management started rebuilding the rosary, by rehabilitating the aisles, constructing arches and bringing in and planting about 900 new roses, representing about 100 new varieties (Fig 5,6.).

At present the rosary covers an area of approx. 0.7 ha and includes about 4000 rosebushes, of which 200 varieties and 7 specie (*Rosa arvensis* Huds., *Rosa galica* L., *Rosa jundzillii* Besser., *Rosa alba* L. *Rosa sempervirens* L. *Rosa wichurana* Crép., *Rosa virginiana* Mill.).

On the main avenue, from the gate on the left, immediately after the "Mediterranean plants" sector, we see the group of species from the Fabaceae family (*Cercis siliquastrum* L., *Cladastris lutea* Koch., *Gymnocladus dioica* (L.) C. Koch.), "History of Roses" (Fig.7.), which attempt to present 30 years of variety evolution. It is mainly composed of *Rosa gallica* L. and varieties such as 'Rose de Recht', 'The Fairy', 'Crimson Glory', 'Masquerade', 'Peace', 'Queen Elizabeth', 'Super Star', 'Nina Weibul', 'Pascali' 'Mister Lincoln'.

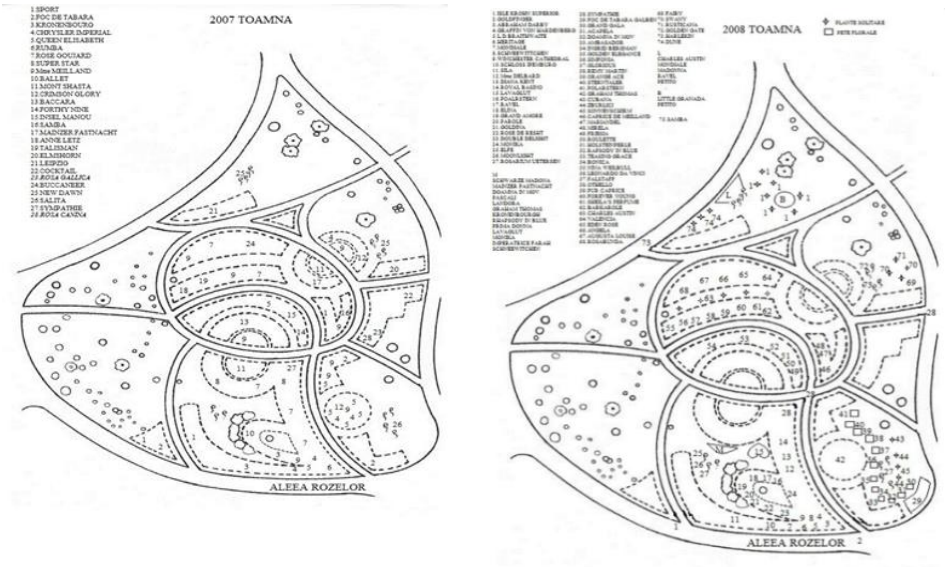


Fig. 5. Rosary plan 2007-2008 (orig.)

If we visit the Rosary on the main aisle, in front of the exhibition greenhouses (Fig.8.), we are greeted on the left by a mini-collection of English roses that is distinguished by the way the flowers (peony) are opened, by the shape of the rosebushes and by their perfume ('Abraham Darby' which has peach fragrance). Next, along the alley, we find the 'Chrysler Imperial' group that dazzles us with the fragrance that reminds us of grandmother's garden, followed by 'Queen Elizabeth'. On the right we find a red and yellow 'Foc de Tabără'. It is the beginning of a Japanese-style arrangement in which we find varieties such as 'Grand Gala', 'Doamna în Mov', 'Acapella', 'Remy Martin' and 'Sterntaler'.

Still on the left side, we have 'Madame Delbard' in dark red color, and next to the lavender bushes we have a huge heart made of about 50 red roses of the 'Lavaglut' variety. Moving along on the aisle we have some new varieties that were planted in 2016 like 'Chartreuse de Parme', 'Heather Austin', 'Pat Austin', 'Paul Gaugain', 'Pierre Arditi'. Immediately we pass under an archway of roses from the 'Sympathie' variety and find on the left several varieties from the old collection like 'Baccara', 'Mount Shasta' or 'Peace'. On the right we have a special kind called 'Caprice de Meilland' which impresses us through the delicacy of pink petals and its sweet fragrance. We walk along the alley and on the left and we find a variety called 'Rhapsody in Blue', whose fragrance reminds us of grandmother's perfume.

Fig.6. Aspects from the rehabilitation of the aisles and the construction of arches (orig.)

If we visit the Rosary on the main aisle, in front of the exhibition greenhouses (Fig.8.), we are greeted on the left by a mini-collection of English roses that is distinguished by the way the flowers (peony) are opened, by the shape of the rosebushes and by their perfume ('Abraham Darby' which has peach fragrance). Next, along the alley, we find the 'Chrysler Imperial' group that dazzles us with the fragrance that reminds us of grandmother's garden, followed by 'Queen Elizabeth'. On the right we find a red and yellow 'Foc de Tabără'. It is the beginning of a Japanese-style arrangement in which we find varieties such as 'Grand Gala', 'Doamna în Mov', 'Acapella', 'Remy Martin' and 'Sterntaler'.

Fig. 7. Some aspects from the "History of Roses" (orig.)

Still on the left side, we have 'Madame Delbard' in dark red color, and next to the lavender bushes we have a huge heart made of about 50 red roses of the 'Lavaglut' variety. Moving along on the aisle we have some new varieties that were planted in 2016 like 'Chartreuse de Parme', 'Heather Austin', 'Pat Austin', 'Paul Gaugain', 'Pierre Arditi'. Immediately we pass under an archway of roses from the 'Sympathie' variety and find on the left several varieties from the old collection like 'Baccara', 'Mount Shasta' or 'Peace'. On the right we have a special kind called 'Caprice de Meilland' which impresses us through the delicacy of pink petals and its sweet fragrance. We walk along the alley and on the left and we find a variety called 'Rhapsody in Blue', whose fragrance reminds us of grandmother's perfume.

One of the next steps for the collection, will be to create a special area honoring the late great breeder Dr. Ştefan Wagner, but also setting up a rose nursery for grafting.

Fig 8. Aspects from the rosary (orig.)

CONCLUSIONS

- The first documents about the Rosary sector date back to 1886, which shows that it was established after the return of the Botanical Garden in Cotroceni;
- The documents show that between 1886 and 1944 there was an important collection of roses, which consisted of about 200 varieties and was situated on the site where the Exhibition Green Houses are today;
- During the period 1976-1978 the Rosary sector was moved, with the construction of the Exhibition Green Houses where it is still today;
- In the period between 2008 and 2010 the reorganization and enrichment of the present collection was 80 % redone by introducing 150 new varieties, represented by 2500 rosebushes;
- Among the projects for rehabilitation and improvement of the landscape aspect we can mention:
  - The "History of Roses" - the attempt to present through the varieties of roses, how they evolved under the "guidance" of specialists over time, from the year 1840 ('Rose de Rescht') until 2001 with 'Parole';
  - The archway - Variety of roses of different colors arranged in arches that form a multicolored aisle;
  - Rehabilitation of brick paths to complete the painting offered by the variety of colors;
- Now there are more than 200 varieties represented by 4000 rosebushes covering an area of 0.7 ha;

REFERENCES

Diaconescu V. 1981. Gradina Botanică din Bucureşti — 120 de ani de activitate neîntreruptă, Acta Botanica Horti Bucurestiensis 1979-1980, pp 3-17.

Ionescu G.M. 1902. Istoria Cotrocenilor, Lupescilor (Sf. Elefterie) şi Grozăvescilor, pp. 7-8.

Săvulescu T. 1961. Gânduri cu prilejul centenarului Grădinii Botanice din Bucureşti. Acta Botanica Horti Bucurestiensis, pp 7-8.

Tarnavschi I.T. 1961. Grădina Botanică din Bucureşti la împlinirea unui veac de existenţă. Acta Botanica Horti Bucurestiensis, pp 9-22.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

HYPERURICEMIA AND ITS CORRELATION WITH METABOLIC SYNDROME

Olaru Mariana Luminiţa[1]*

[*]University of Craiova, Biology Department, Al.I.Cuza 13, 200 585, Craiova
**E-mail*: luminitaolaru@yahoo.com

Keywords*: hyperuricemia, metabolic syndrome, triglycerides*

ABSTRACT

Metabolic syndrome, also known as syndrome X or dysmetabolic syndrome, refers to a cluster of metabolic conditions that can lead to heart disease. The underlying causes of metabolic syndrome include overweight and obesity, physical inactivity, genetic factors and getting older.

Hyperuricemia is commonly associated with obesity, glucose intolerance, hypertension, dyslipidemia, and atherosclerotic cardiovascular disease. The resemblance of the metabolic syndrome and hyperuricemia has led to the suggestion that hyperuricemia is a part of the metabolic syndrome.

This study shows serum uric acid is markedly associated with metabolic syndrome and its components, in particular serum triglycerides, HDL-C and serum glucose.

INTRODUCTION

Metabolic syndrome is a combination of metabolic abnormalities that pose an increased risk of cardiovascular disease including: insulin resistance, hyperinsulinemia, hypertriglyceridemia, HDL-cholesterol lowering and hypertension.

(http://rmj.com.ro/articles/2010.3/RMR_Nr-3_2010_Art-3.pdf)

The contribution to the establishment of appropriate terminology was brought by the World Health Organization (WHO) which in 1998 launched its first definition. According to the WHO, metabolic syndrome is glucose intolerance (IGT) or diabetes mellitus and / or insulin resistance plus two or more of the components: high blood pressure > 140/90 mmHg; serum triglycerides > 150 mg/dl and/or low HDL cholesterol < 35 mg/dl in men and < 39 mg/dl in women; abdominal obesity: hip ratio > 0,90 in men and > 0,85 in women, BMI > 30 kg/m^2; microalbuminuria > 20 μg minimum.

Approximately 20 %-30 % of the population in industrialized countries has metabolic syndrome.

(https://www.webmd.com/heart-disease/guide/metabolic-syndrome#3)

The "National Cholesterol Education Program Adult Treatment Panel III" identifies metabolic syndrome as a constellation of clinical elements associated with an increased risk of developing type 2 diabetes and atherosclerotic cardiovascular disease (Ramos et al. 2001).

Any three of the following traits in the same person meet the criteria for the metabolic syndrome(Alberti 2009): abdominal obesity white race (CA-CA ≥ 94 cm in men / ≥ 80 cm in women); serum triglycerides ≥ 150 mg/dl; HDL-cholesterol < 40 mg/dl in men and < 50 mg/dl in women; blood pressure of 130/85 or above; glycemia ≥ 100 mg/dl.

There are authors who used two definitions of metabolic syndrome (Chinali et al. 2008) one for adults with both supporters and opponents and the second, pediatric

definition used in children and adolescents. For these, in the period of growth and development, it is impossible to choose a single threshold value for a variable considered risk factor (Daniels 2008).

Regardless of how it is defined, metabolic syndrome is a significant predictor of diabetes. Among its components, impaired fasting glucose is generally considered to be the most predictive predictor of diabetes mellitus (Cheung et al. 2007).

The metabolic syndrome, which is a cumulative risk factor that causes cardiovascular disease and diabetes (abdominal obesity, dyslipidemia, hypertension, altered glucose tolerance) is well defined in adults and its frequency is estimated at about 25 % of the population.

(http://rjp.com.ro/articles/2011.3/Pedia_Nr-3_2011_Art-9.pdf)

The concept of metabolic syndrome, though controversial, continues to gain acceptance, as a major health problem in the world.

Each component of the metabolic syndrome is actually a factor that can cause increased cardiovascular risk, but also moderate expression of metabolic syndrome components is a higher risk for cardiovascular disease than their isolated presence.

Further elements of the metabolic syndrome not found in the defined criteria (proinflammatory and prothrombotic status, insulin resistance) are determinants of increased cardiovascular risk.

(http://www.umfiasi.ro/scoaladoctorala/tezedoctorat/teze%20doctorat/rezumat%20preda%20maria%20ecaterina.pdf)

Excess fat in the stomach area is a greater risk factor for heart disease than excess fat in other parts of the body, such as on the hips. The risk for metabolic syndrome increases with age is highest in the population over 65 years.

(https://www.nhlbi.nih.gov/health-topics/metabolic-syndrome)

Hyperuricemia, the major etiologic factor in gout is an excess of uric acid in the blood (http://chemocare.com/chemotherapy/side-effects/hyperuricemia-high-uric-acid.aspx).

Because is an increasingly common medical problem not only in the advanced countries, but also in the developing countries, hyperuricemia may play a role in the development and pathogenesis of a number of metabolic, hemodynamic, and systemic pathologic diseases, including metabolic syndrome, hypertension, stroke, and atherosclerosis (Billiet et al. 2014).

In recent years there has been a renewed interest in hyperuricemia and its association with a number of clinical disorders other than gout, including hypertension, atherosclerosis, cardiovascular disease, and chronic kidney disease. It has been described that hyperuricemia is associated with metabolic syndrome components (Conen et al. 2004, Schachter 2005), such as obesity, glucose intolerance, dyslipidemia, hyperglycemia and hypertension (Chen et al. 2007, Billiet et al. 2014).

The resemblance of the metabolic syndrome and hyperuricemia has led to the suggestion that hyperuricemia is a part of the metabolic syndrome (Liou et al. 2006).

MATERIAL AND METHODS

The purpose of our study was to investigate the prevalence of hyperuricemia and the association between uric acid levels and the various metabolic syndrome components.

The present paper is based on a retrospective statistical study comprising a group of patients tested between December 2017 and June 2018, who presented themselves at the Medical Analysis Laboratory Priority Medical, Craiova during the aforementioned period for the determination values of serum uric acid concentrations. Uric acid (UA) determinations values were also correlated with serum triglycerides (TRI),

serum HDL cholesterol (HDL-C) and serum glucose (GLU) determination values of the same patients.

The values of these indices were determined with the Biosystems A15 automatic analyzer. Method used for serum trigycerides, HDL cholesterol, glucose and uric acid dosage in clinical practice is the spectrophotometric method.

The present study has as a data source of analyzes the results included in worksheets. In the final analysis were included a total of 117 subjects, men (M) and women (W), aged between 21 and 85 years.

Individuals in the study were divided according to clinical criteria, normal or pathological results of trigycerides (TRI), HDL cholesterol (HDL-C), glucose (GLU) and uric acid (UA) determinations, epidemiological criteria, gender (80 men subjects and 37 women subjects), and age groups (21-40 years, 41-60 years, 61-85 years of the patients (reviewed in the analysis report of each patient).

Through the statistical processing of the results from the analysis bulletins a data base was developed which was used for their graphical and tabular representation, interpretation and discussion of the results, as well as draw conclusions by reading them.

RESULTS AND DISCUSSIONS

In an adult, normal values of trigycerides (TRI) are under 150 mg/dl, and normal values of glucose (GLU) are from 70 to 105 mg/dl.

According to their serum levels of HDL cholesterol (HDL-C), the participants were categorized into 3 groups, as follows: low risk (LR) - HDL-C > 60 mg/dl, average risk (AR) - HDL-C from 40 to 60 mg/dl and high risk (HR) - HDL-C < 40 mg/dl.

Normal values of uric acid (UA) were also categorized into 2 groups, as follows: men < 7 mg/dl, women < 5,7 mg/dl.

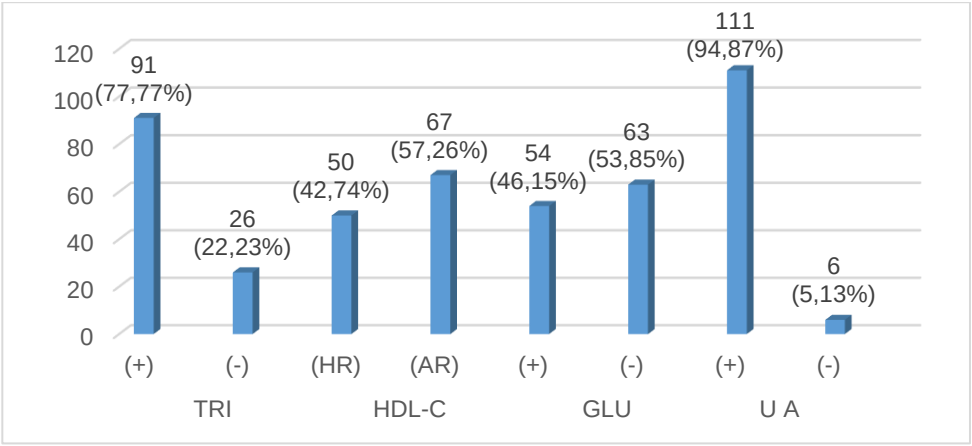
An analysis of the subjects' distribution according to the positive (+) and negative (-) results of the determinations (Table 1, Graphic 1), showed an imbalance in the uric acid (U A) values, the number of patients with positive values, 111 (94,87 %), being much higher of the negative one, 6 patients (5,13 %).

The distribution of subjects according to the positive and negative results of triglyceride (TRI) determinations indicates that a large number of individuals 91 (77,77 %) showed positive values (+), the remaining, 26 (22,23 %), having negative values (-) (Table 1, Graphic 1).

Table 1

Gender dynamics of positive (+) and negative (-) values of triglycerides (TRI), HDL cholesterol (HDL-C), glucose (GLU) and uric acid (UA)

TRIGLYCERIDES				**HDL-CHOLESTEROL**				**GLUCOSE**				**URIC ACID**			
(+)		**(-)**		**(HR)**		**(AR)**		**(+)**		**(-)**		**(+)**		**(-)**	
M	W	M	W	M	W	M	W	M	W	M	W	M	W	M	W
63	**28**	**17**	**9**	**31**	**19**	**49**	**18**	**29**	**25**	**51**	**12**	**74**	**37**	**6**	**0**
91 (77,77 %)		**26 (22,23 %)**		**50 (42,74 %)**		**67 (57,26 %)**		**54 (46,15 %)**		**63 (53,85 %)**		**111 (94,87 %)**		**6 (5,13 %)**	



Graphic 1. The dynamics of positive (+) and negative (-) values of triglycerides (TRI), HDL cholesterol (HDL-C), glucose (GLU) and uric acid (UA)

Concerning HDL-C risk group assignment revealed that of the 117 investigated individuals none of them were in the low-risk group. In contrast, the number of average-risk (AR) individuals, 67, recorded the highest percentage (57,26 %), the remaining 50 being the high-risk (HR) individuals, 42,74 % (Table 1, Graphic 1).

Regarding serum glucose (GLU), 63 individuals (53,85 %) were in normal range (-), compared with 54 individuals (46,15 %) who had elevated blood glucose levels (+) (Table 1, Graphic 1).

In conclusion, of the 111 patients (94,87 %) with hyperuricemia, 91 of them (77,77 %) had hypertriglyceridemia, 60 patients (42,76 %) were at high risk of HDL-C, and 54 individuals (46,15 %), had hyperglycemia.

Hyperuricemia has been correlated with three components of metabolic syndrome (hypertriglyceridemia, high risk HDL-C, hyperglycemia) (Table 2).

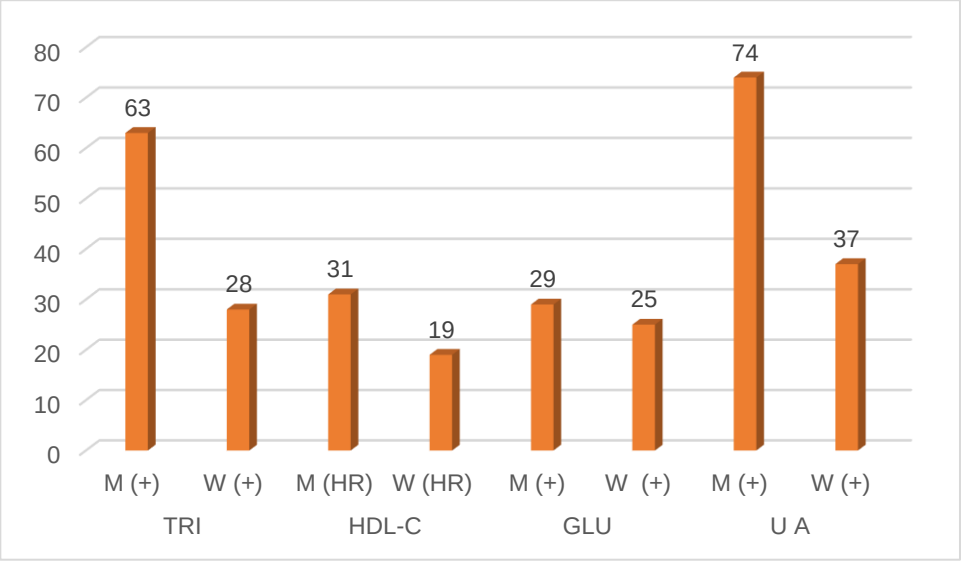
The results of this study show a significant correlation between hyperuricemia and hypertriglyceridemia.

Regarding the gender distribution of patients with positive values of the four indices (Table 2, Graphic 2), women occupy the highest percentage of all determinations, except for hypertriglyceridemia, which is approximately equal to men and women.

Table 2

The dynamics by gender and the age group of the patients number with positive values (+) of triglycerides (TRI), HDL cholesterol (HDL-C), glucose (GLU) and uric acid (UA)

Age group	**TRIGLYCERIDES**		**HDL-CHOLESTEROL**		**GLUCOSE**		**URIC ACID**	
	M (+)	W (+)	M (HR)	W (HR)	M (+)	W (+)	M (+)	W (+)
21-40 years	25 (39,68 %)	1 (3,57 %)	9 (29,03 %)	1 (5,26 %)	3 (10,35 %)	3 (12 %)	24 (32,44 %)	3 (8,11 %)
41-60 years	29 (46,03 %)	12 (42,86 %)	9 (29,03 %)	8 (42,10 %)	15 (51,72 %)	10 (40 %)	34 (45,94 %)	15 (40,54 %)
61-85 years	9 (14,29 %)	15 (53,57 %)	13 (41,94 %)	10 (52,64 %)	11 (37,93 %)	12 (48 %)	16 (21,62 %)	19 (51,35 %)
TOTAL	63 (78,75 %)	28 (75,67 %)	31 (38,75 %)	19 (51,35 %)	29 (36,25 %)	25 (67,56 %)	74 (92,5 %)	37 (100 %)

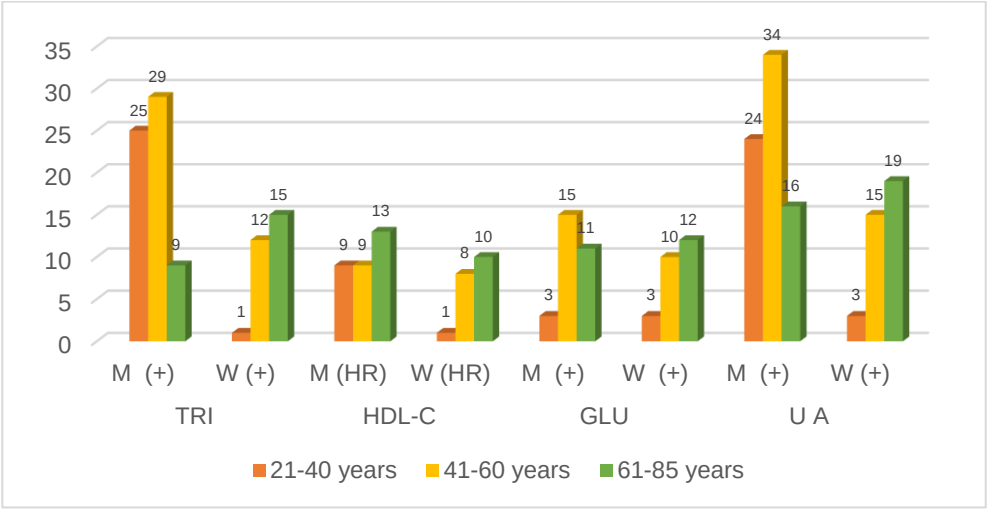


Graphic 2. Gender dynamics of the patients number with positive values (+) of triglycerides (TRI), HDL cholesterol (HDL-C), glucose (GLU) and uric acid (UA)

In individuals of the study group, hyperuricemia was met in the proportion of 92,5 % in men and in the maximum percentage of 100 % in women (Table 2).

On the contrary, a study by chinese researchers showed that hyperuricemia was more common in men (19,07 %) than in women (3,42 %) (Chen et al. 2007).

High differences were observed in the age group and gender distribution of the same subjects with positive (+) values determinations (Table 2, Graphic 3).



Graphic 3. The dynamics by gender and the age group of the patients number with positive values (+) of triglycerides (TRI), HDL cholesterol (HDL-C), glucose (GLU) and uric acid (UA)

In the 41-60 age group, hyperuricemia occurs in approximately equal proportions in both sexes, 45,94 % in men, and 40,54 % in women. In the 21-40 age group, hyperuricemia occurs in a higher percentage in men, 32,44 %, compared with only 8,11 % in women. The situation is reversed in the age group 61-85 years, where the higher percentage is for women, 51,35 %, compared with only 21,62 % for men (Table 2).

Conen et al. 2004 showed the same results. The prevalence of a serum uric acid level in men was 35,2 % and the prevalence of a serum uric acid level was 8,7 % in women. Serum uric acid was strongly related to serum triglycerides in men as well as in women.

According to a study of Chinese researchers the contribution of uric acid as an additional component of the metabolic syndrome in middle-aged men seems to be insignificant (Liou et al. 2006).

The situation is similar in patients with hypertriglyceridemia. Thus, in the 41-60 age group, hypertriglyceridemia occurs in approximately equal proportions in both sexes, 46,03 % in men, and 42,86 % in women. In the 21-40 age group, hypertriglyceridemia occurs in men, 39,68 %, versus only 3,57 % in women. The situation is reversed in the age group 61-85 years, where the higher percentage is for women, 53.57 %, compared with only 14.29 % for men (Table 2).

With regard to HDL-C, the age group 21-40 years is at high-risk only 5,26 % of women, the remaining 29,03 % being men. In the other two age groups the situation is reversed, the percentage of women being higher for both - the 41-60 age group, 42,10 % women and 29,03 % men and for the age group 61-85 years – 52, 64 % women and 41,94 % men (Table 2).

These correlations were similar to those in the literature.

Not only collectively, but also individually, hypertension, obesity, dyslipidemia, hyperglycemia, and insulin resistance are positively correlated with serum levels of uric acid (Billiet et al. 2014).

The research data of Schachter 2005 and Chen et al. 2007, showed the same results and indicated that serum triglyceride was markedly associated with hyperuricemia. Hyperuricemia and hypertriglyceridemia are suggested to be associated with insulin resistance syndrome.

Bușu et Stolear studied the impact of hyperuricemia on metabolic syndrome components. A direct proportional correlation of hyperuricemia and hypertriglyceridemia has been observed in the study group.

Also, HDL-C values were significantly lower in these patients (http://library.usmf.md:8080/jspui/bitstream/123456789/255/1/SINDROMUL%20METABOLIC%20%C5%9EI%20HIPERURICEMIA.pdf).

In the study of Chen et al. 2007, uric acid was negatively correlated with serum HDL-C, but this association was not evident among women.

Differences were also observed with respect to the positive (+) values of serum glucose measurements. Women occupy a smaller percentage in the 41-60 years age group, 40 %, compared to 51,72 % in men. The 21-40 age group recorded approximately equal percentages, 12 % for women and 10,35 % for men, whereas in the 61-80 age group, women recorded much higher values, 48 %, against men, 37,93 % (Table 2).

Yoo et al. 2005 reported that hyperglycemia was a remarkable risk factor for hyperuricemia. Serum uric acid concentration was found to be independently correlated with insulin resistance and the risk factors of metabolic syndrome (Yoo et al. 2005).

Hyperuricemia predicts the development of hypertension, obesity, and type 2 diabetes mellitus (Billiet et al. 2014).

CONCLUSIONS

Metabolic syndrome is a cluster of conditions: increased blood pressure, high blood sugar, excess body fat around the waist, and abnormal cholesterol or triglyceride levels, that occur together, increasing risk of heart disease, stroke and diabetes.

Hyperuricemia, the excess of uric acid in the blood is commonly associated with obesity, glucose intolerance, hypertension, dyslipidemia, and atherosclerotic cardiovascular disease.

The resemblance of the metabolic syndrome and hyperuricemia has led to the suggestion that hyperuricemia is a part of the metabolic syndrome.

Hyperuricemia is an increasingly common medical problem not only in the advanced countries, but also in the developing countries.

This study shows serum uric acid is markedly associated with metabolic syndrome and its components, in particular serum triglycerides, HDL-C and serum glucose.

REFERENCES

Alberti K.G., Eckel R.H., Grundy S.M., Zimmet P.Z., Cleeman J.I., Donato K.A., Fruchart J.C., James W.P., Loria C.M., Smith S.C. Jr., 2009, Harmonizing the metabolic syndrome. Circulation 120(16):1640-5. Available online at https://www.ncbi.nlm.nih.gov/pubmed/19805654

Billiet Laura, Doaty Sarah, Katz J.D., Velasquez M.T., 2014, Review of Hyperuricemia as New Marker for Metabolic Syndrome. ISRN Rheumatology, Article ID 852954. Available online at

https://www.hindawi.com/journals/isrn/2014/852954/

Chen L.Y., Zhu W.H., Chen Z.W., Dai H.L., Ren.J.J., Chen J.H., Chen-Qian L., Zheng L.F., 2007, Relationship between hyperuricemia and metabolic syndrome. J Zhejiang Univ Sci B.; 8(8):593–598. Available online at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1934956/

Cheung B.M., Wat N.M., Man Y.B., Tam S., Thomas G.N., Leung G.M., Cheng C.H., Woo J., Janus E.D., Lau C.P., Lam T.H., Lam K.S., 2007, Development of diabetes in chinese with the metabolic syndrome. Diabetes Care, 30(6):1430-6. Available online at

https://www.ncbi.nlm.nih.gov/pubmed/17337491

Chinali M., de Simone G., Roman M.J., Best L.G., Lee E.T., Russell M., Howard B.V., Devereux R.B., 2008, Cardiac markers of preclinical disease in adolescents with the metabolic syndrome: the strong Heart Study. *J. Amer, Coll Cardiol*; 52:932–938. Available online at

http://www.onlinejacc.org/content/accj/52/11/932.full.pdf

Conen D., Wietlisbach V., Bovet P., Shamlaye C., Riesen W., Paccaud F., Burnier M., 2004, Prevalence of hyperuricemia and relation of serum uric acid with cardiovascular risk factors in a developing country. BMC Public Health.; 4(1):9. Available online at https://www.ncbi.nlm.nih.gov/pubmed/15043756

Daniels S.R., 2008, Metabolic syndrome and cardiovascular abnormalities in Children. J. Am Coll. Cardiol., 52(11):939-40. Available online at https://www.ncbi.nlm.nih.gov/pubmed/18772066

Liou T.L., Lin M.W., Hsiao L.C., Tsai T.T., Chan W.L., Ho L.T., Hwu C.M., 2006, Is Hyperuricemia Another Facet of the Metabolic Syndrome?, Journal of the Chinese Medical Association, Volume 69, Issue 3, pp 104-109. Available online at

https://www.sciencedirect.com/science/article/pii/S1726490109701868

Ramos F., Baglivo H.P., Ramirez A.J., Sánchez R., 2001, The metabolic syndrome and related cardiovascular risk. Current Hypertension Reports, 3: 100-106. Available online at https://www.ncbi.nlm.nih.gov/pubmed/11276389

Schachter M., 2005, Uric acid and hypertension. Curr Pharm Des; 11(32):4139–4143. Available online at

https://www.ncbi.nlm.nih.gov/pubmed/16375735

Yoo T.W., Sung K.C., Shin H.S., Kim B.J., Kim B.S., Kang J.H., Lee M.H., Park J.R., Kim H., Rhee E.J., Lee W.Y., Kim S.W., Ryu S.H., Keum D.G., 2005, Relationship between serum uric acid concentration and insulin resistance and metabolic syndrome. Circ J.; 69(8):928–933. Available online at

https://www.ncbi.nlm.nih.gov/pubmed/16041161

***http://chemocare.com/chemotherapy/side-effects/hyperuricemia-high-uric-acid.aspx

***http://library.usmf.md:8080/jspui/bitstream/123456789/255/1/SINDROMUL%20METABOLIC%20%C5%9EI%20HIPERURICEMIA.pdf

***http://rjp.com.ro/articles/2011.3/Pedia_Nr-3_2011_Art-9.pdf

***http://rmj.com.ro/articles/2010.3/RMR_Nr-3_2010_Art-3.pdf

***http://www.jmedar.ro/pdf/vol12/iss2/JMA12-2-09Gligor.pdf

***http://www.umfiasi.ro/scoaladoctorala/tezedoctorat/teze%20doctorat/rezumat%20preda%20maria%20ecaterina.pdf

***https://www.nhlbi.nih.gov/health-topics/metabolic-syndrome

***https://www.webmd.com/heart-disease/guide/metabolic-syndrome#3

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

STUDY ON KNOWLEDGE AND BEHAVIOR TOWARDS ORAL HYGIENE RULES

Olimid Diana[1]*

[1]University of Craiova, Department of Biology and Environmental Engineering, A. I. Cuza Street, No. 13, Craiova
**Correspondence author e-mail:* olimiddiana@yahoo.com

Keywords*: oral cavity, hygiene methods, prevention*

ABSTRACT

The aim of this study was to evaluate the knowledge and attitudes of 347 subjects regarding the oral health and hygiene practices.

Regarding the age, of the 347 subjects, 63.11 % were female. The female patient group was divided into age groups. The analysis showed that the majority of patients were under 49 years of age, 33.79 % belonged to the 30-39 years of age group, 26.48 % to the 18-29 years of age group, and 18.72 % to the 40-49 years of age group. The lowest number of patients belonged to the 60-69 years of age group.

Regarding the reason for presenting to the dentist, only 25.36 % of the subjects presented for a prophylactic examination, respectively 29.68 % of the female subjects, and only 17.96 % of the male subjects. Pain was the main symptom that caused the presentation to the dentist's office, respectively in 71.42 % of cases.

INTRODUCTION

The oral cavity is the first part of the digestive tube and contains the teeth, the gum (gingiva) surrounded by periodontium and alveolar bone and the tongue. The soft structures and the inner tissue of the cheeks are lined with mucous membrane. The oral cavity plays roles in taste because taste buds are present on it, in the qualitative control of the food, in mastication, salivation, swallow and speech act (Papilian V., 2014).

A proper oral hygiene is necessary for a fresh breath, healthy teeth and gum. The oral hygiene is the practice of keeping the oral cavity clean to prevent dental diseases. These pathologic conditions include dental caries, gingivitis, periodontitis (Vlad R.S., 2003).

MATERIALS AND METHODS

The study was conducted on a group of 347 subjects (male and female) aged 18 to 69 years. The study was performed into a private dental care practice for a period of 6 months, between October 2017 and March 2018.

Oral hygiene assessment was made by using a questionnaire with the following aspects:

- the age and the gender;
- the cause to visit the dentist (prophylactic exams or pathologic con-ditions);
- the knowledge of the proper teeth brushing technique;
- the use of the dental floss;
- the use of the mouthwash.

RESULTS AND DISCUSSIONS

Regarding the age, of the 347 subjects, 63.11 % were female. The female patient group was divided into age groups. The analysis showed that the majority of patients were under 49 years of age, 33.79 % belonged to the 30-39 years of age group, 26.48 % to the 18-29 years of age group, and 18.72 % to the 40-49 years of age group. The lowest number of patients belonged to the 60-69 years of age group (table 1; figure 1).

The distribution of the male subjects according to the age group showed the same tendency, 60,15 % of them were under the age of 49.

The obtained results show that females are more interested than men in maintaining dental health. Also, the addressability to the dentist is higher for young people, due to the interest in the esthetic aspect of teeth and facial expression. This aspect is very important at the moment, given that the integration into society and the way we are perceived by the others also depends on the physical appearance. The way a person speaks, smiles and the self-esteem determines the attitude of others towards her.

At young ages, the esthetic aspect may be more important than dental health, but the fact that youngsters present to the dentist is a first step because he can provide advice (counsel) so that the patient start to be aware of the importance of maintaining hygiene and health of the oral cavity.

Table 1

The repartition of the cases according to the gender

The gender	No. of cases	Percentage
Women	219	63,11%
Men	128	36,89%

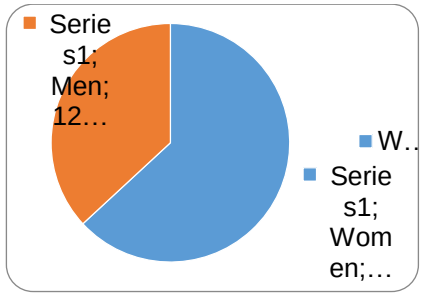


Figure 1. The repartition of the cases according to the gender

Table 2

The repartition of the cases according to the age group

Age group	18-29	30-39	40-49	50-59	60-69
No. of cases	58	74	41	27	19
Percentage	26,48 %	33,79 %	18,72 %	12,33 %	8,68 %

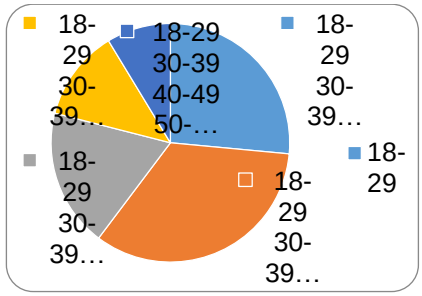


Figure 2. The repartition of the cases according to the age group

Regarding the reason for presenting to the dentist, only 25.36 % of the subjects presented for a prophylactic examination, respectively 29.68 % of the female subjects, and only 17.97 % of the male subjects (table 3, 4, figure 3, 4).

The result is according to the general tendency to call a physician only in the case of a pathological condition manifested by symptoms such as pain or gingival bleeding. Pain was the main symptom that caused the presentation to the dentist's office, respectively in 71.43 % of cases (table 5, figure 5).

Table 3

The repartition of the female subjects according to the cause of dental exam

The cause of the exam	No. of cases	Percentage
Prophylactic exam	65	29,68 %
Pathologic condition	154	70,32 %

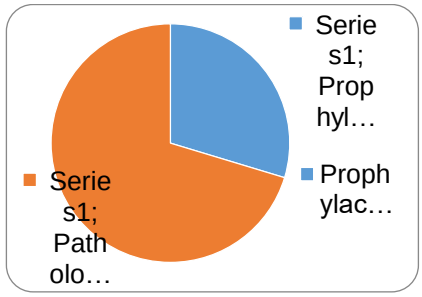


Figure 3. The repartition of the female subjects according to the cause of dental exam

Table 4

The repartition of the male subjects according to the reason of the dental exam

The reason of the exam	No. of cases	Percentage
Prophylactic exam	23	17,97 %
Pathologic condition	105	82,03 %

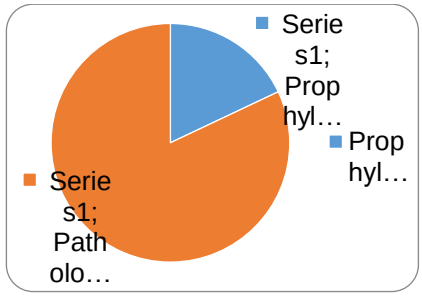


Figure 4. The repartition of the male subjects according to the reason of the dental exam

Table 5

The repartition of the cases according to the main symptom associated to the pathology condition

Symptom	No. of cases	Percentage
Pain	185	71,43 %
Gum bleeding	34	13,13 %
Others	40	15,44 %

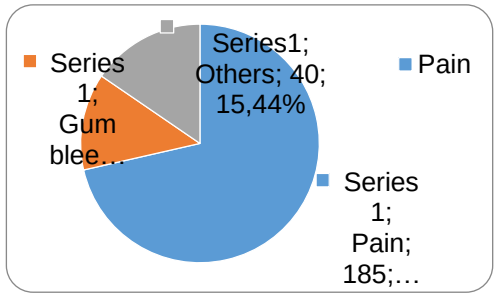


Figure 5. The repartition of the cases according to the main symptom associated to the pathological condition

The repartition of the cases according to the proper teeth brushing technique showed that 69,86 % of women reported the correct technique, while only 57,81 % of men knew the right movements and their order (table 6).

Table 6

The distribution of the cases according to the correct technique

The proper brushing technique	No. of cases	Percentage
Women	153	69,86 %
Men	74	57,81 %

Dentists recommend that teeth be cleaned by brushing with fluoride toothpaste at least twice a day. This is essential for preventing tartar build-up which causes the dental injuries (caries).

The best way to remove the bacterial plaque deposited on dental surfaces is gingival-dental brushing. Even if brushing is associated with other practices of maintaining oral hygiene (scaling, professional brushing, subgingival curettage and

curettage of soft areas on the surface of the dental root, the local application of antiseptic and antibiotic substances), the essential condition to prevent gum damage is the daily removal of the bacterial plaque through dental brushing (Vlad R.S., 2003).

If the patient does not understand this and does not get the correct dental brushing technique, all the secondary procedures initiated by the dentist will be doomed to failure. Prophylactic exams should be done every six months.

For home dental brushing, the best brushes are the ones made of natural hair (pork or camel hair), soft or medium consistency plastic brushes, those with high consistency risking to unnecessarily injure the gums and produce over time gingival retraction or loss of dental hard substance.

According to many authors, gingival-dental brushing should be performed after each meal or snack, so at least 3-5 times a day. It is recommended a correct brushing in the morning, when waking up and in the evening, before bedtime.

The dentist is required to inform the patient about the correct brushing technique, and when fully mastered by the patient, the brushing time should not exceed 5 minutes.

Correct dental brushing will begin with one of the arches, either the maxillary or the mandibular one. Only after brushing is completed at one of the dental arches, brushing will be performed at the other one. The end of the toothbrush should be held at an angle of 45° to the longitudinal axis of the teeth, and in this position vertical movements will be made only from the gum to the tooth, otherwise risking traumatizing the gum (WHO, 2013).

For each group of teeth, 10 vertical movements will be performed for cleaning the gingival-dental ditch, the gingival edge and dental surfaces. Vertical movements will be performed on dental groups, for lateral surfaces, both on the exterior and on the inside of the arches. For the occlusal surfaces that perform the crushing and trituration of food, the brushing will be horizontal combined with brush rotations,in order to effectively remove food debris accumulated in the ditches and beaks of these dental surfaces (Mahnoush N. D., 2007).

After use, the toothbrush should be washed under a strong jet of water and then shaken vigorously to remove water.

The brushes should be changed after a period of time ranging from 3 to 6 months due to their degradation and impregnation with organic debris and bacteria.

It is necessary to spend at least three minutes brushing each time, but no more than 5 minute.

It should be brushed also the surface of the tongue. Tongue cleaning removes bacteria, food particles, fungi as Candida and dead cells.

A study made in Bucharest, in two schools, on a group of 46 students aged 10 to 12 years showed that the entire group had a moderate degree of oral hygiene. Almost 40 % of children had a number of streptococci colonies over the limit and a high risk for dental caries (Funieru C. et al., 2015).

Over the last decade, the supply of electric dental brushes has increased. However, these brushes in most cases perform only a rotating, beneficial, but not sufficient movement.

Electrical brushing is especially indicated for young children, lazy people, non-cooperating people, either due to a physical disability in the upper limbs, or because of mental illness and for people who wear fixed orthodontic appliances.

An important step to maintaining the dental hygiene is flossing. This technique is necessary to removing food and plaque between teeth and along the gum line where the toothbrush can’t reach.

The evaluation showed that 39,72 % of women and 24,21 % of men use the dental floss for a proper hygiene of the interdental spaces (table 7).

Table 7

The repartition of the cases according to the use of the dental floss

The use of dental floss	No. of cases	Percentage
Women	87	39,72 %
Men	31	24,21 %

Flossing should be done once a day, preferably before bedtime.

It is recommended to use enough floss to enable easy use, usually 5 centimeters. Floss is then wrapped around the middle finger or index finger and supported the thumb on each hand. It is then held tightly and moved up and down between each tooth. It is important to floss under visible areas by curving the floss around each tooth. The gum bleedings are normal at the first usage of floss (Vlad R.S., 2003).

Between two brushings, for hygiene it is enough to rinse the mouth vigorously with water or various antiseptic solutions.

This practice can't replace the teethbrushing. The most effective antiseptic solution is clorhexidine which is absorbed on the dental surface where kills the bacteria and stops the development of the bacterial plaque. The antiseptic eficacity remain until 8 hours after use (Mahnoush N. D., 2007).

Fluoride mouthwash and toothpaste are not recommended for small children younger than six years because they may swallow the rinse. Too much fluoride may be toxic to infants (Marques L. A. et al., 2008).

The distribution of the cases showed that 7,76 % of women have never used the mouthwash, 38,81 % have used occasionally and 53,43 % have used every day. For the male subjects the percentages were 16,40 %, 49,21 % and 34,37 % (table 8).

Table 8

The distribution of the cases according to the use of the mouthwash

The use of the mouthwash	Women		Men	
	No. of cases	Percentage	No. of cases	Percentage
Every day	117	53,43 %	44	34,37 %
Occasionally	85	38,81 %	63	49,22 %
Never	17	7,76 %	21	16,41 %

A study published in 2011 in West Indian Medical Journal evaluated the dental health knowledge and attitudes of primary school teachers toward developing dental health education. The 75 % of respondent were female. 28,9 % of participants had received training in health education and only 6,9 % in dental health education. 92 % of teachers identified irregular tooth brushing as an important cause of dental disease, only 65 % and 53 % respectively identified the amount and frequency of sugar consumption as important causative factors.

85 % of the teachers believed that gum disease is caused by bacterial infections and 67 % thought it was caused by lack of vitamins. Most of the subjects thought that proper tooth brushing (90 %), visiting the dentist (89 %) and eating a good diet (79 %) would prevent gum disease.

Teachers were aware that fluoride toothpaste helped prevent caries. 97 % of all agreed that dental education should be included in the school curriculum.

The most important obstacles to the implementation of a health promotion program are the lack of material resource (77 %), lack of adequate training (70 %), and lack of support from local administration (47 %) (Ramroop V. et. al., 2011)

The association between oral hygiene and oral cancer or pharynx was studied in a hospital based case control study in the metropolitan area of Sao Paulo, Brazil, from 1998 to 2000. The information on risk factors were obtained through interviews.

The risk of oral cancer was higher among subjects who reported regular gingival bleeding during tooth brushing. Patients who reported never attenting dental visits had a risk of 2,5 compared to those who attented annual dental exam. Subjects who used mouthwash more than once a day showed a 3-fold increase in the risk of oral cancer compared to those who never used them. In Brasil, many mouthwash products contain as much as 27 % alcohol, which is a risk factor for oral cancer. (Marques L. A. et. al., 2008).

The treatment of dental disease is expensive in both developed and developing countries and exceeding the cost of treating cardiovascular disease, cancer and osteoporosis (Sheiham A., 2001).

Some people used different forms of teeth cleaning tools. Indian medicine has used the neem tree and its products. A number of plants are used as chewing sticks in West Africa such as the lime tree, the orange tree, the roots of senna, neem, nutmeg (Muhhamad S. and Lawal M. T., 2010).

CONCLUSIONS

The main goals of the prophylactic measures are removal of the bacterial plaque from the teeth and gingival areas adjacent to the dental surfaces and stimulation of blood circulation in the gingiva.

The women, especially the youngest, are more preoccupied than men to keep the oral hygiene, to do frequent dental examinations and more interestedly about the facial appearance.

The parental involvement in promotion of the dental health education in schools is essential.

The prophylactic measures should be applied from the early years of life which is why the parents have a great responsibility to teach children to eat healthy foods and to learn the hygiene rules.

The implication of the dental profession could be an important part in oral health promotion.

Dental diseases influence the self-esteem and are expensive to treat, so their prevention is very important.

It is the responsability of the national health authorities to provide educational programmes.

REFERENCES

Funieru C., Sfeatcu Ruxandra Ionela, Funieru Elena, Răescu Mihaela, Ivan Loredana, Dumitrache Adina Mihaela. 2015. Studiu asupra factorilor de risc ai cariei dentare la un lot de şcolari din Municipiul Bucureşti. Romanian Journal of Stomatology. Vol. 61, issue 2, pp. 156-160.

Mahnoush N. D. 2007. Afecţiunile gingivale şi paradontoza pe înţelesul tuturor. Ed. M.A.S.T. pp. 103-125.

Marques L.A., Eluf-Neto J., Figueiredo R.A.O., de Gois J. F., Kowalski L. P., de Carvalho M. B., Abrahao M., Wunsch V. 2008. Oral health, hygiene practices and oral cancer. Rev. Saude Publica, 42(3):471-9.

Muhhamad S., Lawal M. T. Oral Hygiene and the use of plants. Scientific Research and Essays. Vol. 5(14), pp. 1788-1795, 18 July 2010. Available online at http://www.academicjournals.org/SRE. ISSN 1992-2248.

Papilian V. 2014. Anatomia omului, vol. 2, Splahnologia, ed. a 12-a, Edit. ALL, Bucureşti, pp. 4-38.

Ramroop V., Wright D., Naidu R. 2011. Dental health knowledge and attitudes of primary school teachers toward developing dental health education. West Indian Medical Journal. Vol. 60, no. 5. Oct. 2011. Print version. ISSN 0043-3144. pp. 576-80.

Sheiham A. 2001. Dietary effects on dental diseases. Public Health Nutrition. 4:569-91.

Vlad Roxana Speranţa. 2003. Dinţii şi bolile lor. Grupul Editorial Corint, Bucureşti, pp. 47-85.

*** WHO. 2013. Oral Health Surveys: Basic Methods. 5-th ed. WHO Press. Geneva. Available online at http://www.who.int.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

SUSTAINABILITY CONSTRAINS OF HYDROPONIC HELOPHYTE BIOFILTERS IN RECIRCULATED AQUACULTURE

Popa Radu[1,2], Cimpoiaşu Vily Marius[2*]

1 - University of Southern California, Department of Biological Sciences, 3616, Trousdale Parkway, Los Angeles, CA, 90089, rpopa@usc.edu
2 - University of Craiova, Faculty of Horticulture, Biology and Environmental Engineering Department, Frontier in Biology and Astrobiology Research Center, A.I. Cuza Street, no 13, RO 200585, Craiova, Romania
*Correspondence author e-mail: vilycimpoiasu@yahoo.com

Keywords*: Biofilter, Recirculated aquaculture, Hydroponic, Sustainability, Helophite plants, Wetland.*

ABSTRACT

Wastewater treatment adds large costs to Recirculated Aquaculture Systems (RAS), often rendering intensive aquaculture operations financially unsustainable. Emergent marshland plants (called helophytes), used in the form of Hydroponic Helophyte Biofilters (HHB) are proposed as a straightforward means to lower the cost of water treatment in RAS. We analyzed main constrains in the sustainability of RAS/HHB systems. We discuss the cost of recirculating water through HHB systems; criteria to select the best helophytes, consequences of evaporative loss, and optimal ratios between RAS and HHB. Calculations have been made for a theoretical RAS with 20 kg catfish m^{-3} grown *in temperate continental conditions and HHB with cattail at a density of 70 kg* m^{-2}*. We show that the cost of maintaining water quality in a RAS/HHB system with catfish and cattail in temperate climate are sustainable and can reach less than 20 % from revenue.*

INTRODUCTION

Some of the most promising food production pathways in modern agriculture are hydroponics and Recirculated Aquaculture Systems (RASs). These technologies have high biomass yield, yet are expensive and polluting. Water treatment technologies that can be connected with RAS include filtration, settling, aeration, sterilization, nitrification, denitrification and hydroponics. In this paper we analyze the merits of Hydroponic Helophite Biofilters (HHBs) when connected to RAS (Fig. 1). Emergent helophytes are plants that live in marshes or lake-edge environments, have perennating plant organs in soil or mud below the water level, and aerial parts (stems, leaves, flowers) above the water level. What recommends helophytes for hydroponic filters is their fast growth, hardiness, simple propagation from over-wintering buds and tolerance of the submersed parts to low O_2. What recommends HHBs for RAS is their high biofilter potential, culture simplicity, high buffer capacity and potential for automation. The pollutants targeted in this study are organic carbon (C_{org}), nitrogen (N) and phosphorus (P). Unlike in aquaponics, the purpose of HHBs is not to grow another crop, but to lower the cost of water treatment by using a natural filtration system.

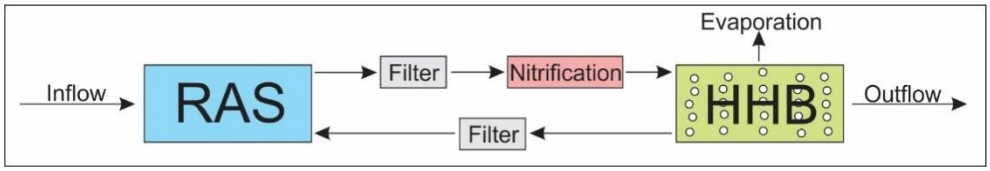


Fig. 1. A Recirculated Aquaculture System (RAS) with a Hydroponic Helophyte Biofilter (HHB). A filter upstream from the HHB reduces the particulate organic load. A nitrification unit converts part of ammonia (NH_4^+) to nitrate (NO_3^-) and increases the HHB efficiency, because many plants prefer up-taking N-NO_3^- to N-NH_4^+.

The theoretical RAS/HHB model analyzed in this study is a 100 m^3 circular tank with 100 m^2 surface area and 1 m deep, used to farm catfish in a temperate climate. The system is active 8 months per year, populated in April with 2-12 inch fingerlings and harvested in Nov., when the HHB stops functioning and fish reached harvestable size (400-500 g) and stopped growing. The HHB section is a 1,000 m^2 and 14 cm shallow water raceway with 0.5 % slope, planted with hydroponic cattail (i.e. 100 L of water m^{-2} and 70 kg of wet weight (WW) plant biomass m^{-2}). Water flows at 100 m^3 h^{-1} and fresh water is added from an external source at a rate of 10 m^3 per day.

This paper analyzes: (1) the cost of recirculating water in RAS/HHB systems; (2) the best helophytes for HHBs; (3) consequences of increased evaporative loss in HHBs; (4) principles of pairing up fish species with helophytes; and (5) optimizing ratios between RAS and HHB subunits.

RESULTS AND DISCUSSIONS

1) The cost of recirculating water in RAS/HHB systems

Lowering the pumping head is expected to decrease water recirculation costs. Most clarifier/decanter tanks from conventional RAS filters are 1.5-2.5 m tall, while HHBs are shallow (20-30 cm) relative to the fish tank (Fig. 2). The most common types of water pumps in aquaculture are: airlift, radial and axial pumps. Air lift pumps (used in some small systems and aquaria) work with low heads, but are little efficient. Centrifugal (or radial flow) pumps are the most common in aquaculture, but best suited for raising water at high elevation. Axial flow (impeller or propeller) pumps are highly efficient when large volumes of water are moved at low head. They are frequently employed at clearing up flooded fields. For RAS/HHB systems with very large water tanks or ponds (such as ≥ 1,000 m^3) axial pumps are the best choice.

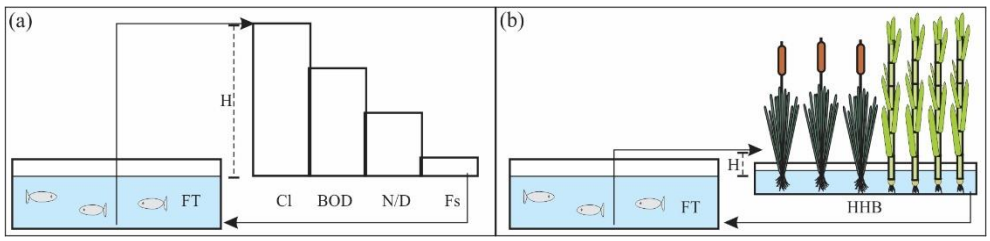


Fig. 2 Differences in pumping head (H) between: (a) RAS with conventional filters; and (b) RAS with HHB filter. FT = fish tank. Cl = Clarifier/decanter. BOD = bioreactor for mineralizing dissolved organic carbon. N/D = nitrification/denitrification bioreactors. Fs = filters. H = 1.5-2.5 m in (a) and 0.2-0.3 m in (b).

The cost of recirculating water in RAS can be derived as follows:

$$C_P = \frac{\mathrm{V} * \rho * \mathrm{H} * \mathrm{g} * P_{ef} * \mathrm{HPM} * \mathrm{Months} * E_{\$}}{T_t * 3600 * 1000} \quad \text{(Eq.1)}$$

where:
C_P = cost of pumping water in a full growth cycle of a RAS system [$];
V = volume of water the fish tank [L];
ρ = density of water [kg/L];
H = pumping head [m];
g = gravitational acceleration (9.81 m s^{-2});
P_{eff} = the pump's efficiency (%);
HPM = hours of pumping per month [24*30 = 720 hours];
Months = months in the fish growth cycle;
$E_{\$}$ = price of electricity = $ 0.12 kWh^{-1}; and
T_t = turnover time of the water from the fish tank [h].

In these calculations, we assumed that 2,000 kg of fish are harvested, having $2,000 total retail value, and that an impeller pump with 80% efficiency is used to recirculate water. Based on Eq.1 the water circulation costs are $301 per growth season (i.e. 15.5 % from retail) in the case of a conventional RAS with 2 m head, and $45 (= 2.25 % from retail) in a RAS/HHB system with 0.3 m head.

2) Best helophytes for HHBs

Here, selection criteria include: suitability to hydroponics, plant density, growth rate, and withstanding low O_2, nutrient deprivation and nutrient imbalance. HHB plants can be selected from species of bulrush (*Scirpus spp.*), cattail (*Typha spp.*), reeds (*Phragmytes spp.*), papyrus (*Cyperus spp*.), *Eleocharis*, swamp grass (*Cladium spp*.), wild rice (*Zizania spp*.), flowering rush (*Butomus spp*.), yellow flag (*Iris spp*.) and sweet flag (*Acorus spp*.). Helophites vary greatly in their suitability for HHB. For example, *Phragmites* and most bamboos have more biomass density than cattail, but are richer in ligno-cellulose, and are more expensive to trim. Papyrus, grows fast, has large biomass density, it is less woody and easy to trim, yet does not grow well in temperate conditions. Bulrush and sweet flag have non-woody texture and are easy to trim, but the biomass density is low. Some helophytes have commercial value that may lower RAS/HHB costs. For example, wild rice seeds are a valuable commodity, cattail rhizomes can be used to make bio-ethanol, cattail leaves can be fed to animals and reed biomass can be composted.

With regards to biofilters, *Typha angustifolia* and *T. latifolia* are some of the best studied helophytes. These plants reach a density of 21-30 stems m^{-2} or 5.6 kg WW m^{-2} in wetlands (Coon et al. 2000; Urban et al., 1993), but can be maintained at 150-220 stems m^{-2} or 40-100 kg WW m^{-2} in hydroponic cultures. The geographic distribution of cattails is broad, from tropical to subarctic with annual mean temperature ranging from 6°C to 28°C (Davis, 1991; Newman et al., 1996). Densely packed cattail in hydroponic cultures do not require special props (important for low infrastructure costs). Cattails withstand well nutrient deprivation (Miao and Sklar, 1998; Lorenzen et al., 2001). The hydroponic medium for fastest cattail growth contains: 43 ppm K; 20 ppm Ca; 9.76 ppm Mg; 28.8 ppm $N\text{-}NO_3^-$; 2.8 ppm $N\text{-}NH_4^+$ and 3.1 ppm $P\text{-}PO_4^{3-}$ (Richardson et al., 1990; Davis, 1991; Newman et al., 1998). Cattails prefer up-taking $N\text{-}NO_3^-$ relative to $N\text{-}NH_4^+$, a N:P ratio of about 10:1 and P is biofiltered better in positive Eh conditions (DeLaune et al., 1999; Li et al., 2010). A BOD bioreactor is not necessary in a cattail HHBs and nitrification and aeration increase the biofilter efficiency. The NH_4^+/NO_3^- ratio influences

plant biomass and root exudates significantly (Wu et al., 2016). Retaining nitrogen depends on phosphorus availability (Urban et al., 1993; DeBusk et al., 1994; Rutchey and Vilchek, 1994).

3) Consequences of HHB evaporative loss

Evaporation from the HHBs influences the net water loss and salinity. Our RAS/HHB dynamic model (Fig.1) has 4 reservoirs (fish tank, filters, nitrification and HHB) and 5 flows (RAS inflow, RAS/HHB flow, HHB/RAS flow, HHB outflow and evaporation). In RAS about 10 % of the fish tank volume is replaced daily with clean fresh water from an external source (i.e. 2,400 m^3). Evaporative water loss is highly variable, and depends on many factors such as temperature, humidity, wind, light intensity, the type of plant, vegetal biomass and the growth state of the plant. Hydroponic cattail at a density of 70 kg/m^2, noon temperature 22-25^oC and 45 % atmospheric humidity) evaporates 3.6-8.3 $L\ m^{-2}\ d^{-1}$. At a yearly average of 2 $L\ m^{-2}\ d^{-1}$ the net evaporative water loss of a 1,000 m^2 hydroponic system in temperate conditions is approximately 480 $m^3\ yr^{-1}$. Agricultural water costs are estimated to 0.01 \$ m^{-3}, but the price of water varies widely. Hence, the cost of water loss cannot be accurately predicted and has to be determined in each area.

4) Matching helophyte species with fish species

The following criteria are important here: fish sensitivity to pollutants, biofilter thresholds by the plants and temperature range for fish and plants.

Some species of fish, such as carp and catfish, are more tolerant to pollutants, while trout and salmon are more sensitive. Chemical context will also influence toxicity. For example, the acute toxicity of nitrite varies between < 1 ppm to > 10 ppm depending on chloride. Un-ionized ammonia (UIA), one of the most toxic pollutant in RAS (Knepp and Arkin, 1973; Tomasso et al., 1980; Hargreaves and Tucker, 2004) is a fraction of the total ammonium dissolved in water (https://www.svl.net/2016/01/unionized-amonia-calculator/). The UIA abundance depends on pH and temperature. The recommended limit for UIA is 0.005 ppm (EU aquaculture guidelines). At > 0.02 to 0.2 ppm UIA is potentially toxic, 0.3 ppm is the toxic threshold for rainbow trout and 1 ppm UIA is lethal to most fish. A good HHB system is one that can maintain the UIA below 0.005 ppm at reasonable cost.

The concentration below which removal of a pollutant no longer occurs is labelled C_{min}. The cattail $C_{min}(PO_4^{3-})$ can be as low as 0.0012-0.025 ppm, with lowest value in aerated conditions. The cattail $C_{min}(NH_4^+)$ varies between 0.036-0.1026 ppm. One key requirement for an efficacious HHB system is: $C_{min} < C_{tox}$, where: C_{tox} is the recommended limit of a pollutant in a given system. The broadleaf cattail's $C_{min}(NH_4^+)$ is approximately 0.036 ppm at pH 8 and 20^oC (Dyhr-Jensen and Brix, 1996), i.e. < 0.002 ppm UIA. Efficient nitrogen uptake occurs when the N:P g:g ratio is close to 10:1. Hence, lowering the UIA to 0.005 ppm requires a minimum concentration of 0.05 ppm $P\text{-}PO_4^{3-}$. This can be easily obtained by adding a little soluble phosphate mineral to the system (e.g. apatite, hydroxyapatite, struvite).

Successful RAS/HHB systems requires matching fish with plants and local climate. Most temperate plants slow down growth in the fall. Because during the fish production cycle the fish stock are abundant and the pollutants are also abundant and harder to biofilter, the HHB plants have to be growing till the fish harvest time. Not many plants do this. Climate / fitness diagrams such as the one from Fig. 3 are used select HHB plants. Based on this diagram, the best fish and plant species for temperate climate are catfish (or carp) and cattails or temperate reeds.

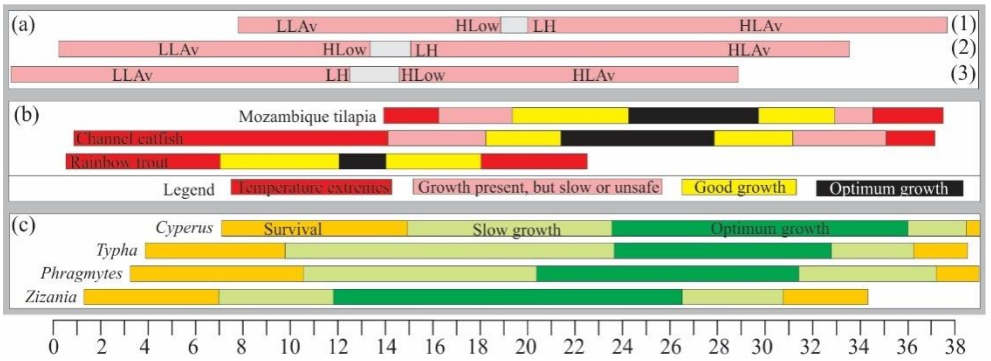


Fig. 4 Example of climate/fitness diagrams used to match the best fish and helophyte plants with a geographic location. (a) Local climate conditions in three geographic areas: (1) Hot southern and subtropical climate; (2) Temperate continental; and (3) Cold temperate and alpine. (b) Growth conditions for various fish. (c) Growth conditions for various marshland plants. LLAv = lowest lunar average temperature. HLAv = Highest Lunar Average temperature. LH = Lowest high lunar average. HLAv = Highest Low Lunar Average.

5) Size ratio between RAS and HHB

The sustainability of RAS/HHB requires that the HHB section is as large as necessary to withstand pollution peaks, yet not oversized. Calculations are based on: biomass and growth of the fish and plants; production of pollutants; safe levels for the pollutants; water circulation, the biofilter' efficiency and temperature.

1st. Experimental HHB systems are constructed, with similar water:plants proportions to the model RAS/HHB. The following have to be known: the surface area, amount of plants, water volume and flow rate. Temperature control and aeration are necessary, and physical-chemical parameters should be measurable.

2nd. Water is spiked with pollutants at similar concentration with values expected in fish tanks 12 hours after feeding. Temperature is maintained at desired control value that is between the low and high monthly average. Pollutants are monitored. A reasonable goal for the final BOD is 3-7 mg/L O_2 (Farooqi et al., 2008). A desirable goal for UIA is 0.005 ppm; cattail can reach < 0.002 ppm UIA.

3rd. The reaction rate constant is determined for each pollutant at a Control temperature (e.g. k_T(BOD) h^{-1}; k_T(UIA) h^{-1}, etc.). To do this, the evolution of the pollutants is graphed, with time on the OX axis and $-ln(C(t)/C_0)$ on the OY axis. The linear part of the graph is used to calculate the rate constant:

$$k_{20} = [-ln(C(t)/C_0] / t \qquad \text{Eq.2}$$

where: k_{20} = the biofiltration rate constant at 20°C for the given experimental system (h^{-1}); $C(t)$= the pollutant concentration after time t; C_o = the initial concentration of the pollutant; and t = time (days).

The k_{20} varies significantly between habitats, the hour of the day, wetland communities, HHB designs and HHB management, and will deviate from linearity toward the ends of the concentration range of a species. Eq.2 should not be used to calculate k_T in non-linear parts of the graph.

4th. The rate constant is calculated at other temperatures as well:

$$k_T = k_{20} \cdot (\theta^{(T-20)}) \qquad \text{Eq.3}$$

where: k_T = calculated reaction rate at the desired temperature (T); θ = the temperature coefficient for the rate constant, *e.g.* θ(BOD) = 1.06 and $\theta(NH_4^+)$ = 1.048; k_{20} = reaction rate constant at the experimentally measured temperature (here 20°C); and T = desired temperature (°C);

The biological rate constants depart from chemical predictions near the margins of a species' temperature range. Hence, k_T values should only be calculated for temperatures that are close to the measurement T (e.g. +/- 3°C). Control measurements have to be made at various points (e.g. at 5°C intervals) to cover the temperature range predicted for the entire growth season.

5th. The detention time (the time water should remain in the HHB in order to reach a desired level) is:

$$t_{det} = \frac{-ln\left(\frac{C}{C_o}\right)}{k_T} \qquad \text{Eq.4}$$

where: t_{det} = detention time (days); C_o is the pollutant concentration entering in the HHB system (mg/L); and C is the desired pollutant concentration exiting the system (mg/L).

For sustainability purposes it is important to set up reasonable concentration targets. For example, the recommended limit for a fish/pollutant pair may be C_{tox} = 0.005 ppm. Yet even though cattails C_{tox} < 0.002 ppm, it is best to calibrate the system to reasonable values, rather than impose unnecessary burden on the HHB's size.

6th. The necessary HHB surface area is calculated from:

$$A_s = \frac{Q_{avg} \cdot t_{det}}{\eta \cdot d_W} \qquad \text{Eq.5}$$

where: A_s = the necessary surface area for the HHB flow bed (m^2); Q_{avg} = average daily flow through the biofilter system (m^3/day); t_{det} = estimated detention time (days); η = the effective porosity of the medium (the proportion of the non-solid volume to the total volume of materials in the biofilter; and d_W = active depth of the biofilter system (m).

We used Eqs. 2-5 to estimate efficient RAS:HHB size ratios in a RAS/HHB system. The model system has a RAS fish tank (100 m^3 of water; 100 m^2; maximum fish load 20 kg of catfish m^{-3} and 1 hr. water turnover time) and a cattail-HHB unit (up to 1,000 m^2; 70 kg of plants m^{-2}; 14 cm water depth; 57 % porosity; and up to 800 m^3 of water). The fish are fed with 3 % of their body mass per day. The feed contains 41 % crude protein and 6.6 % nitrogen (i.e. 1.98 g of N kg_$fish^{-1}$ day^{-1}). Based on an estimated ammonium excreted by catfish of approximately 0.75 umol h^{-1} g $weight^{-1}$ (Garcia et al., 2012), 14 % of the feed nitrogen was not retained by the fish and ends up in water. Assuming that most of the nitrogen released was in dissolved form (ammonium and urea), the 100 m^3 RAS system has produced 2,000 kg x 3 % x 14 % = 84 kg of N day^{-1}. This is equivalent to 8,400 g N / 100,000 L water / 24 = 3.5 ppm $N\text{-}NH_4^+$ h^{-1} for a flow rate of 100 m^3 h^{-1}. Nitrification is used to produce a solution with approximately 32 ppm $N\text{-}NO_3^-$ h^{-1} and 0.32 ppm $N\text{-}NH_4^+$ h^{-1} (i.e. 0.012 ppm UIA h^{-1} at pH 8 and 20°C).

Using experimental systems with proportions between water and cattail similar to the model RAS/HHB we have obtained $k_{20}(N\text{-}NO_3^-)$ = 1.29 d^{-1} and $k_{20}(NH_4^+)$ = 0.94 d^{-1}. The surface area needed to lower $N\text{-}NO_3^-$ from 32 ppm to 0.58 ppm at 20°C is 93 m^2 while lowering the $N\text{-}NH_4^+$ from 0.32 ppm to 0.132 ppm (i.e. 0.005 ppm UIA) requires 28.3 m^2. The 0.58 ppm target value for $N\text{-}NO_3^-$ was selected to reach the recommend safe level 0.005 ppm UIA should all nitrate be reduced to ammonium. Correcting for

temperatures as low as 10°C (consistent with night temperatures in late fall of temperate continental climate) the safe surface area of the cattail-HHB needed to control N-related toxicity is 166 m^2.

CONCLUSIONS

We analyzed requirements and costs of an HHB system using broadlealf cattail (*Typha latifolia*) and narrowleaf cattail (*Typha angustifolia*) for RAS wastewater treatment. System specifications were analyzed based on costs and benefits. These include the cost of the HHB infrastructure, costs of recirculating water, consequences of evaporation from the HHB, criteria for selecting the best halophyte plants and filtration efficiency by the HHB. The target fish in this study is channel catfish and the target chemical is un-ionized ammonia (putatively the most toxic pollutant in recirculated aquaculture). We found the following parameters for the RAS/HHB system: 100 m^2 of RAS with 100 m^3 of water, populated with 20 kg of catfish m^{-3}, 100 m^3 h^{-1} water flow rate and 190 m^2 of HHB with 14 cm deep hydroponic culture and 70 kg of cattail m^{-2}. We assume a yearly revenue from fish of $ 2,000 and an HHB biofilter with EPDM rubber liner and concrete margins with 20 years life span and 30 $\$m^{-2}$ investment cost and 1.5 $\$m^{-2}$ yearly usage costs. The HHB system costs have been estimated to $249 for HHB infrastructure usage, $45 for water recirculation, $1 for fresh water to compensate evaporation, $24 for fresh water input and $100 in labor. According to our model, the cost of maintaining water quality in a RAS/HHB system with catfish and cattail in temperate climate can be brought as low as 20 % from revenue. Comparative to aquaponics, the surface area planted with hydroponic cultures in a RAS/HHB is approximately five times smaller. Revenue sources from HHB can come from example from Zizania seeds, cattail leaves use as fodder and biomass from reeds, bamboo and papyrus used to make compost.

REFERENCES

Coon, W.F., J.M. Bernard, and F.K. Seischab. 2000. Effects of a cattail wetland on water quality or Irondequoit Creek near Rochester. New York, US Geol. Surv., Water-Resources Investigations Report. 00-4032.

Davis S.M. 1991. Growth, decomposition, and nutrient retention of *Cladium jamaicense* Crantz and *Typha domingensis* Pers. In the Florida Everglades. Aquatic Botany. 40(3): 203-224.

DeBusk, W.F., K.R. Reddy, M.S. Koch, and Y. Yang. 1994. Spatial distribution of soil nutrient in a northern Everglades marsh: Water conservation area 2. SSSA J. 58(2): 543-552.

DeLaune, R.D., A. Jugsujinda and K.R., Reddy. 1999. Effect of root oxygen stress on phosphorus uptake by cattail. J. Plant. Nutrition. 22(3): 459-466.

Farooqi, I.H., F. Basheer and J. Chaudhari 2008. Constructed wetland system (CWS) for wastewater treatment. Proceedings of Tall 2007: The 12th World Lake Conference 1004-1009.

Hargreaves J.A. and C.S. Tucker, 2004, Managing ammonia in fish ponds, Southern Regional Aquaculture Center, SRAC Publication No. 4603.

Dyhr-Jensen K. and H. Brix, 1996, Effects of pH on ammonium uptake by *Typha latifolia* L. Plant, Cell and Environment. 19(12): 1431-1436.

Garcia, L. D. O., Braun, N., Becker, A. G., Loro, V. L., and Baldisserotto, B. 2012. Ammonia excretion at different life stages of silver catfish. Acta Scientiarum. Animal Sciences, 34(1), 15-19.

Knepp G.L. and G.F. Arkin. 1973. Ammonia toxicity levels and nitrate tolerance of channel catfish. The Progressive Fish-Culturist. 35(4): 221-224.

Li, S., J. Lissner, I.A. Mendelssohn, H. Brix, B. Lorenzen, K.L. McKee and S. Miao. 2009. Nutrient and growth responses of cattail (Typha domingensis) to redox intensity and phosphate availability. Ann. Bot. 105(1): 175-84.

Lorenzen, B., H. Brix, I.A. Mendelssohn, K.L. McKee, and S.L. Miao. 2001. Growth, biomass allocation, and nutrient use efficiency in *Cladium jamaicens* and *Typha domingensis* as affected by phosphorus and oxygen availability. Aquatic Botany. 70(2): 117-133.

Newman, S., J.B. Grace and J.W. Koebel. 1996. Effects of nutrients and hydroperiod on *Typha*, Cladium, and *Eleocharis*: Implications for Everglades restoration. Ecol. Applic. 6(3): 774-783.

Newman, S., J. Schuette, J. B. Grace, K. Rutchey, T. Fontaine, K. R. Reddy, and M. Pietrucha. 1998. Factors influencing cattail abundance in the northern Everglades. Aquatic Botany 60(3): 265-280.

Miao, S. L., and F. H. Sklar. 1998. Biomass and nutrient allocation of sawgrass and cattail along a nutrient gradient in the Florida Everglades. Wetlands Ecol. Manage. 5(4): 245-263.

Richardson, J. R., W. L. Bryant, W. M. Kitchens, J. E. Mattson, and K. R. Pope. 1990. An evaluation of refuge habitats and relationships to water quality, quantity, and hydroperiod. Boynton Beach, Fla.: A.R.M. Loxahatchee National Wildlife Refuge.

Rutchey, K., and L. Vilchek. 1994. Development of an Everglades vegetation map using SPOT image and the global positioning system. Photogramm. Eng. Remote Sens. 60(6): 767-775.

Tomasso, J.R., C.A. Goudie, B.A. Simco and K.B. Davis. 1980. Effects of environmental pH and calcium on ammonia toxicity in channel catfish, Transactions of the American Fisheries Society, 109(2): 229-234.

Urban, N.H., S.M. Davis and N.G. Aumen. 1993. Fluctuations in sawgrass and cattail densities in Everglades Water Conservation Area 2A under varying nutrient, hydrologic, and fire regimes. Aquatic Botany 46(3-4): 203-223.

Wu, H., K. Xu. X. He and X. Wang. 2016. Removal of nitrogen by three plant species in hydroponic culture: plant uptake and microbial degradation. Water, Air and Soil Pollution. 227: 324.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

EVALUATION OF NOISE LEVELS IN AN IDUSTRIAL AREA OF CRAIOVA CITY, ROMANIA

Popescu Simona Mariana[1]*, Căpruciu Ramona[1]

[*]University of Craiova, Faculty of Horticulture, Craiova
* *Correspondence author. E-mail*: popescu_simona83@yahoo.com

Keywords*: noise, pollution, urban and industrial area.*

ABSTRACT

In the present society, noise in cities is considered a health problem and it has been well studied worldwide. Noise is unwanted sound and acts on the whole body because the auditory sensation reaches the central nervous system through which it affects other organs. This paper presents the evaluation of the noise level in an industrial area of the city of Craiova, Romania. The noise level measurements were carried out under normal conditions of activity within the objective investigated with BRUEL & KJAER 2238 sound meter, in good weather conditions, during day, evening and night hours in week days between March and June, 2017. The results of the study revealed that the noise level was not exceeded in any of the 2 points of interest: access gate and workshops area and no necessary actions are required to protect the area.

INTRODUCTION

Alongside air, water and soil, noise pollution is becoming a major concern for the modern society. Noise is unwanted sound and when it exceeds a certain amount that causes harm to human activities or animal life it becomes an environmental pollutant.

Among the most important sound characteristics regarding pollution is the intensity determined by the amount of energy transported by the sound wave which penetrates per second a surface unit perpendicular to the sound propagation direction.

Nowadays noise in cities is considered a health problem affecting quality of life in urban areas and it has been well studied worldwide (Zannin et al. 2002; Guedes et al. 2011; Frei et al., 2014). The response of the human ear to sound is dependent on the frequency of the sound. Noise acts on the whole body because the auditory sensation reaches the central nervous system through which it affects other organs and produces stress, fatigue, decreased or loss of auditory capacity, mental instability (Schwela et al. 2005 Babisch et al. 2005). Very high noise levels can cause damage to buildings, appliances and instruments.

The present study was conducted to show the noise level measurements carried out in an industrial area of the city of Craiova, Romania. The measured noise levels were classified according to the environmental legislation in effect for the country.

MATERIAL AND METHODS

The study was conducted in the S-E part of Craiova city, where an industrial company operates its activity which is the production of industrial electric motors and generators, heavy duty power transformers, railway and urban vehicles, manufacture of metal structures and parts of metal structures, manufacture of containers and similar

products of steel. Right next to the company, in the close vicinity, there is also the shopping mall of the city. The noise level measurements were carried out under normal conditions of activity within the objective investigated with BRUEL & KJAER 2238 sound meter, provided with a weighing circuit A, C and L, response "slow, fast", software BZ 7126 and microphone ZC 0030. All the noise measurements were taken in good weather conditions, without rain or strong wind, between March and June 2017 in week days, the average of the measurements being presented in this study.

Table 1

Measuring periods for noise

Period of one calendar day	Time interval (local time)
day	13.00
evening	19.00
night	22.00

The noise measurements were performed at the functional limit of the company in 2 measuring points located on the cardinal directions of the source in daytime, evening and night mode (Table 1), as follows:

- Point no. 1 - in front of the access gate (which is very close to the access gate of the mall also) - in direction N;
- Point no. 2 – in front of the workshops of the company – in direction S.

The spatial distribution of noise pollution in urban areas depends on various parameters like construction density, open spaces, the shape and physical position of buildings, the type of passages and population distribution (Ariza-Villaverde et al., 2014).

RESULTS AND DISCUSSIONS

The noise sources within the company are represented by: transport, loading and unloading of raw materials and finished products, the metal workshop and by the other production activities. The company's specific noise sources are discontinuous. Other noise in the area is caused by heavy traffic and the flow of people reaching the shopping mall.

Maschke, 1999 suggests that 65 dB (A) is the sound level limit for noise exposure of a population in an urban environment. In other countries, for example India, the day time ambient noise standard of Leq is 75 dB (A) and that for night time is 70 dB (A) for industrial area (Hunashal and Patil, 2012). For Romania the allowable noise levels, for urban areas, according to the national regulations is 65 dB (A) - equivalent continuous sound level.

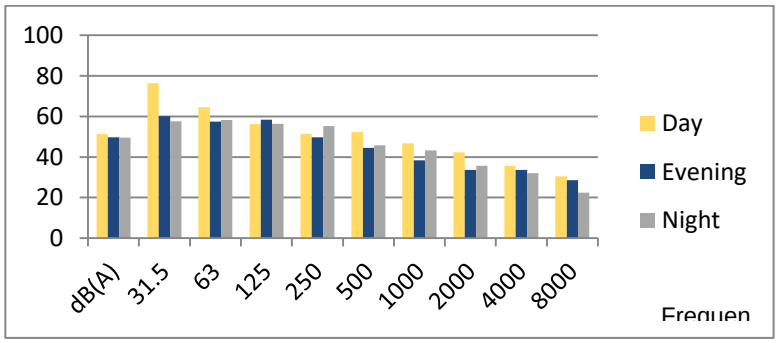


Figure 1. The level of noise measured at the access gate, N direction

The results obtained for the access gate measurement point (Fig. 1) revealed that the noise level exceeded (76.4 dB) only one time the legal limit of 64.5 dB (A), recorded during daytime for the frequency of 31.5 Hz. In the rest of the cases the noise level measured in daytime, evening and night was below the limit and no exceeding frequencies were recorded.

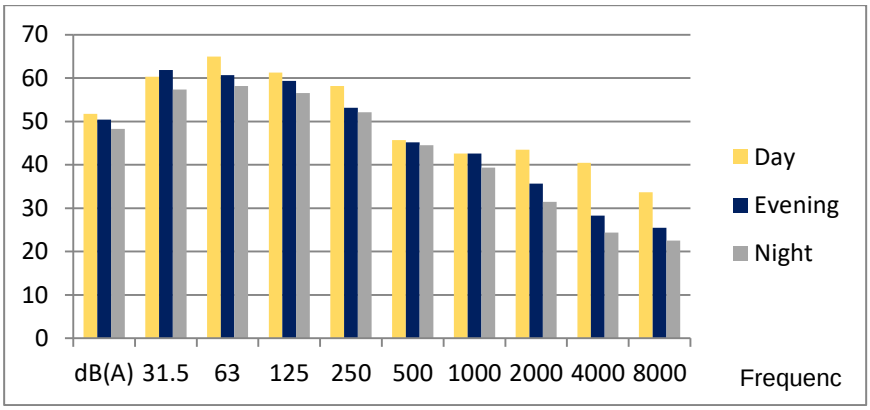


Figure 2. The level of noise measured at the workshops, S direction

Regarding the noise level measured at the workshops area (Fig. 2) there were recorded values over 60.0 dB (A) but no exceeding frequencies were recorded during the selected hours in daytime, evening and night respectively.

CONCLUSIONS

The results of the measurements evaluated in this study revealed that the level of the noise in the studied area was not exceded in any of the 2 points were the measurements were carried out, namely the access gate and workshops area respectively.

No special facilities and equipment are required to protect the area because: the buildings of the company's workshops are of brick structure, without openings, with sealed metal doors, that represent an important factor for noise mitigation. In the work area staff are provided with noise protection materials.

Nevertheless, if the noise is not controlled, in the future the frequency of noise complaints will show an increase because of rapid increase in population, city life activities and industrialization.

REFERENCES

Ariza-Villaverde, A.B., Jiménez-Hornero, F.J., Gutiérrez De Ravé, E., 2014. Influence of urban morphology on total noise pollution: Multifractal description. Sci. Total Environ. 472, 1–8.

Babisch W, Beule B, Schust M, Kersten N, Ising H. 2005. Traffic noise and risk of myocardial infarction. Epidemiology;16(1):33–40.

Frei, P., Mohler, E., Röösli, M., 2014. Effect of nocturnal road traffic noise exposure and annoyance on objective and subjective sleep quality. Int. J. Hyg. Environ. Health 217 (2–3), 188–195.

Guedes ICM, Bertoli SR, Zannin PHT. 2011. Influence of urban shapes on environmental noise: a case study in Aracaju Brazil. Sci Total Environ; 412:66–76.

Hunashal Rajiv B., Patil Yogesh B. 2012. Assessment of noise pollution indices in the city of Kolhapur, India. Procedia - Social and Behavioral Sciences 37, 448 – 457.

Maschke C. 1999. Preventive medical limits for chronic traffic noise exposure. Acustica; 85(1999):444–8.

Schwela D, Kephalopoulos S, Prasher D. 2005. Confounding or aggravating factors in noiseinduced health effects: air pollutants and other stressors. Noise Health; 7:41–50.

Zannin PHT, Diniz FB, Calixto A, Barbosa W. 2002. Environmental noise pollution in the city of Curitiba, Brazil. Appl Acoust; 63:351–8.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

CHROMIUM BIOACCUMULATION IN THREE POACEAE SPECIES

Dan Răzvan Popoviciu[1]*, Bogdan-Ştefan Negreanu-Pîrjol[2], Ticuţa Negreanu-Pîrjol[2]

„Ovidius" University of Constanţa, Faculty of Natural Sciences and Agricultural Sciences, Constanţa, Romania
[2]„Ovidius" University of Constanţa, Faculty of Pharmacy, Constanţa, Romania
* *Correspondence author. E-mail*: dr_popoviciu@yahoo.com

Keywords*: Hordeum murinum, Leymus racemosus, Lolium perenne, bioaccumulation, chromium.*

ABSTRACT

Chromium concentration was determined, through HR-CS-AAS, in tissular and rhizospheric soil samples from three Poaceae species growing in Romanian ruderal and coastal areas: Hordeum murinum L., Leymus racemosus ssp. sabulosus (M. Bieb.) Tzvelev and Lolium perenne L. Biological Accumulation Coefficients (BAC) were calculated.

The highest average concentration was found in L. racemosus (22.21 mg/kg) higher than the 1.5 mg/kg "standard reference" levels, but below the hyperaccumulation threshold (1,000/300 mg/kg) With 0.11-0.54 average BAC, all selected species can be considered as moderate accumulators, with the highest values in L. racemosus.

Results show that L. racemosus, although not an accumulator under natural conditions, has a potential for Cr phytostabilization, or enhanced phytoextraction experiments.

INTRODUCTION

Research in heavy metal phytoaccumulation is a growing field, due to its multiple applications. Industrial expansion leads to an increasing demand in heavy metal mining and processing and, thus, to increasing soil pollution issues, affecting biodiversity, crops and, indirectly, human health. This in turn requires new and non-invasive soil remediation techniques.

On the other hand, identifying new metal ores, or extracting metal from subeconomic ones are also priorities.

For all these, knowledge of natural metal accumulators is of great importance. While heavy metals usually induce various types of toxic effects in plants (especially at root level), some species are able to cope with this by means of exclusion, root sequestration or general bioaccumulation (accumulating, in specific tissues, metal concentrations higher than in the surrounding soil).

The extreme version of bioaccumulation is called "hyperaccumulation" (100-1,000 times more metal ions than in normal vegetation). The practical application of plant metal bioaccumulation and hyperaccumulation include phytoprospection, phytoremediation (phytostabilization and phytoextraction) and phytomining (Rascio & Navari-Izzo 2011, Tang et al. 2012).

The aim of this research was to assess chromium bioaccumulation in three common Poaceae species growing in Romanian marine coastal areas and not only.

Chromium occurs (either trivalent or hexavalent) in minerals such as chromite, crocoite, bentorite, tarapacaite, vauquelinite etc. In normal soils, its concentration ranges

between 10-50 mg/kg. Industrial applications are variate: special alloys, electroplating, pigment industry etc. Tanning industry is a major source of Cr pollution (40 % of known cases; Oliveira 2012).

Cr is not an essential nutrient for plants. It is usually stored in vacuoles of root cells. Phytotoxic effects include an inhibition of root growth, water absorption, growth of stems and leaves, proper development of photosynthetic apparatus, a lower productivity and a lower seed viability (Shanker et al. 2005). Cr phytoaccumulators include *Amaranthus dubius*, *Brachiaria decumbens Convolvulus arvensis*, *Dyera costulata*, *Genipa americana*, *Ipomoea aquatica*, *Pennisetum purpureum*, *Pluchea indica* (Oliveira 2012).

The three species investigated include two ruderal grasses and one specific to sandy areas.

Hordeum murinum ssp. *murinum* L. (barley grass, wall barley) is an annual, tuft-forming, species, with a short stem (~30 cm), glabrous green leaves, compound terminal (green or purplish) spikes. A native of Western Eurasia and North Africa, is curently found worldwide. Its uses include foraging, turf and culinary uses (in China; Jacobsen & von Bothmer 1995).

Leymus racemosus ssp. *sabulosus* (M. Bieb.) Tzvelev (mammoth wildrye) is a perennial, tuft-forming species, with extensive rhizomes, long, pubescent stem (~100 cm), long, glaucous green leaves (20-40 cm) and long, terminal compound spikes (15-30 cm). A native of Central Asia, it is currently found in many temperate areas. In Romania, it only grows on littoral sands. Uses include dune stabilization or mine tailing revegetation (St. John et al 2010).

Lollium perenne L. (perennial ryegrass) is a perennial, tuft-forming grass, with short rhizomes, 30-100 cm stems, narrow, dark green leaves and narrow, terminal compound spikes. A native of Eurasia and North Africa, it currently grows worldwide. Its uses include foraging, turf and erosion control (Ogle et al. 2008).

MATERIAL AND METHODS

Plant material was collected from marine beaches and surroundings in Constanţa, Romania. Samples from aboveground organs (stems and leaves) and rhizospheric soil were collected from different areas of the “Trei Papuci” and “Modern” beaches, from three individuals for each species.

Organ samples were cut into small pieces and, together with soil samples, oven-dried for 3 days at 80ºC. 0.25 g of each sample were digested overnight in 5 mL concentrated HNO_3 and boiled 1 hour at 150 ºC. 2 mL H_2O_2 (30 %) were added, followed by 2-hour boiling. The solution was made up to 50 mL with distilled water, adding $CaCl_2$ (0.5 %) and NH_4Cl (2 %) (Shanker et al. 2004, Popoviciu et al. 2016, Popoviciu et al. 2017).

Analysis was done with a HR-CS Atomic Absorption Spectrometer (ContrAA700, Analytik Jena AG), with air-acetylene flame at 357 nm wavelength.

Resulting metal concentrations were expressed as mg/kg and used to calculate the biological accumulation coefficients (BAC; Nazir et al. 2011, Obasi et al. 2013):

$$BAC = [Cr]_{Shoot}/[Cr]_{Soil}.$$

RESULTS AND DISCUSSIONS

Average tissular metal concentrations are shown in Fig. 1, while soil chromium levels are shown in Fig. 2 (1.9 mg/kg minimal detection limit of the device). Fig. 3 shows average BAC values for each studied species.

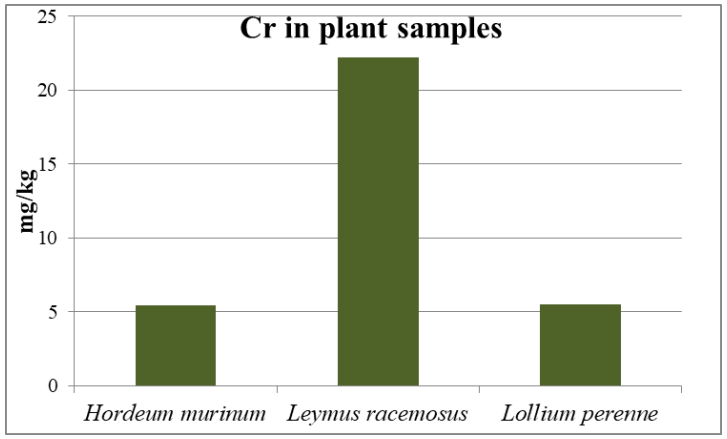


Figure 1. Average chromium concentrations in aboveground organs of selected Poaceae species (mg/kg; dry weight).

Normally, plant tissues have low Cr concentrations. The „standard reference plant" (an average model of known species) contains 1.5 mg/kg Cr (Van der Ent et al. 2013). All three species had tissular chromium levels higher than this standard (Fig. 1). The highest average concentration was found in *L. racemosus* (22.21 mg/kg – not constant, however; the highest value found in one individual was 32.08 mg/kg).

Soil concentrations ranged mostly between 22.68-55.08 mg/kg (Fig. 2), i.e. normal soil Cr levels (Oliveira 2012).

Most authors define Cr hyperaccumulation as starting from 1,000 mg/kg tissular concentration, with no toxic effects, with some proposing an alternate value of 300 mg/kg (Rascio & Navari-Izzo 2011, Van der Ent et al. 2013). According to these thresholds, none of the three Poaceae species is a hyperaccumulator under normal soil conditions.

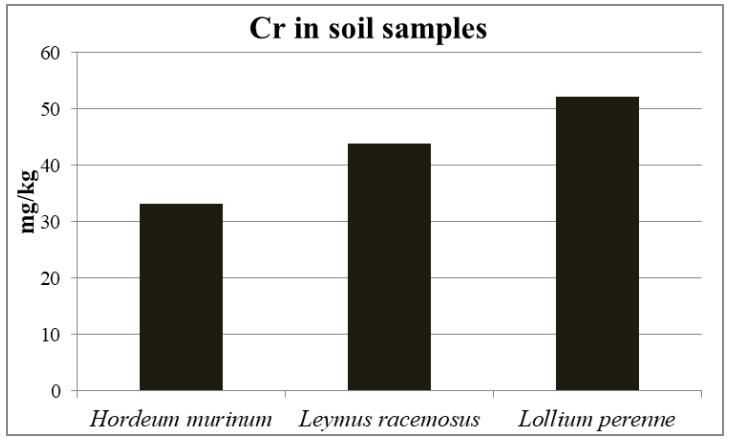


Figure 2. Average chromium concentrations in rhizospheric soil for selected Poaceae species (mg/kg; dry weight).

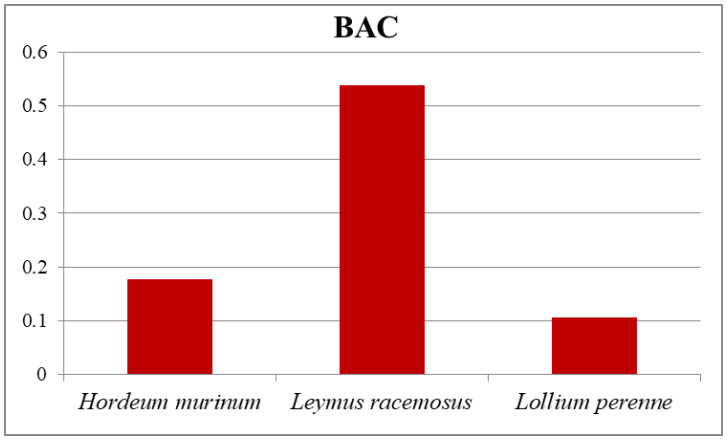


Figure 3. Average chromium biological accumulation coefficients for selected Poaceae species.

Biological accumulation coefficients indicate whether a certain species concentrates more metal ions in aboveground organs than in surrounding soil. BAC can be variable – influenced by local factors, such as heavy metal levels in soil or the availability of certain nutrients. However, it is extremely useful in assessing the usefulness of a plant for phytoextractive purposes (Rascio & Navari-Izzo 2011, Van der Ent et al. 2013).

Some authors (Sekabira et al., 2011) propose a scale ranging from non-accumulating plants (BAC<0.01) to low accumulators (0.01-0.1), moderate accumulators (0.1-1) and high accumulators/hyperaccumulators (>1). According to this scale, *H. murinum* and *L. perenne* would be classified as low to moderate accumulators (average BAC of 0.18, respectively, 0.11), while *L. racemosus* would fall within the upper range of moderate accumulation (0.54 average, 0.79 highest value).

Other Poaceae, such as oat, sorghum or wheat, are known to show a much lower Cr accumulation than the three studied species (López-Luna et al. 2009). However, due to a low translocation to upper organs, thier phytoextractive potential is low. *L. racemosus* seems to be the only one suitable to further experimenting, for chemically-enhanced accumulation, since it is known that factors such as a lower pH or various chelators can improve the process (Amaria & Brahim 2016).

CONCLUSIONS

The three Poaceae species studied had tissular chromium concentrations above average, while metal levels in surrounding soil were within the normal range. The highest concentrations (although not constant) were found in *Leymus racemosus*. This species also had an average BAC higher than 0.5, while the other two had BAC below 0.2.

None of the species is a high accumulator, according to acknowledged tissular concentration thresholds or BAC values. *L. racemosus* might prove suitable for certain phytostabilization or even phytoextraction purposes, but only after further laboratory research.

REFERENCES

Amaria B., Brahim L., 2016, Cr (III) and Cr (VI) absorption and translocation of *Atriplex halimus* L., International Journal of Biosciences, 9 (6), 234-246.

Jacobsen N., von Bothmer R. 1995, Taxonomy in the *Hordeum murinum* complex (Poaceae), Nordic Journal of Botany, 15, 449-458.

López-Luna J., González-Chávez M.C., Esparza-García F.J., Rodríguez-Vázquez R., 2009, Toxicity assessment of soil amended with tannery sludge, trivalent chromium and hexavalent chromium, using wheat, oat and sorghum plants, Journal of Hazardous Materials, 163, 829-834.

Nazir A., Malik R.N., Ajaib M., Khan N., Siddiqui M.F., 2011, Hyperaccumulators of heavy metals of industrial areas of Islamabad and Rawalpindi, Pakistan Journal of Botany, 43 (4), 1925-1933.

Obasi N.A., Akubugwo E.I., Kalu K.M., Ugbogu O.C., 2013, Speciation of heavy metals and phyto-accumulation potentials of selected plants on major dumpsites in Umuahia, Abia State, Nigeria, International Journal of Current Biochemistry Research, 1 (4), 16-18.

Ogle D., Engle S., Shewmaker G., 2008, Plant guide for perennial ryegrass (*Lolium perenne* L. ssp. *perenne*), USDA-Natural Resources Conservation Service, Aberdeen, ID Plant Materials Center, http://plants.usda.gov/plantguide/pdf/pg_lopep.pdf.

Oliveira H., 2012, Chromium as an environmental pollutant: insights on induced plant toxicity, Journal of Botany, 2012, doi: 10.1155/2012/375843.

Popoviciu D.R., Negreanu-Pîrjol T., Bercu R., 2016, Copper, chromium, zinc and manganese accumulation in three common Brassicaceae on the Romanian littoral, Revista de Chimie, 67 (4), 670-673.

Popoviciu D.R., Negreanu-Pîrjol B.Ș., Bercu R., Negreanu-Pîrjol T., 2017, Chromium bioaccumulation in some herbaceous species from Constanţa littoral area (Romania), SGEM 2017: 17th International Multidisciplinary Scientific GeoConference, 17 (61), 1183-1189.

Rascio N., Navari-Izzo F., 2011, Heavy metal hyperaccumulating plants: how and why do they do it? And what makes them so interesting? Plant Science, 180, 199-181.

Sekabira K., Oryem-Origa H., Mutumba G., Kakudidi E., Basamba T.A., 2011, Heavy metal phytoremediation by *Commelina benghalensis* (L) and *Cynodon dactylon* (L) growing in urban stream sediments, International Journal of Plant Physiology and Biochemistry, 3(8), 133-142.

Shanker A.K., Cervantes C., Loza-Tavera H., Avudainayagam S., 2005, Chromium toxicity in plants, Environment International, 31, 739-753.

Shanker A.K., Djanaguiraman M., Sudhagar R., Chandrashekar C.N., Pathmanabhan G., 2004, Differential antioxidative response of ascorbate glutathione pathway enzymes and metabolites to chromium speciation stress in green gram (*Vigna radiata* (L.) R. Wilczek. cv CO 4) roots, Plant Science, 166, 1035-1043.

St. John L., Ogle D.G., Stannard M., Pavek P., 2010, Plant guide for mammoth wildrye (*Leymus racemosus*), USDA-Natural Resources Conservation Service, Aberdeen, ID Plant Materials Center, http://plants.usda.gov/plantguide/pdf/pg_lera5.pdf.

Tang Y.T., Deng T.H.B., Wu Q.H., Wang S.Z., Qiu R.L., Wei Z.B., Guo X.F., Wu Q.T., Lei M., Chen T.B., Echevarria G., Sterckeman T., Simonnot M.O., Morel J.L., 2012, Designing cropping systems for metal-contaminated sites: a review, Pedosphere, 22 (4), 470-488.

Van der Ent A., Baker A.J.M., Reeves R.D., Pollard A.J., Schat H., 2013, Hyperaccumulators of metal and metalloid trace elements: Facts and fiction, Plant and Soil, 362 (1-2), 319-334.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

CHROMIUM BIOACCUMULATION IN THREE COMMON WOODY SPECIES

Dan Răzvan Popoviciu[1]*, Rodica Bercu[1], Ticuţa Negreanu-Pîrjol[2]

„Ovidius" University of Constanţa, Faculty of Natural Sciences and Agricultural Sciences, Constanţa, Romania
[2]„Ovidius" University of Constanţa, Faculty of Pharmacy, Constanţa, Romania
* *Correspondence author. E-mail*: dr_popoviciu@yahoo.com

Keywords*: Ailanthus altissima, Robinia pseudoacacia, Salix alba, bioaccumulation, chromium*

ABSTRACT

Chromium levels were determined (through HR-CS-AAS) in tissular samples and rhizospheric soil from three commmon woody species: Ailanthus altissima (Mill.) Swingle, Robinia pseudoacacia L., Salix alba L., also calculating Biological Accumulation Coefficients (BAC).

The highest average Cr content was found in R. pseudoacacia (15.38 mg/kg, but with high individual variations), higher than "standard reference" (1.5 mg/kg), lower than hyperaccumulation thresholds (1,000/300 mg/kg) All selected species were moderate accumulators (with average BAC of 0.12-0.44). .

Results show a limited accumulation potential and phytoextractive value in the three selected species.

INTRODUCTION

Heavy metals are an important resource for industry and not only. They are also common pollutants, affecting agriculture, livestock, human health and biodiversity. While high levels of heavy metals in soil are toxic to most plants, some species are able to tolerate and even accumulate them in their organs.

Phytoaccumulation in specific aboveground organs, or metal sequestration at root level are two strategies employed for preventing the intoxication of more sensitive tissues. In extreme cases, some plants are able to accumulate 100-1,000 times more metal ions than the surrounding vegetation – the so-called "hyperaccumulation" (Rascio & Navari-Izzo 2011, Tang et al. 2012).

Potential applications include phytoprospection (metal ore-indicating plants), phytoremediation (cleaning polluted soils by phtyostabilization at root level or phytoextraction and cropping), or even phytomining subeconomic metal ores.

This is why searching for naturally bioaccumulating species and enhancement methods is of great scientific importance. The aim of this study (part of a wider screening effort of local flora) was determine natural chromium accumulation potential in three woody species widely found in Romania.

Chromium (as trivalent or hexavalent ions) is found in chromite, crocoite, bentorite, tarapacaite, vauquelinite and other minerals. Soils usually contain 10-50 mg/kg Cr ions. It is used in metallurgy (for alloys), electroplating, dye industry, or tanning industry (a major source of chromium pollution; Oliveira 2012).

For plants, Cr a non-essential element. It usually accumulates in root cell vacuoles. At high concentrations, it affects proper root development and water absorption. It also hinders general plant growth and productivity, photosynthesis and

seed germination (Shanker et al. 2005). However, some species are known to be Cr bioaccumulators: *Amaranthus dubius*, *Brachiaria decumbens Convolvulus arvensis*, *Dyera costulata*, *Genipa americana*, *Ipomoea aquatica*, *Pennisetum purpureum*, *Pluchea indica* (Oliveira 2012).

The three species studied in this research are trees and shrubs commonly growing as ornamental, spontaneous, or even invasive in many temperate areas.

Ailanthus altissima (Mill.) Swingle (tree-of-heaven, Chinese sumac), from the Simaroubaceae family is native to North-Central China. A medium tree, (up to 18-30 m), with taproot and large pinnated-compound leaves. It is dioecious. An invasive species, it grows in many parts of the world, on variate soil types, various climates (mostly warm/temperate, including arid climates, but not particularly resistant to frost). Vegetative reproduction (through root sprouts) is one of the causes of its invasivity. It is cultivated for ornamental, soil stabilization or, sometimes, medicinal purposes (Kowarik & Säumel, 2007).

Robinia pseudoacacia L. (black locust, false acacia, Chinese scholar tree), from the Fabaceae family, is a medium tree (up to 30 m), with gray/dark-brown bark, pinnated-compound leaves, spiny stipules, white flowers froming pendulous racemes, dark brown legume fruits. Native to Southeastern USA, it is found worldwide. It tolerates variate soil types, but not frost and shade. It is cultivated for ornamental purposes, soil nitrogen enrichment and apiculture (Sitzia et al. 2016).

Salix alba L. (white willow), from the Salicaceae family, is a medium tree or shrub, native to Northern Eurasia, and common in most temperate areas. It has dark grey bark, yellow-orange on new branches, silver-grey, lanceolate leaves and catkins for both male and female flowers. It is dioecious, it reproduces by seeds and twigs. It prefers wetland areas, or other moist areas moisture. It is cultivated in some areas for wood, ornamental or medicinal purposes (Houston Durrant et al. 2016).

MATERIAL AND METHODS

Plant material (branch fragments) was collected from coastal ridges adjacent to “Trei Papuci” and “Modern” beaches, Constanţa, Romania (triplicate samples per species, from different areas). Adjacent soil samples were also collected for comparison.

Samples were fragmented into small pieces and oven-dried (3 days, 80ºC). 0.25 g of each sample were left overnight in 5 mL concentrated HNO_3 and boiled in oven (1 hour, 150ºC). 2 mL of 30 % H_2O_2 were added and the samples were boiled again, for 2 hours. Samples were diluted to 50 mL with distilled water, also adding 0.5 % $CaCl_2$ and 2 % NH_4Cl (Shanker et al. 2004, Popoviciu et al. 2016, Popoviciu et al. 2017).

Metal concentrations were determined by using a HR-CS Atomic Absorption Spectrometer (ContrAA700, Analytik Jena AG), with air-acetylene flame (357 nm wavelength) and expressed as mg/kg.

Subsequently, the biological accumulation coefficients were calculated, based on plant and soil metal concentrations (BAC; Nazir et al. 2011, Obasi et al. 2013):

$$BAC = [Cr]_{Shoot}/[Cr]_{Soil}.$$

RESULTS AND DISCUSSIONS

Average tissular metal concentrations are shown in Fig. 1 shows tissular Cr concentrations in plant samples (average values) and Fig. 2 shows average Cr concentrations in soil samples (1.9 mg/kg is the minimal detection limit for the device used). Fig. 3 shows BAC average values for each of the three species species.

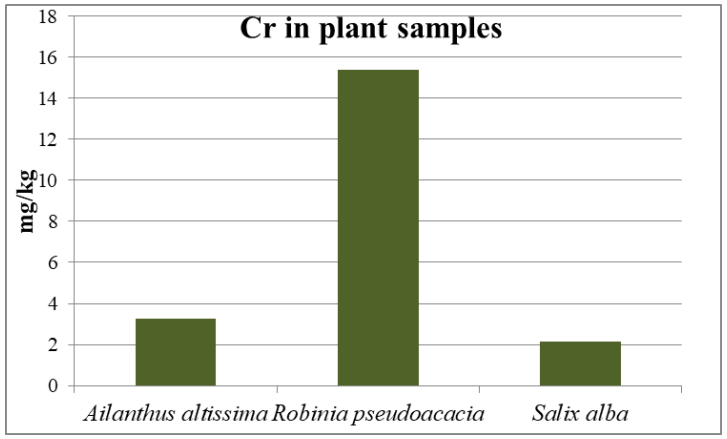


Figure 1. Average chromium concentrations in branch tissues of selected species (mg/kg; dry weight).

Most plants accumulate and store only low amounts of chromium. For comparison, a so-called „standard reference plant" (a theoretical model based on average values in worldwide flora) would contain 1.5 mg/kg (Van der Ent et al. 2013). Among the three species investigated, *A. altissima* and *S. alba* had tissular Cr levels similar to the „reference plant". The average for R. *pseudoacacia* was higher, but only due one single individual (with 46.14 mg/kg).

Soil concentrations ranged between above detection limit to 67.25 mg/kg (Fig. 2), with high variations, but mostly within the normal range (10-50 mg/kg; Oliveira 2012). The highest Cr levels in plant tissue were encountered in a black locust indvidual growing on the soil with the lowest Cr concentration.

Cr hyperaccumulation is considered to start from 1,000 mg/kg concentration in aboveground organs, with no significant toxic effects. An alternative value is 300 mg/kg (Rascio & Navari-Izzo 2011, Van der Ent et al. 2013). Both are much higher than those found in this study.

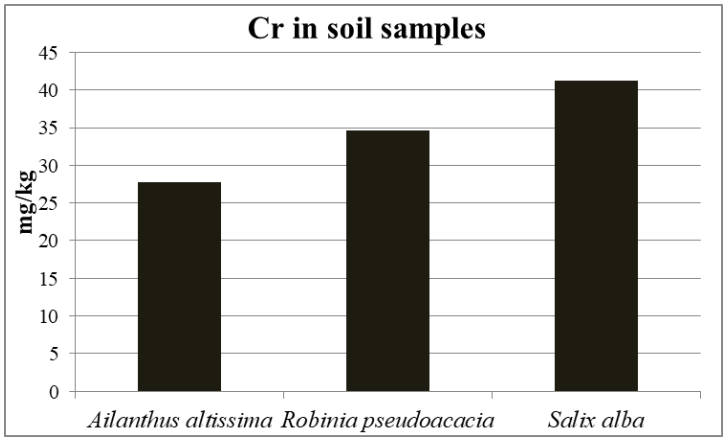


Figure 2. Average chromium concentrations in rhizospheric soil for selected species (mg/kg; dry weight).

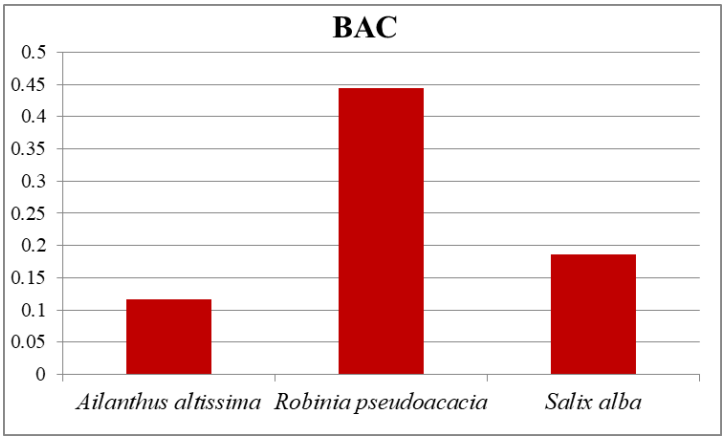


Figure 3. Average chromium biological accumulation coefficients for selected species.

Biological accumulation coefficient (BAC) values are useful for identifying plants that naturally concentrate more metal ions than in the surrounding environment and store them in harvestable organs. It should be noted that BAC for one species is often can be variable, mostly due to soil factors, such as metal concentration or nutrients (Rascio & Navari-Izzo 2011, Van der Ent et al. 2013).

According to their BAC, plants can be classified in non-accumulators (BAC<0.01), low accumulators (0.01-0.1), moderate accumulators (0.1-1) and high accumulators/hyperaccumulators (>1; Sekabira et al., 2011). Thus, *A. altissima* and *S. alba* are at the lower limit between low and moderate accumulation. R. pseudoacacia ranks higher (BAC=0.44), but only due to one isolate accumulation event – on soil with extremely low Cr levels.

Such results are to those obtained on some Poaceae of agricultural interest (oat, sorghum, wheat; López-Luna et al. 2009), or various ruderal herbaceous species (Amaria & Brahim 2016, Popoviciu et al. 2017) and do not indicate any valuable phytoextractive potential).

CONCLUSIONS

The three species investigated had tissular chromium levels close to the normal average. In the case of *R. pseudoacacia*, the average value was higher due to a single accumulation event, on soils with very low Cr content, which does not indicate a valuable trait.

BAC values indicated low to moderate accumulation. Thus, none of the three species is a valuable phytoextractor, on soils with normal Cr concentrations and under normal conditions. For eventual phytostabilization properties (root sequestration), further investgations are required.

REFERENCES

Amaria B., Brahim L., 2016, Cr (III) and Cr (VI) absorption and translocation of *Atriplex halimus* L., International Journal of Biosciences, 9 (6), 234-246.

Houston Durrant T., de Rigo D., Caudullo G., 2016, *Salix alba* in Europe: distribution, habitat, usage and threats, in San-Miguel-Ayanz J. & al. (eds.), European Atlas of Forest Tree Species, Publications Office of the European Union, Luxembourg, pp. 168.

Kowarik I., Säumel I., 2007, Biological flora of Central Europe: *Ailanthus altissima* (Mill.) Swingle, Perspectives in Plant Ecology, Evolution and Systematics., 8, 207-237.

López-Luna J., González-Chávez M.C., Esparza-García F.J., Rodríguez-Vázquez R., 2009, Toxicity assessment of soil amended with tannery sludge, trivalent chromium and hexavalent chromium, using wheat, oat and sorghum plants, Journal of Hazardous Materials, 163, 829-834.

Nazir A., Malik R.N., Ajaib M., Khan N., Siddiqui M.F., 2011, Hyperaccumulators of heavy metals of industrial areas of Islamabad and Rawalpindi, Pakistan Journal of Botany, 43 (4), 1925-1933.

Obasi N.A., Akubugwo E.I., Kalu K.M., Ugbogu O.C., 2013, Speciation of heavy metals and phyto-accumulation potentials of selected plants on major dumpsites in Umuahia, Abia State, Nigeria, International Journal of Current Biochemistry Research, 1 (4), 16-18.

Oliveira H., 2012, Chromium as an environmental pollutant: insights on induced plant toxicity, Journal of Botany, 2012, doi: 10.1155/2012/375843.

Popoviciu D.R., Negreanu-Pîrjol T., Bercu R., 2016, Copper, chromium, zinc and manganese accumulation in three common Brassicaceae on the Romanian littoral, Revista de Chimie, 67 (4), 670-673.

Popoviciu D.R., Negreanu-Pîrjol B.Ș., Bercu R., Negreanu-Pîrjol T., 2017, Chromium bioaccumulation in some herbaceous species from Constanţa littoral area (Romania), SGEM 2017: 17th International Multidisciplinary Scientific GeoConference, 17 (61), 1183-1189.

Rascio N., Navari-Izzo F., 2011, Heavy metal hyperaccumulating plants: how and why do they do it? And what makes them so interesting? Plant Science, 180, 199-181.

Sekabira K., Oryem-Origa H., Mutumba G., Kakudidi E., Basamba T.A., 2011, Heavy metal phytoremediation by *Commelina benghalensis* (L) and *Cynodon dactylon* (L) growing in urban stream sediments, International Journal of Plant Physiology and Biochemistry, 3(8), 133-142.

Shanker A.K., Cervantes C., Loza-Tavera H., Avudainayagam S., 2005, Chromium toxicity in plants, Environment International, 31, 739-753.

Shanker A.K., Djanaguiraman M., Sudhagar R., Chandrashekar C.N., Pathmanabhan G., 2004, Differential antioxidative response of ascorbate glutathione pathway enzymes and metabolites to chromium speciation stress in green gram (*Vigna radiata* (L.) R. Wilczek. cv CO 4) roots, Plant Science, 166, 1035-1043.

Sitzia T., Cierjacks A., de Rigo D., Caudullo G., 2016, *Robinia pseudoacacia* in Europe: distribution, habitat, usage and threats, in San-Miguel-Ayanz J. & al. (eds.), European Atlas of Forest Tree Species, Publications Office of the European Union, Luxembourg, pp. 166-167.

Tang Y.T., Deng T.H.B., Wu Q.H., Wang S.Z., Qiu R.L., Wei Z.B., Guo X.F., Wu Q.T., Lei M., Chen T.B., Echevarria G., Sterckeman T., Simonnot M.O., Morel J.L., 2012, Designing cropping systems for metal-contaminated sites: a review, Pedosphere, 22 (4), 470-488.

Van der Ent A., Baker A.J.M., Reeves R.D., Pollard A.J., Schat H., 2013, Hyperaccumulators of metal and metalloid trace elements: Facts and fiction, Plant and Soil, 362 (1-2), 319-334.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

STATUS OF FOREST HABITATS THE CONSERVATION IDENTIFIED IN SEVERAL PROTECTED AREAS FROM OLTENIA NATURA 2000 SITES (I)

Răduţoiu Daniel[1], Dinulescu Laura Gabriela[2]

1 - University of Craiova, Faculty of Horticulture, Biology and Environmental Engineering Department A.I. Cuza Street, no 13, RO 200585, Craiova, Romania e-mail: radutoiudaniel@yahoo.com
2 - University of Craiova, Master student, Biodiversity and Conservation of Ecosystems

Keywords: *conservation status, forest habitats, NATURA 2000, Oltenia, Romania.*

ABSTRACT

The present paper renders the results of our research concerning the conservation status of the forest from two NATURA 2000 sites located in Oltenia: ROSCI0202 Oltenia Forest Steppe and ROSCI0039 Ciuperceni - Desa. Within these sites, there are two habitats: 91M0 Pannonian-Balkanic turkey oak – sessile oak forests, 91I0 Euro-Siberian steppic woods with Quercus spp.*

The investigation of the conservation status of these habitats was carried out by assessing their conservation status at EU level, namely by including them into one of the four categories - "favourable", "unfavourable-inadequate", "unfavourable-bad", and "unknown" - according to the stated attributes for each habitat, to the threats of destruction and to the dangers that may lead to their destruction or disappearance.

INTRODUCTION

In order to know the conservation status of the habitats within a certain protected area it is required to assess this matter from the viewpoint of the surface occupied by those habitats, of their structure and functions and of their future perspectives.

One of the main issues regarding protected areas consists in their difficult management in the framework of different ownership types.

The measures stipulated by the *Habitats* Directive aim at maintaining or at restoring to a favourable conservation status the natural habitat types, as well as the wild fauna and flora species of community interest (Article 2.2. of the *Habitats* Directive/Council Directive 92/43 EEC).

In order to achieve an objective assessment, the specialised literature data has been harmonised with field information collected by the author and subsequently processed in the laboratory.

Data concerning the study of the habitats within these two areas is scarce in the papers published up to the present (Răduțoiu, 2015), whereas information regarding flora and vegetation is present in numerous studies that deal with the two aspects at the level of certain areas (Buia, 1959; Păun, 1966, 1967, 1985; Cârțu, 1968; Cârțu, 1971; Popescu, 1988; Dihoru and Negrean, 2009).

The two habitat types under analysis offer optimum development conditions to many species of community interest, such as the Scarlet Peony - *Paeonia peregrina*, the Stag Beetle - *Lucanus cervus*, *Carabus hungaricus*, the Greater Capricorn Beetle - *Cerambyx cerdo*, etc.

MATERIAL AND METHODS

The reference values for the favourable status must be assessed according to scientific principles. Their ascertainment for the favourable state is not simple, even if these concepts are not new and they are tackled in a number of scientific papers (Soule and Orians (eds.), 2001; Primack, 2008).

They can differ from those stated in the management plan of the area, because the level of knowledge, understanding and maintenance of conservation measures for habitats may vary from one year to another.

The assessment of the conservation status is more accurate when the knowledge level increases and the volume of collected data is more important. The first such evaluation of the conservation status of a habitat type must be regarded as the starting point in the gradual process of scientific understanding improvement and of increasing the quantity of available data (for example, as a result of the monitoring in accordance with the provisions of Article 11, the *Habitats* Directive).

The conservation status of a natural habitat is considered "favourable" if the natural area of the habitat, as well as the extent of the surfaces covered by the habitat are stable or increasing and if the perspectives show a future progress without significant changes in the existing policy and management.

The unfavourable conservation status falls into two classes: "unfavourable-inadequate" - for those situations when a change at the level of policies or of the management is necessary in order to restore the habitat type or the species to a favourable conservation status, but there is no danger of extinction in the predictable future (e.g.: 50 – 100 years); "unfavourable-bad" - for those situations when the habitat type or the species are threatened with extinction in the foreseeable future (e.g.: 50 – 100 years).

The parameters used to evaluate the conservation status of a habitat are the natural distribution range, the area covered by the habitat, the specific structure and functionality of the habitat, and the future prospects that are associated with it (Combroux and Schwoerer, 2007).

The codes and the description of the habitat types correspond to NATURA 2000 and the Romanian classification system (Doniţă et al., 2005; Doniţă et al., 2006, Gafta and Mountford, 2008).

A colour-coding system was adopted for the graphic representation of the four conservation states (following the guidance document issued by the European Commission: *Assessment and reporting under Article 17 of the Habitats Directive: Reporting formats for 2007-2012 period*): red for "unfavourable-bad" (abbreviation U2); orange for "unfavourable-inadequate" (U1); green for "favourable" (FV); grey for "unknown" (XX).

Specialised field guides were used in order to identify all the species within the analysed habitats (Beldie, 1977, 1979; Ciocârlan, 2009; Sârbu et al., 2013).

The vegetation of these habitats was classified according to the specialized Romanian literature (Sanda et al. 1980, Sanda et al. 2001, Sanda, 2002).

The *Oltenia Forest Steppe* site (Ro: *Silvostepa Olteniei*) is located in the western part of Oltenia Plain, i.e. within the Desnățui Plain, at the contact with the Getic Tableland.

The site consists of six forest plots that cover 9,297 ha (ROSCI0202). 91E0* extends on a surface of 108.4 ha, i.e. 1.2 % of the total site area, 91M0 – 6,487 ha, i.e. 70.7 % of the site, and 91I0* - 975.4 ha, i.e. 10.5 % of the entire site. The territorial boundaries of the six areas that compose the site are marked by the irregular outline of the forest plots, which separates them from the surrounding agricultural land.

The site overlaps the *Poiana Bujorului* Reserve within Plenița Forest.

The *Ciuperceni-Desa* site is located in the Danube Alluvial Plain and it covers a surface of 40,853 ha (ROSCI0039). 91I0* extends over 204.26 ha (i.e. 0.5 % of the area), 91F0 – 40.85 ha (0.1 % of the site), and 92A0 – 1,225.59 ha (3 % of the total area).

RESULTS AND DISCUSSIONS

Following the objective assessment of the field reality during multiple years (2012-2018), it can be stated that we achieved a correct description of the two analysed habitats within the two areas, as well as an adequate framing of the vegetation type characteristic to each habitat and an evaluation of their conservation status that is as accurate as possible.

91M0 Pannonian-Balkanic turkey oak – sessile oak forests

This habitat has the most important range in the Oltenia Forest Steppe site.

Information concerning the phytocoenoses of these forests is mentioned by Păun (1966), Mariana Cârţu (1971) for the Amaradia basin, Cârţu D. (1968) for the area between the Jiu - the Desnăţui - Craiova, Popescu Gh. (1988). They vegetate on soils with seasonal oscillations of humidity (excessively moist during spring and dry during summer).

The association composition highlights the constancy of some species for the recognition of the order *Quercetalia cerris*. These include *Potentilla micrantha*, *Lychnis coronaria*, *Vincetoxicum hirundinaria*, *Lithospermum purpuro-caeruleum*, etc.

The tree layer, which is 10 to 15 meters high, consists of the two recognition species of this vegetation, but with different proportions, Turkey oak or Hungarian oak being dominant. Besides them, *Quercus polycarpa* has a sporadic presence.

The shrub layer, well developed in some phytocoenoses consists of numerous species: *Acer campestre*, *A. tataricum*, *Crataegus monogyna*, *Rosa canina*, *Ligustrum vulgare*, etc.

Certain rare species within the spontaneous flora of Romania (*Acanthus balcanicus* and *Paeonia peregrina*) were identified in the floristic composition of some surfaces covered by this habitat.

Turkey oak represents a valuable wood, with rapid growth, being excellent as firewood. This importance becomes even more obvious if we consider that Turkey oak and Hungarian oak are marginally demanding species to the environmental conditions of the plain, being able to grow in conditions that are unsuitable to other tree species with narrower ecologic amplitude (Răduţoiu, 2008).

This habitat was identified within the settlements of Radovan, Perişor, Mârza, Vârvoru de Jos, Criva, Castrele Traiane, Pleniţa, Verbiţa, Verbicioara, Seaca de Pădure, Gebleşti, between Carpen and Bucovicior, as well as between Bucovicior and Vela.

The shrubs edified by *Prunus spinosa* with *Crataegus monogyna* are present on the edge of the 91M0 habitat.

Following the numerous field trips conducted in the study-area, on the surfaces covered by this habitat, we can state that the conservation status of the 91M0 habitat - *Pannonian-Balkanic turkey oak - sessile oak forests* within ROSCI0202 Oltenia Forest Steppe protected area is favourable (Figure 1, Table 1).

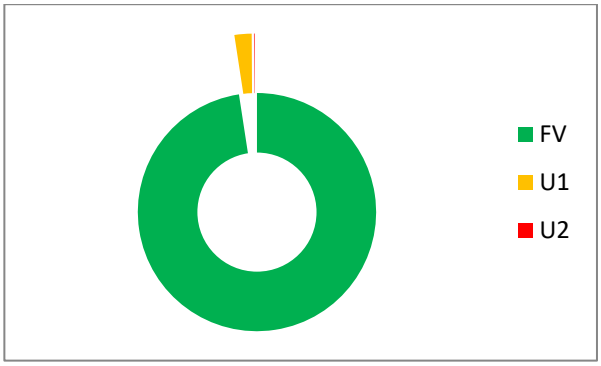


Fig. 1. Conservation status class structure for the 91M0 habitat

91I0* Euro-Siberian steppic woods with Quercus spp.

The typical vegetation of this habitat within the two studied areas belongs to *Aceri tatarici – Quercetum roboris* Zólyomi 1957 (Syn.: *Aceri tatarico-Quercetum pubescentis* Bârcă 1973).

In the Ciuperceni-Desa site, the tree layer displays a good consistency (with 65-80 % coverage) and an obvious stratification. The upper layer, which is 12-14 meters high, is reached by *Quercus robur* and *Carpinus betulus*, whereas the secondary height level belongs to *Acer tataricum*, *Pyrus pyraster* and *Tilia tomentosa*. The shrub layer consists of a high number of species, but the coverage they realise shows low percent values. The regeneration stratum is discontinuous and its presence is not significant, the development of the sapling being affected by the grass layer. The regeneration through root and stump offshoots is more active. The herbaceous layer is dominated by a typically mesophilic flora that includes *Arum orientale*, *Corydalis bulbosa* ssp. *marschalliana*, *Viola canina*.

Table 1.

Assessment of the conservation status for the 91M0 habitat

Parameters	Indicators	Observations
Natural distribution range		The area occupied by this habitat in the site is located in the plain region of Oltenia and in the continental one.
Covered surface		The surface of 6,693.84 ha covered by this habitat is largely identical to that occupied at the moment of designation; major disturbances have not been registered.
Structure and functionality		The unfavourable-inadequate status corresponding to ca. 156 ha is due to the introduction of allochthon species: *Robinia psudacacia, Gleditsia triacanthos*, *Pinus nigra*.
		The unfavourable-bad status corresponding to ca. 6 ha was assigned to those surfaces on which the part of allochthon species exceeds 70 %.
Future perspectives		Future perspectives are good, as long as the appropriate forestry works are complied with.
CONSERVATION STATUS		

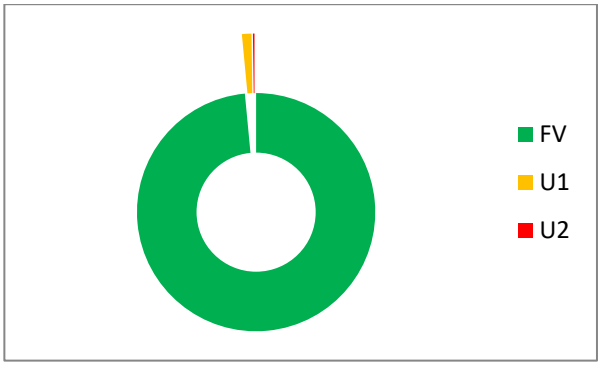


Fig. 2. Conservation status class structure for the 91I0* habitat

Table 2.

Assessment of the conservation status for the 91I0* habitat

Parameters	Indicators	Observations
Natural distribution range		The surface occupied by this habitat in the two areas is located in the plain region of Oltenia and in the continental one.
Covered surface		The surface is largely identical to that occupied at the moment of the designation of the sites; major disturbances have not been registered.
Structure and functionality		The regeneration stratum is discontinuous and its presence is not significant, the development of the sapling being affected by the grass layer.
		The overgrazing conducted on certain areas within the Radovan and Perișor forests.
Future perspectives		Only biotic and abiotic threats exist, but their intensity could be diminished.
CONSERVATION STATUS		

CONCLUSIONS

The analysis of the conservation status corresponding to the forest habitats within the two sites located in Oltenia shows that the 91M0 habitat has very good conservation status on more than 95 % of its surface and the same status corresponds to ca. 80 % of the area of the 91I0* habitat.

The "unfavourable-bad" conservation status displays very low percent values in almost all habitats, with the exception of the 91M0 habitat. Among the main causes that led to the degradation of those surfaces, there are to be mentioned the illegal clearings and the grazing inside the forests. In the absence of urgent measures, the surfaces occupied by these habitats within the two areas might significantly diminish in the near future.

REFERENCES

Beldie Al. 1977. Flora României. Determinator ilustrat al plantelor vasculare. Vol. I. Edit. Acad. Române, Bucureşti, 406 pp.

Beldie Al. 1979. Flora României. Determinator ilustrat al plantelor vasculare. Vol. II. Edit. Acad. Române, Bucureşti, 412 pp.

Buia Al. 1959. Plante rare pentru flora R.P.R. existente în Oltenia. Bul. Com. Ocrot. Monum. Nat.: 13-42. Edit. Acad. Române, Bucureşti.

Cârţu D. 1968. Contribuţii la flora Olteniei. Bul. Şti. Univ. din Craiova, 10: 63-70.

Cârţu Mariana. 1971. Aspecte privind vegetaţia pajiştilor de luncă din Bazinul Amaradiei. Studii şi cercetări. C.C.S.E. Craiova. Intreprinderea Poligrafică Oltenia, Craiova: 93-98.

Ciocârlan V. 2009. Flora ilustrată a României. Pteridophyta et Spermatophyta. 1041 pp. Edit. Ceres, Bucureşti.

Combroux, I., Schwoerer, Ch. 2007. Evaluarea statutului de conservare a habitatelor şi speciilor de interes comunitar din România-Ghid metodologic, 51 pp. și anexele. Edit. Balcanic, Timişoara.

Dihoru Gh. & Negrean G. 2009. Cartea roşie a plantelor vasculare din România. 630 pp. Edit. Acad. Române. Bucureşti.

Doniţă, N., Popescu, A., Paucă-Comănescu, M., Mihăilescu, S., Biriş I.-A. 2005. Habitate din România, Edit. Tehnică Silvică Bucureşti.

Doniţă, N., Popescu, A., Paucă-Comănescu, M., Mihăilescu, S., Biriş I.A. 2006. Habitatele din România. Modificări conform amendamentelor propuse de România şi Bulgaria la Directiva Habitate (92/43/EEC), Edit. Tehnică Silvică, Bucureşti.

Gafta, D., Mountford, O. (coord.), 2008. Manual de interpretare a habitatelor Natura 2000 din România, Edit. Risoprint, Cluj-Napoca.

Păun 1966. Materiale pentru flora şi vegetaţia Raionului Balş. Lucr. Şt. Inst. Agron. T. Vladimirescu" Craiova. Edit. Agro-Silvică, Bucureşti. 6: 35-67.

Păun M. 1967. Vegetaţia Raionului Balş. Regiunea Oltenia. Com. Bot. Bucureşti. Societatea de Ştiinţe Naturale şi Geografie din R.P.R. Bucureşti. 6: 121-127.

Păun M. 1985. Querco-Fagetea Br.-Bl. Vlieg. 37 în Oltenia. Contrib. Bot.: 121-130. Cluj-Napoca.

Popescu Gh. 1988. Phytocoenological consideration on the Quercus cerris L. and Q. frainetto Ten. forest of Oltenia. Rev. Roumanie Biol. Ser. Biol. Veg. 33: 75-91.

Primack R. 2008. A Primer of Conservation Biology. Fourth Edition. Sinauer Associates, Sunderland, MA. 349 pp.

Răduţoiu D. 2008. Flora și vegetația Bazinului Cernei de Olteț. 407 pp. Edit. Sitech. Craiova.

Răduțoiu D. 2015. The conservation status of grassland habitats belonging to protected areas from Oltenia 'Natura 2000' site, Romania. Not. Sci. Biol. 7 (4): 430-434.

Sanda V. & al. 1980. Cenotaxonomia şi corologia grupărilor vegetale din România. Stud. Com. (24) Supliment Ştiinţele Naturii Muzeul Brukenthal: 171 pp. Sibiu.

Sanda V., Popescu A. & Stancu Daniela Ileana 2001. Structura cenotică şi caracterizarea ecologică a fitocenozelor din România. 359 pp. Edit. CONPHIS, Bucureşti.

Sanda V. 2002. Vademecum cenostructural privind covorul vegetal din România. 331 pp. Edit. Vergiliu. Bucureşti.

Sârbu I., Ştefan N. & Oprea A. 2013. Plante vasculare din România. Determinator ilustrat de teren. Edit. VictorBVictor, Bucureşti, 1320 pp.

Soulé M. E., Orians G. H., 2001 - Conservation biology research: its challenges and contexts. In: M. E. Soulé & G. H. Orians (eds), Conservation biology. Society for Conservation Biology, Island Press, Washington, pp. 271-285.

*** Habitats Directive 92/43/EEC – Concil Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (OJ L 206, 22.7.92).

*** ROSCI0202 - Formularul standard Natura 2000 "Silvostepa Olteniei".

*** ROSCI0039 Formularul standard Natura 2000 "Ciuperceni-Desa"

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

STATUS OF FOREST HABITATS THE CONSERVATION IDENTIFIED I N SEVERAL PROTECTED AREAS FROM OLTENIA NATURA 2000 SITES (II)

Răduţoiu Daniel[1], Dinulescu Laura Gabriela[2]

1 - University of Craiova, Faculty of Horticulture, Biology and Environmental Engineering Department A.I. Cuza Street, no 13, RO 200585, Craiova, Romania e-mail: radutoiudaniel@yahoo.com
2 - University of Craiova, Master student, Biodiversity and Conservation of Ecosystems

Keywords: *conservation status, forest habitats, NATURA 2000, Oltenia, Romania.*

ABSTRACT

The present paper renders the results of our research concerning the conservation status of the forest from two NATURA 2000 sites located in Oltenia: ROSCI0202 Oltenia Forest Steppe and ROSCI0039 Ciuperceni - Desa. Within these sites, there are three habitats: 91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae), 91F0 Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris) and 92A0 Salix alba and Populus alba galleries.*

The investigation of the conservation status of these habitats was carried out by assessing their conservation status at EU level, namely by including them into one of the four categories - "favourable", "unfavourable-inadequate", "unfavourable-bad", and "unknown" - according to the stated attributes for each habitat, to the threats of destruction and to the dangers that may lead to their destruction or disappearance.

INTRODUCTION

In order to know the conservation status of the habitats within a certain protected area it is required to assess this matter from the viewpoint of the surface occupied by those habitats, of their structure and functions and of their future perspectives.

One of the main issues regarding protected areas consists in their difficult management in the framework of different ownership types.

The measures stipulated by the *Habitats* Directive aim at maintaining or at restoring to a favourable conservation status the natural habitat types, as well as the wild fauna and flora species of community interest (Article 2.2. of the *Habitats* Directive/Council Directive 92/43 EEC).

In order to achieve an objective assessment, the specialised literature data has been harmonised with field information collected by the author and subsequently processed in the laboratory.

Data concerning the study of the habitats within these two areas is scarce in the papers published up to the present (Răduțoiu, 2015), whereas information regarding flora and vegetation is present in numerous studies that deal with the two aspects at the level of certain areas (Buia, 1959; Păun, 1967; Dihoru and Negrean, 2009).

MATERIAL AND METHODS

The reference values for the favourable status must be assessed according to scientific principles. Their ascertainment for the favourable state is not simple, even if

these concepts are not new and they are tackled in a number of scientific papers (Soule and Orians (eds.), 2001; Primack, 2008).

They can differ from those stated in the management plan of the area, because the level of knowledge, understanding and maintenance of conservation measures for habitats may vary from one year to another.

The assessment of the conservation status is more accurate when the knowledge level increases and the volume of collected data is more important. The first such evaluation of the conservation status of a habitat type must be regarded as the starting point in the gradual process of scientific understanding improvement and of increasing the quantity of available data (for example, as a result of the monitoring in accordance with the provisions of Article 11, the *Habitats* Directive).

The conservation status of a natural habitat is considered "favourable" if the natural area of the habitat, as well as the extent of the surfaces covered by the habitat are stable or increasing and if the perspectives show a future progress without significant changes in the existing policy and management.

The unfavourable conservation status falls into two classes: "unfavourable-inadequate" - for those situations when a change at the level of policies or of the management is necessary in order to restore the habitat type or the species to a favourable conservation status, but there is no danger of extinction in the predictable future (e.g.: 50 – 100 years); "unfavourable-bad" - for those situations when the habitat type or the species are threatened with extinction in the foreseeable future (e.g.: 50 – 100 years).

The parameters used to evaluate the conservation status of a habitat are the natural distribution range, the area covered by the habitat, the specific structure and functionality of the habitat, and the future prospects that are associated with it (Combroux and Schwoerer, 2007).

The codes and the description of the habitat types correspond to NATURA 2000 and the Romanian classification system (Doniţă et al., 2005; Doniţă et al., 2006, Gafta and Mountford, 2008).

A colour-coding system was adopted for the graphic representation of the four conservation states (following the guidance document issued by the European Commission: *Assessment and reporting under Article 17 of the Habitats Directive: Reporting formats for 2007-2012 period*): red for "unfavourable-bad" (abbreviation U2); orange for "unfavourable-inadequate" (U1); green for "favourable" (FV); grey for "unknown" (XX).

Specialised field guides were used in order to identify all the species within the analysed habitats (Beldie, 1977, 1979; Ciocârlan, 2009; Sârbu et al., 2013).

The vegetation of these habitats was classified according to the specialized Romanian literature (Sanda et al. 1980, Sanda et al. 2001, Sanda, 2002).

The *Oltenia Forest Steppe* site (Ro: *Silvostepa Olteniei*) is located in the western part of Oltenia Plain, i.e. within the Desnățui Plain, at the contact with the Getic Tableland.

The site consists of six forest plots that cover 9,297 ha (ROSCI0202). 91E0* extends on a surface of 108.4 ha, i.e. 1.2 % of the total site area, 91M0 – 6,487 ha, i.e. 70.7 % of the site, and 91I0* - 975.4 ha, i.e. 10.5 % of the entire site. The territorial boundaries of the six areas that compose the site are marked by the irregular outline of the forest plots, which separates them from the surrounding agricultural land.

The *Ciuperceni-Desa* site is located in the Danube Alluvial Plain and it covers a surface of 40,853 ha (ROSCI0039). 91I0* extends over 204.26 ha (i.e. 0.5 % of the area), 91F0 – 40.85 ha (0.1 % of the site), and 92A0 – 1,225.59 ha (3 % of the total area).

RESULTS AND DISCUSSIONS

Following the objective assessment of the field reality during multiple years (2012-2018), it can be stated that we achieved a correct description of the three analysed habitats within the two areas, as well as an adequate framing of the vegetation type characteristic to each habitat and an evaluation of their conservation status that is as accurate as possible.

91F0 Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*)

The vegetation of this habitat is well known in Romania and in Oltenia (Popescu et al. 2001). Nevertheless, its phytocoenoses classification is rather difficult. The main association encountered in these areas is *Querco robori-Fraxinetum* Zölyomi 1931.

The research conducted upon this type of vegetation led to the conclusion that the phytocoenoses analysed by us display common and, at the same time, intermediary elements with the descriptions realised by certain botanists (Roman, 1974; Păun, 1985, Popescu et al. 2001).

Consequently, we include the phytocoenoses in the association *Querco robori-Fraxinetum* Zölyomi 1931 (Popescu et al. 2001), considering that the definition corresponds to the presence of the species *Fraxinus angustifolia* subsp*. oxycarpa, F. excelsior*, installed on the place of the former forests of *Quercus robur*, because of the moisture excess (Pop, 1968; Roman, 1974; Păun, 1985).

At national level, these forests are tackled differently (Doltu et al., 1980), depending on the vegetation layer or the area where they have been located.

The association does not cover an important area (40.85 ha). Within these forests, the water table is shallow, the soil being saturated with water almost the entire year.

The relief type is characteristic for the high alluvial plain and the forest type is represented by the mixed foliage riparian forest. The soils are of alluvial type, with mollisols and gleysols.

On the surfaces that are always waterlogged, the ash tree species (*Fraxinus angustifolia* and *Fraxinus excelsior*) are accompanied by *Alnus glutinosa*. *Quercus robur* is absent from these studied areas. As the altitude of the alluvial plain increases and the ground is drier, the European Oak displays abundancy-dominance indices of 1-2.

The *Ulmus* species are present in all surveyed areas, their corresponding abundancy-dominance indices being low.

During the drought periods, when the alluvial plain is not flooded and the ground is not saturated with water, numerous species that are typical of the *Alno-Ulmion* alliance and of the *Salicetalia purpureae* order appear within the phytocoenoses of the association; this demonstrates the common ecology and the sindynamic connections between the associations that are subordinated to them.

The tree layer is dominated by *Fraxinus angustifolia*, *Fraxinus excelsior*, accompanied by *Quercus robur, Ulmus glabra, Ulmus minor, Populus alba, Populus canescens*.

The shrub layer is composed of the following species: *Crataegus monogyna, Acer campestre, Cornus mas, C. sanguinea, Viburnum lantana, Ligustrum vulgare*, etc.

Within the herbaceous layer, *Ranunculus ficaria* ssp. *bulbilifer*, *Scilla bifolia* ssp. *drunensis*, *Viola odorata*, *Anemone nemorosa, A. ranunculoides, Isopyrum thalictroides, Veronica chamaedrys, Polygonatum latifolium, Ornithogalum pyrenaicum*, and *Carex divulsa* are abundant during the vernal season; subsequently, during the summer season, the layer gradually changes and it consists of *Brachypodium sylvaticum, Dactylis glomerata, Geum urbanum, Galium aparine, Agrimonia eupatoria, Cruciata laevipes, Scutellaria hastifolia*, etc.

Analysing the humidity demands of the species located in the surveyed areas, it can be noticed the very good ratio of the mesophytes and of the mesohygrophites. This fact explains once again the variations of the hydrological regime typical of these surfaces. The hygrophilous species prevail during the flood (in areas where *Quercus robur* is nearly absent or it has poor representation), whereas the mesophilic ones are dominant on higher surfaces, where humidity is low.

Within the Ciuperceni – Desa protected area, the conservation status of this habitat is good to moderate (Fig. 1, Table 1).

92A0 *Salix alba* and *Populus alba* galleries

This habitat comprises vegetation located on alluvial soils, with the water table near surface. Obvious changes take place in the floristic composition of the phytocoenoses because of the annual flood.

The vegetation of this habitat belongs to the *Salici – Populetum* association (Tx. 1931) Meyer-Drees 1936.

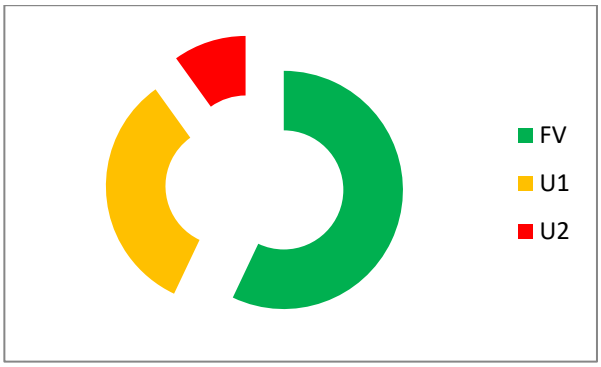


Fig. 1. Conservation status class structure for the 91F0 habitat

Table 1.

Assessment of the conservation status for the 91F0 habitat

Parameters	Indicators	Observations
Natural distribution range		The area occupied by this habitat in the sites is located in the plain region of Oltenia and in the continental one.
Covered surface		The surface in the site is identical. The changes registered in certain areas can be corrected if the interventions are prompt.
Structure and functionality		More than 10 % of the surface of this habitat falls into unfavourable-bad category, because of illegal clearings and of grazing.
Future perspectives		There are human-induced threats that can be diminished if the forestry standards are complied with.
CONSERVATION STATUS		

The willow and poplar forests are frequent on alluvial soils, along watercourses, near water bodies or where water temporarily stagnates.

We shall not conduct a detailed characterization of this association, as it is very well known; only its particular features within the researched area will be mentioned.

The coverage degree within the phytocoenologic surveys that we conducted varies between 85 and 100 %. An obvious stratification is to be noticed within these phytocoenoses: the first layer consists of a large part of species characteristic to the alliance, the order and the class *Salix alba*, *Populus alba,* as well as of species for their recognition; the second layer comprises *Rubus caesius*, *Amorpha fruticosa*, *Vitis sylvestris, Crataegus monogyna, Ligustrum vulgare*; the third layer consists of herbaceous species. The latter layer is strongly influenced by the size and the frequency of recent floods.

Because of the complex combinations realised by the wooden species within the floristic composition of this association, the cenotaxonomic description and classification of these phytocoenoses differs from one author to another.

The conservation status of this habitat within the Ciuperceni-Desa protected area, where it was identified and analysed, is good to moderate.

This type of habitat, which represented the natural vegetation of the Romanian steppe and forest steppe in the past, has favourable conservation status within the two areas (Figure 2, Table 2).

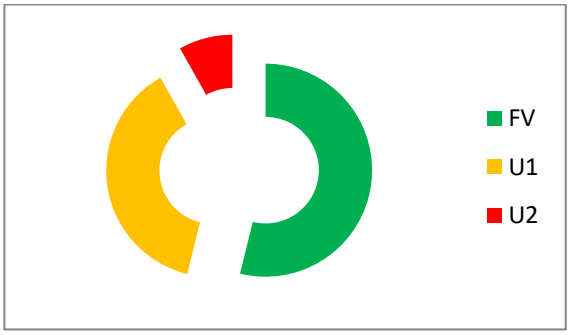


Fig. 2. Conservation status class structure for the 92A0 habitat

Table 2.

Assessment of the conservation status for the 92A0 habitat

Parameters	Indicators	Observations
Natural distribution range		The area occupied by this habitat in the sites is located in the plain region of Oltenia and in the continental one
Covered surface		The surface is largely identical to that occupied by the habitat at the moment of site designation; major disturbances have been registered in certain places.
Structure and functionality		More than 8 % of the surface of this habitat falls into unfavourable-bad category, because of illegal clearings and of grazing.
Future perspectives		There are human-induced threats that must be stopped in order to preserve the surface occupied by this habitat.
CONSERVATION STATUS		

91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

The woodlands with willows grouped in the *Salicion albae* alliance are located along the rivers and their main tributaries. The species vegetate on hygro-mesophillous, alluvial soils or on those rich in organic substances. Among the characteristic species

there are to be mentioned *Salix alba*, *Calystegia sepium*, *Humulus lupulus*, *Populus alba*, *Symphytum officinale,* etc.

In the Oltenia Forest Steppe protected area, the habitat includes alluvial forests edified by the European ash (*Fraxinus excelsior*) and arborescent galleries including tall willow and poplar trees (*Salix alba, Salix fragilis, Populus nigra*), situated along water courses, at low altitudes (e.g. the settlements of Radovan and Ciutura, near Fântânele reservoir – in the area locally known as the *Tail of the Lake*, along the Baboiaşi stream, at the edge of Verbiţa village and in Carpen settlement).

Certain invasive species (*Ambrosia artemisiifolia*, *Cannabis sativa* ssp. *Spontanea*) can disturb the habitat.

Moreover, periodic cleaning measures are required in order to remove the waste accumulated through illegal deliberate disposal near the water or following high water periods when waste material is carried by the overflowing water and left on riverbanks.

The vegetation of this habitat belongs to the association *Salicetum albae* Issler 1924 (Syn. *Salicetum albae-fragilis* Issler 1926 em. Soo 1957)

The phytocoenoses encountered in the study area are present under the shape of longitudinal stripes along both banks of the main rivers. Sometimes, forests edified by European ash (*Fraxinus angustifolia*) are to be found near them (e.g. Radovan – along the Desnăţui stream). On rare occasions, the phytocoenoses of this association form dense riverside coppices, as in the case of Ciuperceni – Desa site.

The upper layers, edified by wooden species, maintain their consistency regardless the climatic conditions during the year, whereas the grass layer undertakes a strong negative influence from the size and the frequency of the floods.

Besides the species that compose the cenotic nucleus of this association, there were also identified other species from neighbouring phytocoenoses: *Urtica dioica, Rubus caesius, Myosoton aquaticum, Lythrum salicaria*, etc.

The 91E0* habitat is characterised by moderate-poor status (Fig. 3, Table 3).

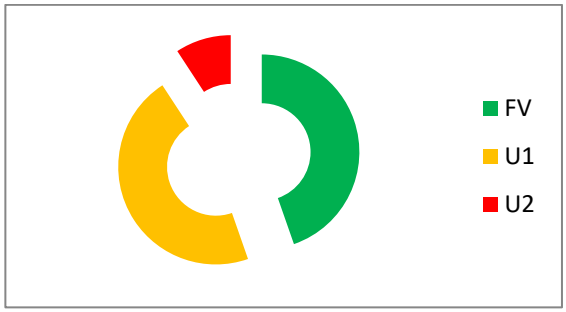


Fig. 3. Conservation status class structure for the 91E0* habitat

Table 3.

Assessment of the conservation status for the 91E0* habitat

Parameters	Indicators	Observations
Natural distribution range		The area covered by this habitat in the sites is located in the plain region of Oltenia and in the continental one.
Covered surface		The surface is largely identical to that occupied by the habitat at the moment of site designation; major disturbances have been registered in certain places.
Structure and functionality		More than 10 % of the surface of this habitat falls into unfavourable-bad category, because of illegal clearings and of grazing.
Future perspectives		There are human-induced threats that can be diminished if the forestry standards are complied with.
CONSERVATION STATUS		

In "Oltenia Forest Steppe", this habitat is located only at the level of Radovan, Perişor and Gebleşti settlements. In Radovan, the shrub layer, which covers limited surfaces, is dominated by Downy Oak (*Quercus pubescens*) and it is represented by small trees on the grasslands edified by *Festuca valesiaca*.

Their physiognomy is given by the European Oak (*Quercus robur*). Secular trees belonging to the species have been identified in some locations (e.g. Radovan and Perișor).

CONCLUSIONS

The analysis of the conservation status corresponding to the forest habitats within the two sites located in Oltenia shows that the 92A0 and the 91F0 habitats are characterised by good to moderate conservation status, whereas the "unfavourable-bad" conservation status corresponds to about 10 % of the 91E0* habitat.

The "unfavourable-bad" conservation status displays very low percent values in almost all habitats. Among the main causes that led to the degradation of those surfaces, there are to be mentioned the illegal clearings and the grazing inside the forests.

REFERENCES

Beldie Al. 1977. Flora României. Determinator ilustrat al plantelor vasculare. Vol. I. Edit. Acad. Române, Bucureşti, 406 pp.

Beldie Al. 1979. Flora României. Determinator ilustrat al plantelor vasculare. Vol. II. Edit. Acad. Române, Bucureşti, 412 pp.

Buia Al. 1959. Plante rare pentru flora R.P.R. existente în Oltenia. Bul. Com. Ocrot. Monum. Nat.: 13-42. Edit. Acad. Române, Bucureşti.

Ciocârlan V. 2009. Flora ilustrată a României. Pteridophyta et Spermatophyta. 1041 pp. Edit. Ceres, Bucureşti.

Combroux, I., Schwoerer, Ch. 2007. Evaluarea statutului de conservare a habitatelor şi speciilor de interes comunitar din România-Ghid metodologic, 51 pp. și anexele. Edit. Balcanic, Timişoara.

Dihoru Gh. & Negrean G. 2009. Cartea roşie a plantelor vasculare din România. 630 pp. Edit. Acad. Române. Bucureşti.

Doltu M.I. Popescu A., Sanda V. 1980. Conspectul asociațiilor vegetale lemnoase din România. Stud. și Comunic. Ști. Nat. Muz. Brukenthal, Sibiu, 24: 315-362

Doniţă, N., Popescu, A., Paucă-Comănescu, M., Mihăilescu, S., Biriş I.-A. 2005. Habitate din România, Edit. Tehnică Silvică Bucureşti.

Doniţă, N., Popescu, A., Paucă-Comănescu, M., Mihăilescu, S., Biriş I.A. 2006. Habitatele din România. Modificări conform amendamentelor propuse de România şi Bulgaria la Directiva Habitate (92/43/EEC), Edit. Tehnică Silvică, Bucureşti.

Gafta, D., Mountford, O. (coord.), 2008. Manual de interpretare a habitatelor Natura 2000 din România, Edit. Risoprint, Cluj-Napoca.

Păun M. 1967. Vegetaţia Raionului Balş. Regiunea Oltenia. Com. Bot. Bucureşti. Societatea de Ştiinţe Naturale şi Geografie din R.P.R. Bucureşti. 6: 121-127.

Păun M. 1985. Querco-Fagetea Br.-Bl. Vlieg. 37 în Oltenia. Contrib. Bot.: 121-130. Cluj-Napoca.

Pop I. 1968. Flora şi vegetaţia Câmpiei Crişurilor. Interfluviul Crişul Negru-Crişul Repede. 280 pp. Edit. Acad. Române. Bucureşti.

Popescu G., Răduţoiu D., Gămăneci Gh. 2001. The flora and the vegetation of the Jilţ Basin, between the localities Negomir and Turceni, Gorj County. Acta Horti Bot. Bucurest. 29: 171-197.

Primack R. 2008. A Primer of Conservation Biology. Fourth Edition. Sinauer Associates, Sunderland, MA. 349 pp.

Răduțoiu D. 2015. The conservation status of grassland habitats belonging to protected areas from Oltenia 'Natura 2000' site, Romania. Not. Sci. Biol. 7 (4): 430-434.

Roman N. 1974. Flora şi vegetaţia din sudul podişului Mehedinţi. 222 pp. Edit. Acad. Române, Bucureşti.

Sanda V. & al. 1980. Cenotaxonomia şi corologia grupărilor vegetale din România. Stud. Com. (24) Supliment Ştiinţele Naturii Muzeul Brukenthal: 171 pp. Sibiu.

Sanda V., Popescu A. & Stancu Daniela Ileana 2001. Structura cenotică şi caracterizarea ecologică a fitocenozelor din România. 359 pp. Edit. CONPHIS, Bucureşti.

Sanda V. 2002. Vademecum cenostructural privind covorul vegetal din România. 331 pp. Edit. Vergiliu. Bucureşti.

Sârbu I., Ştefan N. & Oprea A. 2013. Plante vasculare din România. Determinator ilustrat de teren. Edit. VictorBVictor, Bucureşti, 1320 pp.

Soulé M. E., Orians G. H., 2001 - Conservation biology research: its challenges and contexts. In: M. E. Soulé & G. H. Orians (eds), Conservation biology. Society for Conservation Biology, Island Press, Washington, pp. 271-285.

*** Habitats Directive 92/43/EEC – Concil Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (OJ L 206, 22.7.92).

*** ROSCI0202 - Formularul standard Natura 2000 "Silvostepa Olteniei".

*** ROSCI0039 Formularul standard Natura 2000 "Ciuperceni-Desa"

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓*Biology*
✓*Horticulture*
✓*Food produce processing technology*
✓*Environmental engineering*

HOMEOPATHIC EFFECTS OF SODIUM CHLORIDE HIGH DILUTIONS ON WHEAT SEED GERMINATION AND SEEDLING GROWTH

Rîndaşu Ileana [1], Delian Elena [1]*, Stănică Florin [1]

[1]University of Agronomical Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, Bucharest, Romania
**Corresponding author email*: elenadelian@yahoo.com

Keywords: *Germination indices; Seedlings Vigor; Triticum aestivum; Homeopathic remedies*

ABSTRACT

Germination and early seedlings growth are decisive stages for a good establishment of the plant and implicitly for obtaining a suitable crop, given that especially in these phases different stressors can have a major negative impact. With a view to seeds invigoration, a laboratory experiment has been done by using wheat (Triticum aestivum L.), cv.Glosa and some homeopathic remedies were used for seeds priming, during 24 hrs:V1. NaCl (Natrum muriaticum) – D6; V2. NaCl (Natrum muriaticum) - CH30; V3.NaCl (Natrum muriaticum) - CH200; V4- hydro-priming; V5- non-priming. The obtained results emphasized that the homeopathic remedies had a significant influence on some germination indicators, as mean germination time and mean daily germination (P <0.05). Also, seedlings growth was positively affected by the homeopathic priming treatments. According to our results, the homeopathic remedies may be recommended for further studies as promising alternatives for seeds invigoration.

INTRODUCTION

Homeopathy, a form of complementary medicine, as one of the most controversial subjects in therapeutics was developed by the German physician Samuel Hahnemann (1755–1843) (Swayne, 2000), based on the principle of similitude (like cures like). This method refers to preparations of substances which administrated to healthy subjects determine the manifestation of symptoms, clinical signs and pathological states (see review Ernst, 2002) and when administrated to sick individuals determine the cure of symptoms. Even if many claims that principles on which homeopathy are based are “scientifically implausible” (Lancet, 2005) according to conventional science, homeopathic medicine remain popular (Relton et al., 2017) and there is emerging evidence for its effects *in vitro* and *in vivo* activity (Betti et al., 2010).

Due to population and income growth, as well as rapid urbanization, the global food demand in 2050 is projected to grow by at least 60 percent above 2006 levels (FAO, 2016). Thus, at a globally scale, the way that this requirement can be met is to increase the crop yields (Thirumdas, 2018), to achieve food security under limited arable areas, also to improve the sustainability of agriculture, while reducing its environmental impact **(**Edmondson et al., 2014). Wheat, as one of the most important crop plants worldwide, still remains one of the primary sources of food for human consumption (FAO, 2016). In the same time it is a suitable model plant for physiological studies and not only.

Taking into consideration that in commercial agriculture, rapid and uniform seed germination and seedling emergence are important determinants of successful stand

establishment (Rajjou et al., 2012), germination indices can be appreciated as an effective screening tool in the early stages of plant establishment and also based on their values the physiological traits of a plant at later stages may be surmised (Aflaki et al. 2017). Previous studies have been focused on seed priming as a tool to seeds invigoration by using different practices (Paparella et al., 2015) or physical methods (Araújo et al. ,2016), including those related to plasma **(**Dobrin et al., 2015, cited by Thirumdas, 2018).

The science of Homeopathy has great potentials and could give a new direction that requires attention of the researchers in alternative agriculture (Singhania et al., 2014). To respond to some basic study questions concerning the specificity of homeopathic preparations, healthy plants seem to be a useful tool. Regarding the homeopathic potencies on germination and seedlings growth, wheat is on the first position as an experimental plant model (Betti et al., 2010; Brizzi et al., 2011). There were evaluated the effect of Silver nitrate on seedlings growth; influence of *Arsenicum album* potencies on seeds germination rate and speed of germination; the specific effect of copper sulphate, ferrous sulphate and lead nitrate were also tested with the wheat germination model. The homeopathic potencies effects have been noticed almost in the case of all researches, even if there were used high dilutions, far beyond the Avogadro number (see review Majewsky et al., 2009). Also the positively influence of potentised homeopathic medicine, *Arsenicum album* and *Baryta carbonica* on germination, growth and photosynthetic activity of pea seedlings (*Pisum sativum* L.) was noticed by Panda et al. (2013).

Therefore, the present study was done with a view to use some homeopathic remedies for wheat seeds invigoration.

MATERIAL AND METHODS

Experimental conditions

The experiment has been done at the Faculty of Horticulture of USAMV Bucharest, in laboratory conditions (e.g. a 12-h photoperiod with 150 µmoles photon m^{-2} s^{-1}quantum irradiance, 20°C, 70 % relative humidity).

Biological material and seeds priming treatments

Seeds wheat (*Triticum aestivum* L.) cultivar Glosa were exposed to different priming treatments: V1. NaCl (*Natrum muriaticum*) – D6; V2. NaCl (*Natrum muriaticum*) - CH30; V3.NaCl (*Natrum muriaticum*) - CH200; V4- hydro-priming; V5- non-priming. Four replicates of 25 seeds placed on a filter paper in 9 cm Petri dishes were used, in a factorial experiment based on a completely randomized design. First of all, the seeds were sterilized by sodium hypochlorite 0.5 % for 5 minutes, and after that three times rinsed with distilled water. Then, seeds were submitted to imbibition during 24 hours, in distillated water as well as in different homeopathic remedies as it were mentioned above. The second day, after the seeds air drying they were arranged on Petri dishes and 5 ml distilled water was applied into the dish, as well as on the lid filter paper.

Germination indicators

After 24 hours, during 7 days, the germinated seeds were counted at the same hour every day. A seed was considered as germinated if the radicle protruded the tegument and had 2 mm length. By using these data the following germination indicators have been calculated: cumulative germination percentage (%); electrolytes leakage during seeds imbibition (µS cm^{-1} g^{-1}); final germination percentage (FGP) (%); mean germination time (MGT) (days); mean daily germination (MDG)(number of germinated seeds per day) (Delian and Lagunovschi-Luchian, 2015).

Seedlings vigor

On the seventh day, seedlings were measured for the length of roots and shoots. The following indicators have been established by the following formula: *Seedlings vigour index (SVI)* = seedling length (cm) x final germination percentage (%). *Radicle vigour index (RVI)* = radicle length (cm) × final germination percentage (%). *Shoot vigour index (SVI)* = shoot length (cm) × final germination percentage (Patil et al., 2012, cited by Delian and Lagunovschi-Luchian, 2015).

Statistical analysis

Statistical analysis of the obtained results was done by two-way analysis of variance (ANOVA). To evaluate pairwise significant differences between treatments, means values of the obtained indicators were compared by T test and the differences were taken as significant when P value was ≤ 0.05.

RESULTS AND DISCUSSION

For all homeopathic remedies (HR) used seeds started to germinate at 1 day after sowing (DAS) (33 % of V2), while in the case of V4 and V5 no germination was noticed. Beginning from the second day, a faster germination, with remarkable higher values were registered especially for V2 and V3, a trend that has been later maintained. As we can see in Figure 1, the germination start of hydro-primed (V4) and non-primed seeds (V5) was registered on the second day, with major differences during the germination period, between these variants, in favor of V4. However, germination percentage was close to about 95 %, at 5 days after sowing.

The positive influence of homeopathic remedies can be due to a better water absorption during imbibition period on the one hand (a mean of 51.12 % for V1, V2 and V3, as compared with V4 – 46.98 %), and on the other, possibly an earlier induction of metabolic processes, when the strict germination began. In addition, cellular mechanisms can be triggered based on the imprint memory due to proteins, transcription factors and epigenetics changes induced in primed seed (Chen and Arora, 2013). A faster imbibition after 24 h of imbibition as compared the hydro-priming was also noticed by Mahakham et al. (2017), when rice seeds were primed with homeopathic remedies (AgNPs10 and AgNPs20).

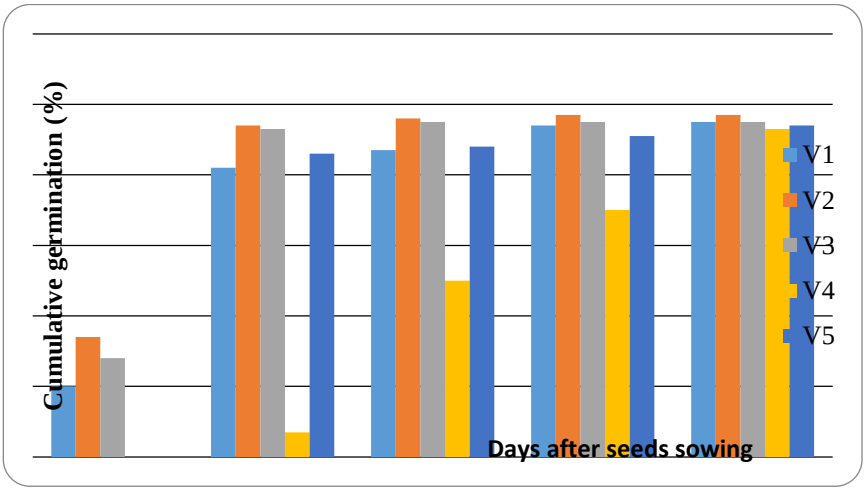


Figure 1. Cumulative germination percentage of wheat seeds under different priming treatments

It can be also mentioned that electrolytes leakage values during imbibition period was lower in the case of V3, as against the hydro-priming (Figure 2), a physiological feature with a major impact on the following germination stages, including those related to seedlings vigor.

These benefits of homeopathic remedies were also reflected into the final germination (FGP) (%) data (Figure 3), with the highest values for V2 (97 %) and the lowest ones for V4 (93 %), even if from the statistical view point, the differences are not significant between variants ($p > 0.05$).

Data presented in Figure 4 show that the mean germination time (MGT) was significantly reduced by homeopathic remedies, from 3.52 days (hydro-primed seeds), to 1.68 days in the case of V3. A lower value was also noticed for V2 (1.69 days) and moreover, even in the case of V1 MGT was significantly lower as against hydro-primed or non-primed seeds.

In addition, regarding the mean daily germination (MDG) data (Figure 5), there can be observed the same trends, with higher and closely values for V3 and V2 (around 39.00) , followed by V1 (22.70). As was expected, the lowest value was registered in the case of V4 (18.60).

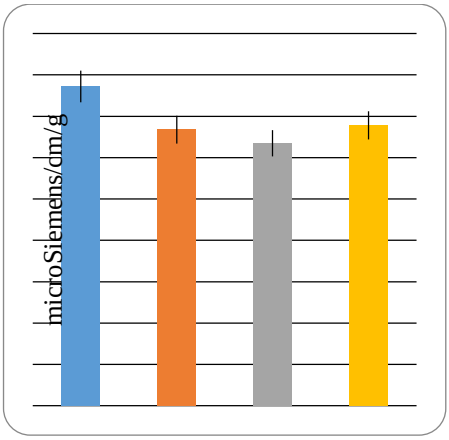


Figure 2. Electrolytes leakage after wheat seeds imbibition period

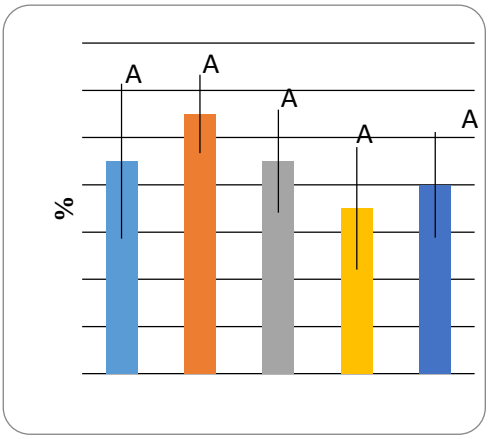


Figure 3. Final wheat seed germination percentage (mean ± SE) (n=4)

Seedlings weight was not significantly influenced in general by the seeds priming treatments, as we can see in Figure 6.A. and Figure 6.B. when shoots and roots fresh weight data were compared with the control value V5, (uppercase letters), or in the case of shoots and roots dry weight (lowercase letters) as against the control. Exception was registered for shoots dry weight, which was significantly higher in the case of V1 (0.007983 g) as against V5 (0.00555 g). The sprouts and roots mass was heavier for both parameters, when compared with the control V5.

Therefore, germination indices can be considered effective screening tools in the early stages of plant establishment. This idea is supported by previous publications, which suggest that physiological traits of a plant at later stages may be surmised by evaluating germination indices.

As we mentioned above, the homeophatic remedies had little effect on the germination speed, while the growth parameters have been influenced. In Figure 7 it can be observed that the seedlings length have been significantly higher, as against the hydro-primed samples.

The sproots length was about two times higher for the treated samples (especially V1 and V3) as compared with the hydro-primed seeds. Also, root to shoot ratio (R/S) had different values (1.27 – for the control -V5 and 0.86 for the homeophatic treatments samples (V2).

Dobrin et al. (2015) obtained remarkably differences concerning these parameters when the cold plasma treatment was applied to wheat seeds (being 0.88 ± 0.016 for the untreated seeds and reaching 1.2 ± 0.005 for the treated samples). The authors' explanation was that this improvement might be due to increased wettability observed for the treated seeds. The cold plasma treatment of seeds has a synergistic effects i.e. it acts as antimicrobial agent (ability to kill wide range of microbes) and enhance the seed germination and plant growth (see review Thirumdas**, 2018).**

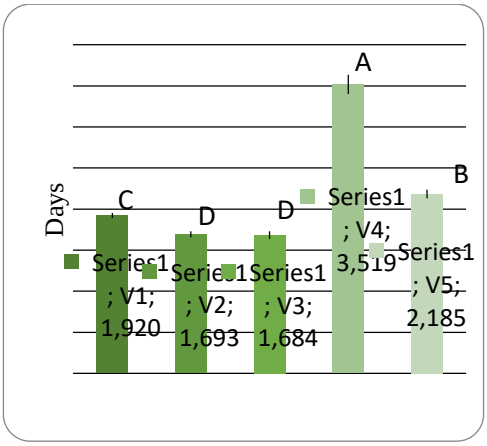


Figure 4. Mean germination time (mean ± SE) (n=4)

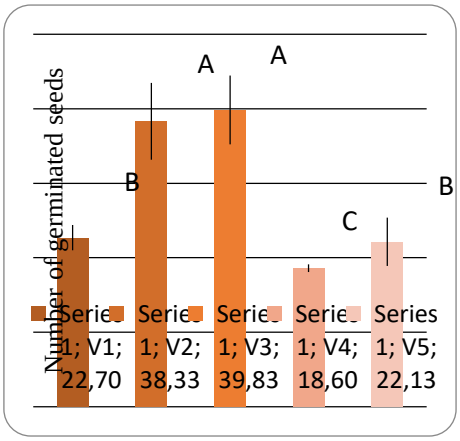


Figure 5. Mean daily germination (mean ± SE) (n=4)

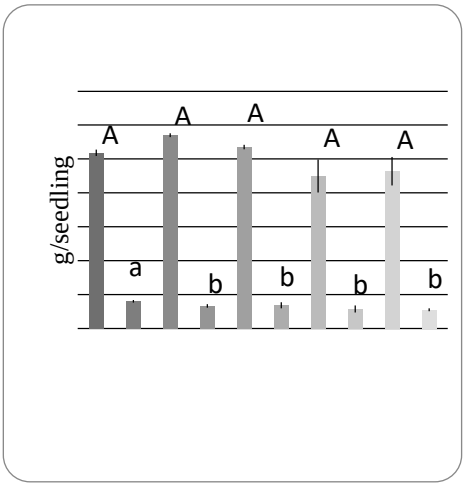


Figure 6.A. Shoot fresh weight (FW) and shoot dry weight (DW) (mean ± SE) (n=4)

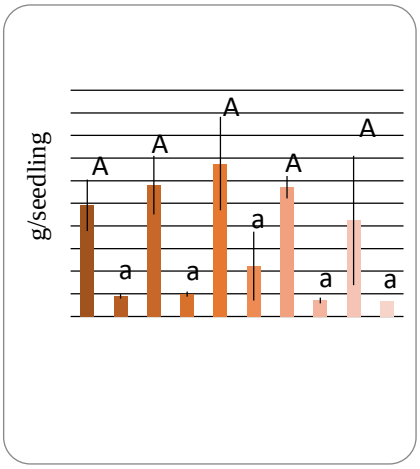


Figure 6.B. Root fresh weight (FW) and root dry weight (DW) (mean ± SE) (n=4)

The homeophatic remedies action mechanism on seeds germination and seedlings growth has not yet been fully elucidated.

Some explanations have recently been done by Mahakham et al. (2017) after the obtained results of the silver nanoparticles (AgNPs) that enhanced seed germination of rice aged seeds. They proposed that nano-priming determined some physiological changes in seeds such as: creation of nanopores that permit a better water uptake, rebooting reactive oxygen species (ROS)/antioxidant systems, an easier wall loosening due to hydroxyl radicals generation, and also a faster starch hydrolysis thanks to nanoparticles catalytic effects.

In fact, there are some similarities between nanoparticles and enzymes; therefore, they are able to mimic natural enzymes activity, as it was noticed by Wei and Wang (2013). In addition, Panda et al. (2013) emphasized the influence of potentised homeopathic medicine, *Arsenicum album* and *Baryta carbonica* on germination, growth and photosynthetic activity of pea seedlings (*Pisum sativum* L.). The effects of three different centesimal potencies (8CH, 32CH, 202CH) of both the medicine were: an increase of plumule and radicle length, with the increase in potency. Also, the photosynthetic pigments content (chlorophyll, carotenoids, and pheophytin) showed similar results. A stimulating effect was noticed on growth as well as on photosynthetic activity, at the higher potency, as compared to untreated one, even after the dilution of drug beyond the Avogadro's number.

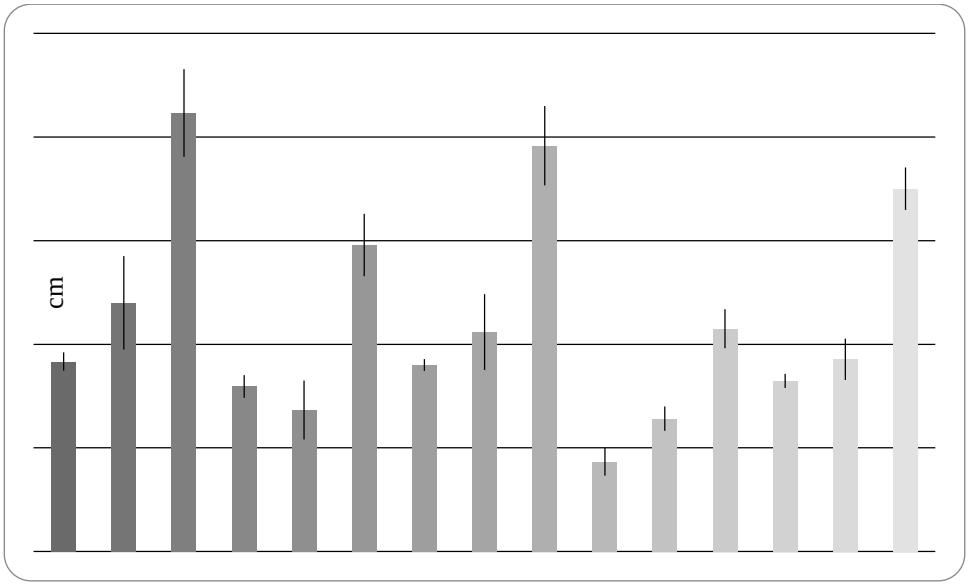


Figure 7. Shoots, roots and seedlings length (means ± SE) (n=4)

CONCLUSIONS

Homeophatic remedies should be a promising alternative for wheat seeds invigoration. Further studies are necessary in order to recommand the more appropriately seeds priming treatments.

REFERENCES

Aflaki, F., Sedghi, M., Pazuki, A., Pessarakli, M. 2017. Investigation of seed germination indices for early selection of salinity tolerant genotypes: A case study in wheat. Emirates Journal of Food and Agriculture. 29(3): 222-226.

Araújo, S.S., Paparella, S., Dondi, D., Bentivoglio, A., Carbonera, D., Balestrazzi, A. 2016. Methods for Seed Invigoration: Advantages and Challenges in Seed Technology. Front Plant Sci. 7: 646.

Betti, L., Trebbi, G., Zurla, M., Nani, D., Peruzzi, M., Brizz, M. 2010. A Review of Three Simple Plant Models and Corresponding Statistical Tools for Basic Research in Homeopathy. The Scientific World Journal*.* 10: 2330–2347.

Brizzi, M., Elia, V., Trebbi, G., Nani, D., Peruzzi, M., Betti, L. 2011. The Efficacy of Ultramolecular Aqueous Dilutions on a Wheat Germination Model as a Function of Heat and Aging-Time. Evid Based Complement Alternat Med. : 696298. doi:10.1093/ecam/nep217.

Chen, K., Arora, R. 2013. Priming memory invokes seed stress tolerance. Environ. Exp. Bot. 94: 33-45.

Dobrin D, Magureanu, M, Mandache, N.B., Ionita, M.D. 2015. The effect of non-thermal plasma treatment on wheat germination and early growth. Innovative Food Science & Emerging Technologies. 29: 255- 260.

Delian, E., Lagunovschi-Luchian,V. 2015. Germination and vigour of primed *Daucus carota* L. seeds under saline stress conditions. Romanian Biotechnological Letters, 20 (5):10833-10840.

Edmondson, J. L., Davies, Z. G., Gaston, K. J., Leake, J. R. 2014. Urban cultivation in allotments maintains soil qualities adversely affected by conventional agriculture. *J. Appl. Ecol.* 51: 880–889.

Ernst, E. 2002. A systematic review of systematic reviews of homeopathy. Br J Clin Pharmacol.54(6): 577–582.

FAO 2016.Food and Agriculture Organization of the United Nations. Rome. The State of Food and Agriculture. Climate Change, Agriculture and Food Security. ISBN 978-92-5-109374-0.

Lancet, 2005.The end of homoeopathy. 366(9487): 690.

Mahakham, W., Sarmah, A.K., Maensiri, S., Theerakulpisut, P. 2017. Nanopriming technology for enhancing germination and starch metabolism of aged rice seeds using phytosynthesized silver nanoparticles. SCIENTIFIC REPORTS | 7: 8263.

Majewsky, V., Arlt, S., Shah, D., 4, Scherr, C., Ja¨ger, T., Betti, L., Trebbi, G., Bonamin, L., Klocke, P., Baumgartner, S. 2009. Use of homeopathic preparations in experimental studies with healthy plants. Homeopathy. 98:228–243.

Panda, S.S., Mohanty, S.S., Dhal, N.K. 2013. Effects of potentised homeopathic medicines on the germination, growth and photosynthetic activity of *Pisum sativum* L. Recent Research in Science and Technology. 5(4): 11-14.

Paparella, S., Araújo, S.S., Rossi, G., Wijayasinghe, M., Carbonera, D., Balestrazzi, A. 2015. Seed priming: state of the art and new perspectives. Plant Cell Rep. 34: 1281-1293.

Patil, J.G., Ahire, M.L., Nikam, T.D. 2012. Influence of Plant Growth Regulators on in Vitro Seed Germination and Seedling Development of Digitalis purpurea L. The Asian and Australasian Journal of Plant Science and Biotechnology*, 6* (Special Issue 1):12-18.

Rajjou, L., Duval, M., Gallardo, K., Catusse, J., Bally, J., Job, C., Job, D. 2012. Seed germination and vigor. Annu. Rev. Plant Biol. 63:507–533.

Relton, C., Cooper, K., Viksveen, P., Fibert, P., Thomas, K. 2017. Prevalence of homeopathy use by the general population worldwide: a systematic review. Homeopathy. http://dx.doi.org/10.1016/j.homp.2017.03.002.

Singhania, P.K., Singhania, A. 2014. Homoeopathy in agriculture. RAHMANN G&AKSOY U (Eds.) Proceedings of the 4thISOFAR Scientific Conference. 'Building Organic Bridges',at the Organic World Congress, 13-15 Oct., Istanbul, Turkey (eprint ID 23727).

Swayne, J. 2000. International Dictionary of Homeopathy. Edinburgh: Churchill Livingstone.

Thirumdas, R. 2018. Exploitation of Cold Plasma Technology for Enhancement of Seed Germination. Agri Res & Tech: Open Access J. 13(2): 555874.

Wei, H., Wang, E. 2013. Nanomaterials with enzyme-like characteristics (nanozymes): next-generation artificial enzymes. Chemical Society Reviews. 42(14):6060-6093.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

RESEARCHES ON THE EVOLUTION OF VINE MOTH IN THE VINEYARD OF S.D. BANU MARACINE

Stan Catalin[1*], Tuca Ovidiu[1] , Ciupeanu Eleonora Daniela[1]

University of Craiova, Faculty of Horticulture, Biology and Environment Protection Department
* *E-mail*: st_catalin2000@yahoo.com

Keywords*: vineyard, vine moth, key pest*

ABSTRACT

This paper presents the researches regarding the evolution of the vine moth during 2017, in the vineyard of S.D. Banu Mărăcine.

Climatic conditions were favorable for the development of the vine moths species, in the case of Lobesia botrana species there were recorded 3 flying peaks that belonged to so many generations. In the case of the species Eupoecilia ambiguella and Sparganotis pilleriana, there were respectively 2 or 1 maximum annual flying, belonging to 2 or 1 generation.

Due to the fact that the vine plantation is newly established, on an uncultivated land area (formerly occupied with spontaneous vegetation), the pests reserve including the moths of the vine was reduced.

INTRODUCTION

Within the vineyard plantation, usually only a few pests have a great economic influence. These are the species that meet year after year, which are called key species, requiring mandatory treatments without which the production obtained cannot be based on the quantitative and qualitative parameters accepted according to the rules in force worldwide (Mary Louise Flint & van den Bosch R.

Vine moths are considered by most specialists to be the most dangerous pests of grapevines, along with mites in the key pest group. (Stan C. 2007).

Among the species of moths found in Oltenia, the most dangerous and for which protection measures are taken, is the green moth Lobesia botrana Den et Schiff. (Mitrea I. et al. 2003).

The prognosis of the grape moth is made by recording the flight curve with the pheromone traps: ATRABOT E 7,for *Lobesia botrana*, a trap for 3 ha or 2 for 5 ha; ATRAPIL E 9 - *Sparganotis pileriana*; ATRAMBIG Z9 - *Eupoecelia ambiguella* (Roșca I. et al., 2000).

The economic damage threshold is reached when are recorded 100 catches / butterflies / trap / week or when 5-7 % of the inflorescences are attacked in the case of the GI generation, or 5-7 % of the total grapes in the case of the GII generation and the GIII generation (Stoian Elisabeta 2001).

MATERIAL AND METHODS

Research on the evolution of moths in the vine was carried out in 2017, in the vineyard plant at S.D. Banu Mărăcine. The plantation was set up in 2016 with different grape varieties (Tamaioasa, Merlot, Feteasca n., Cabernet sauvignon).

The species of vine moths for which the experiments were set during the research period were: Lobesia botrana Den et Schiff., Eupoecilia ambiguella Hb. and Sparganotis pilleriana Den et Schiff. Monitoring the evolution of moth generation was based on catches recorded on atraBOT pheromone traps to capture males of the Lobesia botrana Den et Schiff species., atraAMBIG to capture males of the species Eupoecilia ambiguella Hb. and atraPil for catching specimens of Sparganotis pilleriana Den et Schiff. (Fig.1) Pheromone traps were produced by the Romanian Raluca-Ripan Chemistry Institute Cluj-Napoca. The pheromone traps were installed at the end of April in early May, the norm being 2 traps/ ha. The trap reading was performed over a 7-day period, the captured butterflies being recorded and removed with plastic tweezers to avoid displacement of the adhesive, the replacement of the synthetic pheromone-impregnated capsules and trap adhesive parts was made at a range of 4-5 weeks.

Fig. 1. Feromonal trap atraBot

RESULTS AND DISCUSSIONS

The evolution of the moths in 2017 in the vineyard plantation of SD Banu Mărăcine is correlated with specific climatic conditions, the predominant species being Lobesia botrana Den et Schiff. Adults of the hibernate generation of Lobesia botrana Den et Schiff. have been identified since April 13, 2002, the population level (relative to the number of captured specimens) being moderate. The last butterflies were captured at the end of September. Table nr.1.

Adults of the hibernating generation of Eupoecilia ambiguella have been identified since 04.05.2002 and the population level has been very low and did not require a warning for treatments. Adults of the hibernate generation of Sparganotis pilleriana appeared since 29.06.2002, the population level was very low and did not require a warning for treatments.

Table nr.1

Evolution of vine moths in the vineyard at SD Banu Mărăcine

Year 2017					
Lobesia botrana		Eupoecilia ambiguella		Sparganotis	
Date	Nr. captured males	Date	Nr. captured males	Date observ	Nr. captured males
13.04	1	13.04	-	13.04	-
20.04	5	20.04	-	20.04	-
27.04	11	27.04	-	27.04	-

04.05	32	04.05	1	04.05	0
11.05	71	11.05	5	11.05	0
18.05	125*	18.05	47	18.05	0
25.05	92	25.05	11	25.05	0
01.06	56	01.06	6	01.06	0
08.06	14	08.06	3	08.06	0
15.06	18	15.06	1	15.06	0
22.06	52	22.06	0	22.06	0
29.06	195*	29.06	0	29.06	2
06.07	111	06.07	0	06.07	12
13.07	81	13.07	0	13.07	31
20.07	76	20.07	0	20.07	42
27.07	41	27.07	0	27.07	54
03.08	68	03.08	0	03.08	59
10.08	89	10.08	12	10.08	63
17.08	141*	17.08	29	17.08	27
24.08	89	24.08	57	24.08	19
31.08	42	31.08	12	31.08	3
07.09	37	07.09	4	07.09	1
14.09	25	14.09	0	14.09	0
21.09	13	21.09	0	21.09	0
28.09	3	28.09	0	28.09	0
05.10	1	05.10	0	05.10	0
12.10	0	12.10	0	12.10	0
19.10	0	19.10	0	19.10	0

* = warning of treatments

The climatic conditions of 2017 were favorable for the development of the vine moths species, in the case of Lobesia botrana species there were recorded 3 flying peaks that belonged to so many generations.

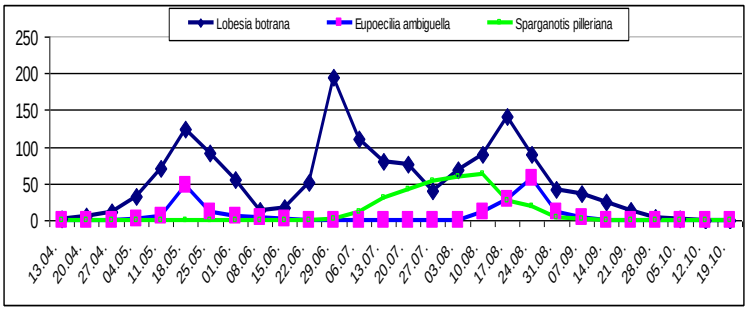


Fig. 2. The dynamics of vine moth flight in correlation with the climatic conditions at SD Banu Mărăcine in 2017

For the hibernating generation (GI), maximum flight (125 butterflies / trap) was recorded in the second decade of May (18.05). The second generation (GII) showed a

maximum flight (195 butterflies / trap) in the third decade of June (29.06), and for the third generation (GIII), the maximum flight (141 butterflies / trap), was recorded in the second decade of August (17.08.). In the case of the species Eupoecilia ambiguella and Sparganotis pilleriana, there were respectively 2 or 1 maximum annual flying, belonging to 2 or 1 generation respectively.

CONCLUSIONS

The vineyard plantation of SD Banu Mărăcine is a young plantation set up on a terrain that was previously occupied by natural grasslands and spontaneous bushes (Crategus monogyna, Prunus spinosa, Rosa canina) so that the biological reserve of vine moths as well as other vines specific pests are very diminished. Besides, there are no vineyards left in the area, which are being overwhelmed by the current owners of the land. This justifies the small number of catches recorded in the pheromone traps for all species of vine moths studied.

REFERENCES

Mary Louise Flint & van den Bosch R., 1981, Introduction to integrated pest management. The Philosophy of Integrated Pest Management pp.107-119. Plenum Press, New York.

Mitrea I., et al., 2003, Combaterea integrată a bolilor, dăunătorilor şi buruienilor la viţa de vie. Lucrările Simpozionului Ştiinţific Internaţional 70 de ani ai Universităţii agrare de stat din Moldova, Seria horticultură, Silvicultură, Protecţia Plantelor, pg. 231, Chişinău

Roșca I. et al., 2000, Combaterea integrată a bolilor și dăunătorilor culturilor agricole, Editura Didactică și Pedagogică R.A., București.

Stan, C., 2007, Cercetări privind combaterea integrată a principalilor dăunători ai plantaţiilor de viţă de vie din Oltenia. Teză de doctorat, Univ. din Craiova, 2007.

Stoian Elisabeta, 2001, Principalele pesticide omologate pentru combaterea dăunătorilor viţei de vie. Rev. Sănătatea plantelor nr. 3/2001.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

RESERACHES ON THE INTEGRATED VINE GREEN MOTH CONTROL (*Lobesia botrana* Den et Schiff.) IN THE VINEYARD OF S.D. BANU MARACINE

Stan Catalin[1*], Ivascu Alexandra[2]

1,University of Craiova,Faculty of Horticulture, Biology and Environment Protection Department,
[2], MA student, Master Program: Ecological Management of Natural Resources (MERN)
* *Correspondence author. E-mail*: st_catalin2000@yahoo.com

Keywords*: vineyard, vine moth, integrated control*

ABSTRACT

This paper presents the researches regarding the integrate control of the vine green moth (*Lobesia botrana* Den et Schiff.) *during 2017, in the vineyard of S.D. Banu Mărăcine.*

The frequency of the vine green moth attack in the year 2017 in the untreated control variant has been recorded with an average of 19.5 %. As a result of the treatments, the average frequency of the attack was considerably reduced: 3.2 % for V5, 2.7 % for V6, 2.2 % for V4, 1.7 % for V3 and 1 % for variant V2. The efficacy of treatments was 94.8 % for V2, 91.5 % for V3, 88.9 % for V4, 86.2 % for V6 and 83.7 % for V5.

INTRODUCTION

Vine moths are considered by most specialists to be the most dangerous pests of grapevines, along with mites in the key pest group. (Stan C. 2007).

Among the species of moths found in Oltenia, the most dangerous and for which protection measures are taken, is the green moth Lobesia botrana Den et Schiff. (Mitrea I. et al. 2003).

The prognosis of the grape moth is made by recording the flight curve with the pheromone traps: ATRABOT E 7, a trap for 3 ha or 2 for 5 ha (Roșca I. et al., 2000).

The economic damage threshold is reached when are recorded 100 catches/butterflies/trap/week or when 5-7 % of the inflorescences are attacked in the case of the GI generation, or 5-7 % of the total grapes in the case of the GII generation and the GIII generation (Stoian Elisabet 2001).

MATERIAL AND METHODS

Research on the integrated control of the the vine green moth was carried out in 2017, in the vineyard plant at S.D. Banu Mărăcine. The plantation was set up in 2016 with different grape varieties (Tamaioasa, Merlot, Cabernet Sauvignon, Feteasca neagra, Chardonay).

Monitoring the evolution of moth generation was based on catches recorded on atraBOT pheromone traps to capture males of the Lobesia botrana Den et Schiff species. Pheromone traps were produced and purchased from the Romanian Raluca-Ripan Chemistry Institute in Cluj-Napoca. Pheromone traps were installed at the end of April. The trap reading was performed over a 7-day period, the captured butterflies being recorded and removed with plastic tweezers to avoid displacement of the adhesive, and

the replacement of the synthetic pheromone-impregnated capsules and trap adhesive parts was made at a range of 4-5 weeks.

The experiments were performed according to the randomized block method, each variant consisting of 100 vines (placed on a row), leaving one row between the variants and applying the treatments using the Solo 546 atomizer. For the biological control of the pest Lobesia botrana Den et Schiff. two species of Trichogramma dendrolimi Mats and Trichogramma embriophagum Htg were used by the use of oofage parasitoids of the genus Trichogramma. For each species, three usage rules were tested: 150,000, 200,000 and 300,000 trichograms / ha / launch respectively.

RESULTS AND DISCUSSIONS

Establishing a warning term for treatments was based on biological, ecological and phenological criteria. For this purpose, the lower biological threshold of the vine green grape moth (Lobesia botrana Den et Schiff.) T0 = 12 ° C, adult flight curve, the host plant phenology as well as the environmental and biological data.

Treatments were performed, with products of Group III and IV toxicity, in order to protect the useful fauna of the vineyards, with an important role in maintaining biochemical balance. In order to increase the effectiveness of the treatments, they were complexed with fungicides, while combating the phytopathogenic agents of the vine. As well it was taken to account the pest's biological reserve, the cultivated variety and the weather conditions during the development and multiplication of the pest.

The dynamics of the vine green moth flight (Lobesia botrana Den et Schiff.) comprised 3 peaks corresponding to the three generations and for each there has been applied a treatment.

Launchers with parasitoids were applied after the adult maximum flight record, after five to seven days, depending on the climatic conditions of each year. The method of launching the oofage parasitoids requires planting white platelets with eggs of the Mediterranean flour moth (Anagasta kuehniella Zell.) parasite by Trichogramma spp. The platelets are installed by hanging on shoots, at different heights each plate contained about 500 parasite eggs.

The frequency of vine green moth attack in the untreated control variant in 2017 has recorded an average value of 19.5 % (Table 1). As a result of the treatments, the average frequency of the attack was considerably reduced: 3.2 % for V5, 2.7 % for V6, 2.2 % for V4, 1.7 % for V3 and 1 % for variant V2.

Table nr.1

Biological efficacy of products used in integrated vine green moth control

Nr. var.	Treatment variant	Attack Frequency (F %)						Efficacy (E %)					
		GI	GII	GIII	Average	Dif. Mt	Signif. dif.	GI	GII	GIII	Average	Dif. Mt	Signif. dif.
V1	Untreated control variant Mt	19	18,5	21	19,5	0	Mt	0	0	0	0	0	Mt
V2	GI- Victenon 50 WP, 1 kg/ha GII- Fastac 10 EC, 0,075 l/ha GIII- Rimon 10 EC, 0,5 kg/ha	0,5	1	1,5	1	-18,5	000	97,3	94,5	92,8	94,8	94,8	xxx
V3	GI- Talstar 10 EC, 0,2 l/ha GII- Calypso 480 SC 0,1 l/ha GIII-Dipel ES, 1 l/ha	1	1,5	2,5	1,7	-17,8	000	94,7	91,8	88,1	91,5	91,5	xx
V4	GI- Bulldock 025 EC, 0,3 l/ha GII- Foray 48B (Biobit XL) 0,1 % GIII-*T. dendrolimii*, 300000/ha/trata.	0,5	3	3	2,2	-17,3	000	97,3	83,7	85,7	88,9	88,9	xx
V5	GI- Calypso 480 SC, 0,1 l/ha GII-10 trap atraBOT/ha GIII- *T. dendrolimii*, 200000 tricog. / ha/trata. + 8 trap/ha	1	4,5	4	3,2	-16,3	00	94,7	75,6	80,9	83,7	83,7	x
V6	GI- Dipel ES 1 l/ha + 8 trap/ha GII-*T. embryophagum*, 300000trich/ ha/treatment GIII-*T. embryophagum*, 300000 trich /ha/treatment	2	3,5	2,5	2,7	-16,8	00	89,4	81,1	88,1	86,2	86,2	x

E %- attack efficacy
F % - attack frequency
G I – first generaion
G II – second generaion
G III –third generaion

The differences, compared to the untreated control variant, of the attack average frequency, recorded during the research period, for all variants were negative, very significant negative difference were presented in the variants: V2, V3, V4.

The average efficacy of the treatments has recorded a value of 94.8 % for variant V2 (treatment with different chemicals for the 3 generations), 91.5 % for V3 (treatment with PI pyrethroid synthesis for GI continued arthropod metalloprotein inhibitor for GII and biological product for GIII), 88.9 % at V4 (treatment with PI pyrethroid synthesis for GI biologic product for GII and oophage wasps from Trichogramma genus for GIII), 86.2 % at V6 (treatment with biological product for GI oophage wasps of the genus Trichogramma for GII and GIII) and 83.7 % to V5 (treatment with arthropod metamorphosis inhibitor for GI Trichogramma oophage wasps combined with mass trapping for GII as well for GIII Trichogramma oophage wasps combined with mass trapping).

Fig. 1. Pheromonal trap for capture male butterflies (*L. botrana*)

CONCLUSIONS

Integrated vine moths control involves combining preventive methods of control with the application of biological and chemical control measures to limit moth populations below the economic threshold of pests (P.E.D.).

It is noteworthy that V2 in which chemicals were used has produced the best results, but very good results have also been obtained in V3 and V4 variants where first-generation chemicals combined with biological products have been used for the following generations.

Variants V5 and V6 in which we only used biological products have shown weaker results, but given that these products are not polluting for the viticultural ecosystem and for grapes, we recommend using these variants of treatment in any integrated moth control scheme of vines.

REFERENCES

Mitrea I., et al., 2003, Combaterea integrată a bolilor, dăunătorilor şi buruienilor la viţa de vie. Lucrările Simpozionului Ştiinţific Internaţional 70 de ani ai Universităţii agrare de stat din Moldova, Seria horticultură, Silvicultură, Protecţia Plantelor, pg. 231, Chişinău

Roșca I. et al., 2000, Combaterea integrată a bolilor și dăunătorilor culturilor agricole, Editura Didactică și Pedagogică R.A., București.

Stan, C., 2007, Cercetări privind combaterea integrată a principalilor dăunători ai plantaţiilor de viţă de vie din Oltenia. Teză de doctorat, Univ. din Craiova, 2007.

Stoian Elisabeta, 2001, Principalele pesticide omologate pentru combaterea dăunătorilor viţei de vie. Rev. Sănătatea plantelor nr. 3/2001.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

MONITORING OF NITRATES CONTENT OF GROUNDWATER AND SURFACE WATER OF CURTEA DE ARGEŞ MUNICIPALITY, ARGEŞ COUNTY

Denisa Elena Tudor[1]*, Doru Gabriel Bucur[2]

[1]Agency for Payments and Intervention in Agriculture Argeş
[2]Office for Pedological and Agrochemical Researches Argeş County
* *E-mail:* denisaelenatudor@yahoo.com

Keywords*: nitrates, monitoring, water, vulnerability, pollution*

ABSTRACT

This study shows nitrate concentrations in surface waters and groundwater of Curtea de Argeş Municipality said under current legislation vulnerable to nitrate pollution of agricultural origin.

The research took place in the seasons of summer and autumn of 2016, by sampling water from wells, springs and the two reservoirs located on the Argeş River, for their analysis of physical and chemical and assessing progress nitrate content after a period of about three months.

INTRODUCTION

Nitrates are compounds of nitrogen and are part of the natural cycle, thereof may develop a potentially toxic to living organisms where the values exceed a certain level as critical.

Global concerns regarding the content of nitrates in surface waters and groundwater have increased in recent decades. This is due to the adverse manifested on the human body after consumption of water with high concentrations of nitrates (Proca et al. 2009).

Most research in the field have concluded that the accumulation of these contaminants in soil and water sources are caused mainly by practicing inadequate agricultural purposes (Sánchez Pérez et al. 2003, Lawniczak et al. 2016).

In Romania, the law (Law no. 458/2002, Law no. 311/2004) establishes a maximum concentration allowed in drinking water of 50 mg/L nitrate and the ammonium and nitrite 0.5 mg/L.

By common Order no. 1552/743 of 2008 Curtea de Argeş Municipality was included as part of the areas vulnerable to pollution by nitrates from agricultural sources.

MATERIAL AND METHODS

In 2016 a study was conducted to assess the content of nitrate in groundwater bodies and the surface held in two stages, with sampling of water in 41 strategic locations (mainly wells) plotted in Figure 1. Water samples were collected and from lakes Curtea de Argeş and Zigoneni (samples number 18 and number 41).

With the support of a powerful multi-parameter device (HANNA) have obtained information from the moment regarding the nitrate content of water samples collection.

The first stage (Series 1) was conducted in the third decade of July and consisted of water sampling of the 41 points, selected to cover the entire surface investigated as possible.

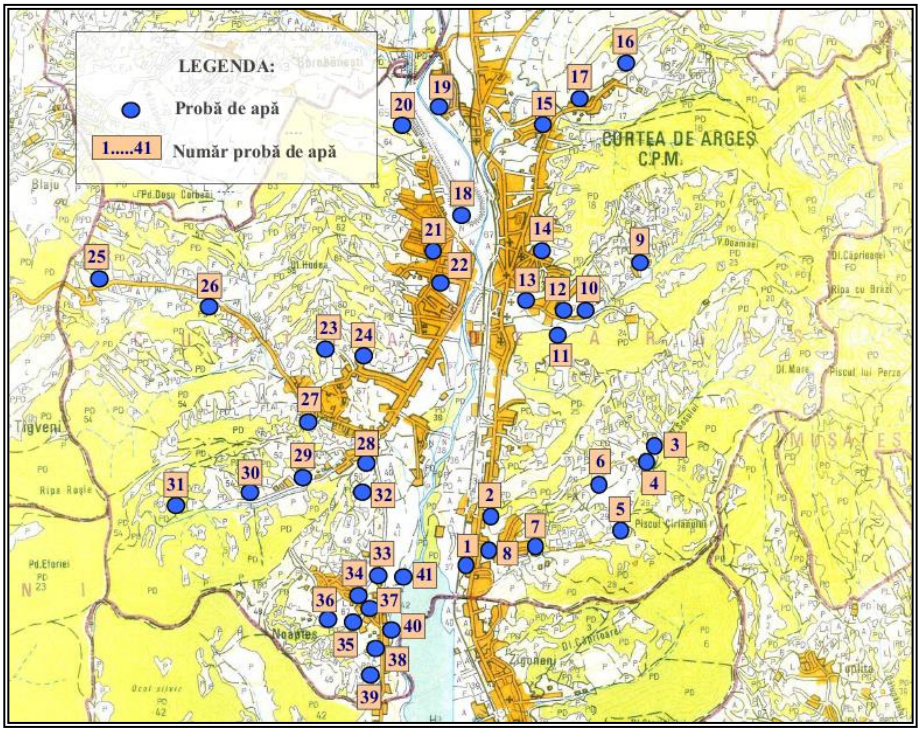


Figure 1. The location of sampling of water from the Curtea de Arges Municipality

The second stage of harvesting (Series 2) water samples held in October, water sampling points being made of the same monitoring.

Known as the relationship between nitrate concentrations in surface waters and groundwater in relation to other biotic and non-biotic factors, research has involved the summary of the natural knowledge that characterizes Curtea de Argeş Municipality.

RESULTS AND DISCUSSION

Geomorphologically, Curtea de Argeş Municipality is looming on the southern tip of Subcarpathians Argeş (Muscelele Getice), in contact with Getic Piedmont and includes much of the same name inter-hill depression. It comprises a depression area with meadows and terraces lacy aprons parasitized train meandered shaped by the old course of the Argeş River and a hilly area with long slopes predominantly oriented east and west and interfluvial narrow ridges.

It occupies an area of approx. 75 km^2 and has a population of 33.000 inhabitants.

The depth of water tables is relative to topography. On hills, the heights of the groundwater table has at depth of 30-40 meters, and in the valleys is 1-5 meters.

The climate is temperate-continental with an average temperature of 9 ^{O}C and the average precipitation of 730 mm. The rainfall is during May to July. Dry intervals are from January to March and September to December.

Forests occupy about 25 % of the perimeter of the municipality and are predominantly composed of beech (*Fagus sylvatica*) mixed with oak (*Quercus Petraea*), hornbeam (*Carpinus betulus*) and ash (*Fraxinus excelsior*).

The slopes subject to erosion and high peaks are characterized by *regosols* (Tudor et al. 2013). Some secondary peaks, rather narrow evolved *luvisols*. Meadows are characterized by ,,*young soils*" - type *fluvisols. Eutricambosoils* have a pretty wide spatial distribution, growing in some sectors floodplain, terraces, aprons and frequently on slopes. The Argeş River terraces have also developed *pelosoils,* constructed entirely of fine pedogenetic material, and the glacis are characterized by *preluvosoils*. Some sectors have evolved *phaeozems* slope, well matured soils, with a deep and rich in humus surface horizon.

For reasons of pedological, is showed that 12 % of the agricultural area presents high vulnerability to pollution by nitrates; 16 % of the average present moderate vulnerability and 72 % reduced vulnerability to pollution by nitrates.

As a result of water samples from different sources, have been determined concentration of nitrate (NO_3) and other physical and chemical parameters such as: the content of ammonium (NH_4), the acidity of the water (pH) and water content of oxygen, is indicated at the same time and the depth of sampling (Table 1).

By the interpretation of the data obtained from the first stage of the research, the percentage showed that of the 41 bodies of analyzed water, 83 % had nitrate concentrations below 25 mg/L, 12 % had levels between 25 and 50 mg/L and only 5 % had levels between 50 and 75 mg/L.

In the second step of monitoring, was a trend toward water purification in that the number of water bodies, in the gap nitrate concentrations 0-25 mg/L up to 90 %, registering only 5 % of between 25 and 50 mg/L. However, the percentage of wells remained above the threshold of 50 mg/L.

Regarding water bodies that exceed the maximum level for consumption, there was one aspect. While in the well number 29 the nitrate concentration increased in July-October at 66.12 mg/L to 71.26 mg/L, and well number 33 values were raised from 40.03 to 56.01 mg/L NO_3, in the well with the number 4 to the other way round.

Table 1

Physical and chemical analyzes of water samples collected in July and October of 2016 in the Curtea de Arges Municipality

No.	Series 1	Series 2	Series 1/Series 2				
	NO_3 (mg/L)	NO_3 (mg/L)	NH_4 (mg/L)	Water temperature ^0C	pH	Dissolved oxigen (mg/L)	Harvesting depth
1	24.56	17.13	0.30/0.25	13.6/15.2	7.0/7.1	4.3/3.8	2.5/2.6
2	0.33	12.80	2.36/0.11	11.9/12.0	6.5/6.5	8.8/3.7	8.7/3.7
3	19.87	3.39	0.39/0.30	11.5/12.6	6.7/6.9	1.2/4.2	2.0/2.5
4	74.08	43.10	6.82/4.01	11.4/14.0	7.1/7.6	4.2/3.8	2.1/1.9
5	3.84	4.19	2.16/3.65	11.5/12.3	6.6/7.4	2.9/3.0	3.8/3.7
6	4.45	1.48	0.87/0.35	13.9/15.5	6.6/7.1	3.5/2.9	1.8/1.5
7	6.90	14.66	0.40/0.40	12.0/13.3	7.2/7.5	1.5/3.4	3.8/3.7
8	24.24	11.46	0.38/0.29	11.7/11.9	6.7/6.9	1.6/3.5	6.1/4.4
9	30.04	10.23	0.85/0.31	11.1/11.8	7.1/7.0	3.0/2.7	2.4/2.4
10	18.58	1.66	0.53/0.09	12.9/11.7	7.0/7.3	1.0/3.3	2.5/3.6
11	12.41	7.40	0.85/0.40	12.1/12.2	7.3/7.4	5.1/6.2	3.1/4.3
12	8.64	5.05	0.27/0.17	11.6/11.5	7.5/7.2	6.8/5.4	4.1/3.5
13*	18.26	8.69	0.33/0,24	15.8/11.7	6.1/7.3	5.3/6.0	-
14	14.22	11.96	0.16/0.40	11.0/11.3	7.1/7.2	4.0/5.6	1.8/2.0
15	12.19	5.82	0.22/0.18	11.7/13.0	6.3/6.3	1.7/4.1	3.4/3.2
16	1.09	1.19	0.26/0.09	13.7/15.4	7.0/7.2	1.9/2.9	1.1/1.5
17	1.64	1.59	1.50/0.34	11.5/15.6	7.0/7.7	4.9/3.6	4.1/0.7

18**	5.34	11.62	0.06/0.02	12.4/9.3	8.8/8.1	9.4/8.8	-
19	13.66	10.14	0.84/0.28	17.4/18.5	7.3/7.1	2.0/3.1	1.6/1.6
20	6.79	6.74	4.26/1.33	11.4/11.3	7.1/7.3	1.4/3.8	0.1/0.8
21	47.67	10.62	0.37/0.18	11.5/12.3	7.2/7.4	4.5/5.9	3.0/3.3
22	6.26	5.70	0.33/0.16	18.5/12.8	7.0/7.1	4.7/4.2	2.7/2.5
23	2.14	4.42	0.09/0.12	13.4/14.2	7.5/7.5	3.0/2.9	3.2/3.3
24	9.47	10.12	1.83/0.95	11.613.0	7.4/7.3	2.8/2.3	5.1/4.9
25	0.92	1.24	0.10/0.06	11.8/13.3	7.3/7.4	1.9/2.8	3.4/2.4
26	7.09	8.11	3.22/2.35	14.7/13.3	7.4/7.4	3.9/3.4	2.0/2.1
27	13.45	9.28	0.49/0.16	11.7/12.7	7.2/7.2	5.1/2.0	3.3/2.5
28	6.95	13.02	1.32/0.40	13.6/14.2	7.2/7.6	2.4/3.7	1.3/0.8
29	66.12	71.26	0.18/0.10	10.8/12.2	7.0/7.1	2.9/3.5	4.8/4.7
30	49.16	33.63	0.34/0.92	13.6/14.3	7.0/7.1	2.5/4.7	1.3/1.2
31	9.30	9.06	0.35/0.09	12.7/14.5	6.9/7.0	2.8/5.0	2.8/2.5
32	10.95	15.34	0,18/0.07	12.4/13.4	7.0/7.2	6.8/5.0	2.5/2.0
33	40.03	56.01	0.26/0.09	12.3/13.3	7.0/6.9	5.6/3.6	1.3/1.5
34	11.64	6.29	0.28/0.17	13.7/13.4	6.6/6.9	3.9/5.2	2.7/1.2
35	11.09	18.97	0.22/0.12	11.4/12.0	6.5/6.8	2.3/2.1	2.9/4.4
36	10.80	10.07	0.16/0.42	11.6/13.0	7.1/7.2	3.3/2.9	4.0/3.6
37	16.81	22.08	0.26/0.15	11.2/11.9	6.9/7.1	4.9/4.6	3.8/3.1
38	3.56	5.66	0.18/0.09	11.6/11.7	7.1/7.3	4.1/3.5	7.2/6.2
39	6.47	20.16	0.29/0.07	12.1/14.1	6.7/6.7	4.0/3.2	3.4/2.9
40	7.87	13.46	0.22/0.13	10.9/11.6	6.7/6.8	4.1/3.9	5.1/4.6
41***	2.80	3.76	0.08/0.07	12.6/10.0	7.9/8.0	7.4/5.4	-

* sample taken from a spring coastal
** sample taken from the lake Curtea de Argeş
*** sample taken from the lake Zigoneni

In this latter source of water, nitrate concentrations have decreased significantly in the fall by 42 %, going from 74.08 mg/L NO_3 - value recorded in July - at 43.10 mg/L NO_3 in October.

The same was observed in the water body number 21, where the accumulation of nitrates were recorded in summer season 47.67 mg/L, so that later in the autumn, to fall by 78 % to a concentration of only 10.62 mg/L NO_3.

Similarly, it reveals considerable reduction of nitrate concentrations in the body of water and the number of 9 to 30 mg/L NO_3 to 10 mg/L NO_3.

The remaining water bodies monitored maintained at relatively safe for consumption.

With regard to the ammonium content in water, they have been identified in the summer values below 0.5 mg/L in 70 % of samples (compared to 85 % in the fall), between 0.5 mg/L and 1 mg/L in 10 % (compared with 5 % recorded in the autumn) and above 1.0 mg/L to 6.8 mg/L to 20 % of the samples taken in July (compared to 10 % in the fall).

Other analytical data were interpreted according to the Order 161/2006 of M.M.G.A. on quality standards for surface waters.

With regard to the water temperature, it has quite variable. In summer values have ranged 10.8 ^{0}C and 18.5 ^{0}C, and in autumn they were between 9.3 ^{0}C and 18.5 ^{0}C. The water temperature is not standardized.

The two sets of samples had pH values between 6.3 and 8.8, weak acid to moderate alkaline. Quality standards set for drinking water pH 6.5-8.5.

Dissolved oxygen in water is classified into five quality categories. The analysis reflected that in summer one sample (2.4 %) is a Class I quality with over 9 mg/L O_2, two samples of water (4.9 %) class II quality (between 7.0 to 8.9 mg/L O_2), six samples (14.6 %) grade III (between 5.0 to 6.9 mg/L O_2), ten samples (24.4 %) grade IV (between 4.0 to 4.9 mg/L O_2), and the more samples, the number of 22 (53.7 %) in grade V (below 4.0 mg/L O_2).

In the autumn a single sample of water (2.4 %) is graded Class II; 9 samples (22 %) in Class III; 5 samples (12.2 %) in Class IV; 26 samples (63.4 %) in grade V of quality.

CONCLUSIONS

Inclusion of Curtea de Argeş Municipality as part of the areas vulnerable to pollution by nitrates from agricultural sources, determined that in the year 2016 to conduct a study to assess the content of nitrate in groundwater bodies and surface.

By the interpretation of the resulting data, about 50 % of waters studied in two stages (Figure 2) contain nitrate concentrations below 10 mg/L.

It was found that in some waters monitoring points nitrate suffered considerable fluctuations in a relatively short time (about three months).

It also noted a downward trend in nitrate concentrations in autumn compared to the summer. One hypothesis is that the first sample of evidence has been collected in full vegetative season and wetter than autumn. This season is conducive to fertilization phase of agricultural perimeters, nitrates consumed by plants with rainwater or irrigated, were subjected to leaching through the soil profile to groundwater.

In any case, to reduce the risk of water pollution and stabilize concentrations of nitrate in water consumption at optimal levels, is recommended to apply the rules of the Local Action Plan against pollution caused by nitrates from agricultural sources. Household level recommended proper management of wastewater, domestic waste and standardizing chemical and organic fertilizers.

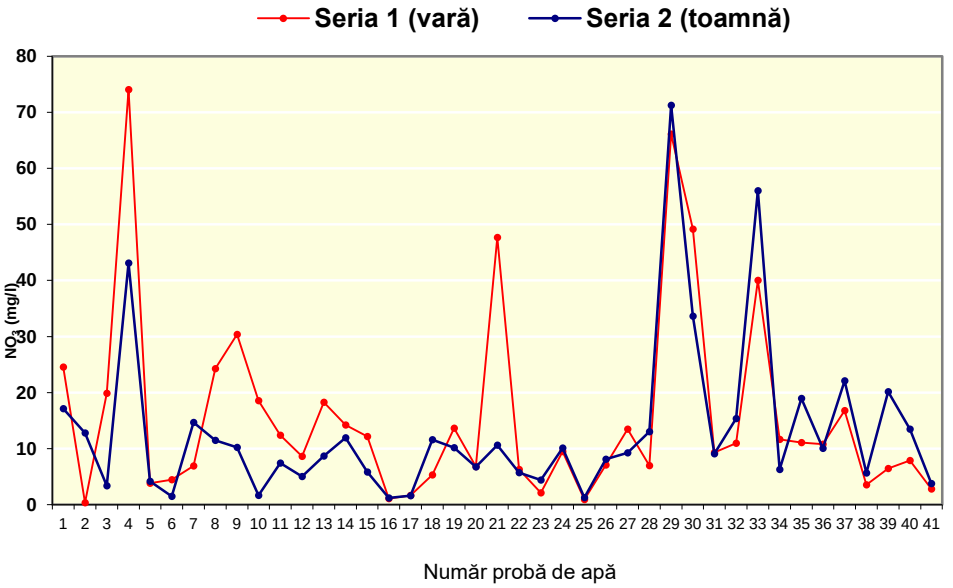


Figure 2. The variation of the nitrate concentrations in the water sources of the Municipality of Curtea de Argeş in the two series of monitoring.

REFERENCES

Lawniczak A. E., Zbierska J., Nowak B., Achtenberg K., Grześkowiak A., Kanas K., 2016, Impact of agriculture and land use on nitrate contamination in groundwater and running waters in central-west Poland. Environmental Monitoring and Assessment. Vol. 188, No. 3, pp. 1-17

Proca C., Micu D., Danielescu C., Manea F., 2009, Case Study of the Risk Assessment of Nitrates on Human Health in the West Side of Romania. In: Simeonov L.I., Hassanien M.A (eds) Exposure and Risk Assessment of Security C: Environmental Security. Springer, Dordrecht, pp. 509-516.

Sánchez Pérez J., Antiguedad I., Arrate I., Garcia-Linares C., Morell I., 2003, The influence of nitrate leaching through unsaturated soil on groundwater pollution in an agricultural area of the Basque country: a case study. Science of The Total Environment. Vol. 317, Issues 1-3, pp. 173-187.

Tudor D. E., Bucur D. G., Creangă I., 2013, Studiu pedologic şi agrochimic elaborat în vederea realizării şi reactualizării Sistemului Judeţean şi Naţional de Monitorizare sol-teren pentru Agricultură, teritoriul Curtea de Argeş, Arhiva Oficiului de Studii Pedologice şi Agrochimice Argeş.

*** Legea nr. 458/2002 privind calitatea apei potabile; - M.O. nr. 552/iulie 2002.

*** Legea nr. 311/2004 pentru modificarea si completarea Legii nr. 458/2002 privind calitatea apei potabile; - M.O. nr. 582/30.06.2004.

*** Ordinul nr. 161/2006 pentru aprobarea Normativului privind clasificarea calitatii apelor de suprafata in vederea stabilirii starii ecologice a corpurilor de apa - Ministerului Mediului si Gospodaririi Apelor (M.M.G.A.).

*** Ordinul nr. 743 din 12 decembrie 2008 pentru aprobarea listei localităţilor pe judeţe unde există surse de nitraţi din activităţi agricole.

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

CONTRIBUTIONS TO THE STUDY OF THE DISTRIBUTION OF SOME INSECTS SPECIES LISTED ON IUCN RED LIST ON THE PROTECTED AREA SLVOSTEPA OLTENIEI

Țuca Ovidiu[1*], Stan Catalin[1], Ciupeanu Călugăru Eleonora Danela

University of Craiova,
** Correspondence author. E-mail*: ovidiu_tuca@hotmail.com

Keywords*: Carabus hungaricus Fabr., Cerambyx cerdo L., Lucanus cervus L., Hyles hippophae Esp.*

ABSTRACT

This paper presents the researches regarding the main features and the distribution of the endangered insects species, from the protected area Silvostepa Olteniei.

From our observation regarding the protected area Silvostepa Olteniei, we have identified a number of four insect species protected under the IUCN red list: Carabus hungaricus Fabr., Cerambyx cerdo L., Lucanus cervus L. and Hyles hippophae Esp.

In the Protected Natural Area, taking into account the habitat requirements, we have identified two saproxylic species and located their habitat in some forests from the protected area: Întorsura, Perişor, Târnava, Mărăcinele, Ştiubeiului, Verbicioara and Pleniţa. The other beetle species has been located on several meadows near: Radovan, Vela, Bucovicior, Tencănău, Vârvoru de Jos, Regarding the lepidopteran species, it was observed on the sunny and vegetated shores of Lake Ciutura, the Desnăţui and Terpeziţa.

INTRODUCTION

The degradation of natural ecosystems continues unabated, threatening the long-term survival of many species around the world (Pimm et al.2014). In response, many conservation efforts have emerged to stop and reverse this degradation, among which the establishment of protected areas is considered one of the most effective (Hannah et al.2007, Andam et al. 2008, Jenkins and Joppa 2009).

Worldwide there are more than 200,000 protected areas (Juffe-Bignoli et al.2014), many of which have been established for the conservation of particular species of interest. Yet, their establishment and successful management may entail additional benefits beyond the long-term survival of the species of interest, including the conservation of entire biodiversity pools and the provision of ecosystem services such as carbon sequestration (Vina and Liu 2017). It has been demonstrated (Tanaka and Tanaka 1982, Moeed and Mead 1985, Neumann 1979) that Coleoptera may be used as indicators of overall community structure, sometimes referred to as 'indicators of habitat quality'.

All functional groups of communities, ie. detritivores, herbivores, predators etc. are represented within this order, and the dynamics of sampling are better understood than with many other.

MATERIAL AND METHODS

Research regarding the distribution of the endangered insects species was carried out in 2017, in protected area Silvostepa Olteniei.

For the inventory of coleopteran species, several outcomes are needed on the ground. The most efficient method is generally the transept method. Movement is done on forest roads without a compact canopy or along the slit. The transits have a length of 500 m and a width of 20 m, and between the ends of two neighboring transects there must be a distance of 25 m. In case of habitats with small surface the transitions may be shorter and if the species has a very low density may be longer. If the surface of the habitat permits, five transects are made.

For our researches we have used the manual collection, directly from the habitat, of individuals, a method commonly used in faunistic studies and only in addition to research into the diversity and ecology of populations.

A positive aspect of this method is that it allows the collection of individuals in the target group without directly affecting other invertebrates. It is the simplest method for determining presence/absence data, while also allowing individuals to be easily identifiable on the field

RESULTS AND DISCUSSIONS

Geographically, the area is located in the western part of the Oltenia Plain, more precisely in the Desnatuiu Plain, in contact with the Piedmont Getica Platform. The land is generally horizontal, with more or less deep depressions and short slopes. The altitude of the terrain varies between 60 m and 230 m. Groundwater is located on terraces over 10m deep, approaching the surface only in the meadow.

The forest vegetation is specific to the phycoclimatic areas of the forest and the forest steppe. There is a predominance of cereals, garnishes, cere-garnites, which account for more than 80 % of forests, pedunculate oak, oak, russian oak and quartzine mixtures. The proposed site consists of 6 polygons, representing 6 forest bodies the forest areas of Caprioara-Tencanau-Maracine, Tarnava-Intorsura, Perisor, Plenita and Verbicioara) and Seaca-Stiubei. Following our researches in the protected area Silvostepa Olteniei, we have identified four endangered insects species listed on I.U.C.N. Red List: *Carabus hungaricus* Fabr., *Cerambyx cerdo* L., *Lucanus cervus* L. and *Hyles hippophae* Esp.

From the beetle species, two are saproxylic and has been identified and located their habitat in some forests from the protected area: Întorsura, Perişor, Târnava, Mărăcinele, Ştiubeiului, Verbicioara and Pleniţa. The other beetle species has been located on several meadows near : Radovan, Vela, Bucovicior, Tencănău, Vârvoru de Jos, While the lepidoperan species has been observed on the sunny banks of lake Ciutura as well the rivers and Terpeziţa.and Desnăţui (Tuca & al 2016).

Carabus hungaricus is a beetle species native to the Palearctic. The hungarian ground beetle's length is 22-28 mm. Black, and the head is densely dotted, the elytron densely granulated, slightly grossy. It has a wing cover with 3 rows of small pit, otherwise almost completely smooth. The last part of the lower mandibular palp is slightly shorter than the last before one.In the Protected Natural Area, taking into account the habitat requirements of the species and the observations on it, it is estimated that there are stable populations in the investigated distribution areas. The species was identified on several meadows near: Radovan, Vela, Bucovicior, Tencănău, Vârvoru de Jos,. *Cerambyx cerdo* L.The adult has a body length of 28-50 mm, being the largest species in the Cerambycidae family in our country. The female is larger than the male. The body is brownish or black-brown. The Pronot is glossy, with discoidal wrinkles. The abdomen is glossy, with rare puberty, excluding the last sternit, who has a thick puberty. The apode and eucephalus larvae is whiteish-yellowish, with a small head and reddish, and on the dorsal part of the body there are oval shaped chitinous plates, with a body length of 80-90 mm.

Specific information. In the Protected Natural Area, taking into account the habitat requirements of the species and the observations on it, it is estimated that there are stable populations in the investigated distribution areas.

The species was identified in the forests and forests of the forests: Intorsura, Perişor, Târnava, Mărăcinele, Ştiubeiului, Verbicioara and Pleniţa.

Lucanus cervus L. The stag beetle is one of the most spectacular looking beetle. The giant antler-like mandibles are used in courtship displays, and wrestling with other males. Although rather fearsome in appearance, the mandibles cannot be closed with any force. You are more likely to be nipped sharply by the female stag beetle, a smaller insect than the male that lacks the huge jaws. The stag beetle, superficially, appears black all over but, in certain lights, it can be seen to have dark maroon or brown wing cases.The impressive mandibles also have a reddish sheen to them. The wing cases are glossy; the head and thorax are a dull black.

In the Protected Natural Area, taking into account the habitat requirements of the species and the observations on it, it is estimated that there are stable populations in the investigated distribution areas. The species was identified in the forests and forests of the forests: Intorsura, Perişor, Târnava, Mărăcinele, Ştiubeiului, Verbicioara and Pleniţa.

HyLes hippophaes Esp. The adult has a robust body, covered with a brown pubescence, the wings are brown, the front wings have a darker oblique transverse band, the macules on the hind wings are reddish orange.

Adults of this species have fairly large variations in coloration, in fact the color of adults depends much on temperature. Thus the heat causes a more reddish coloration, while the hotter temperatures cause a darker coloration.

Specific information. In the Protected Natural Area, taking into account the habitat requirements of the species and the observations on it, it is estimated that there are stable populations in the investigated distribution areas. The species was observed on the sunny and vegetated shores of Lake Ciutura, the Desnăţui and Terpeziţa.

CONCLUSIONS

Following our researches in the protected area Silvostepa Olteniei, we have identified four endangered insects species listed on I.U.C.N. Red List: *Carabus hungaricus* Fabr., *Cerambyx cerdo* L., *Lucanus cervus* L. and *Hyles hippophae* Esp.

In the Protected Natural Area, taking into account the habitat requirements of the species and the observations on it, it is estimated that there are stable populations in the investigated distribution areas.

In the Protected Natural Area, we have identified all the coleopteran species in the forests: Intorsura, Perişor, Târnava, Mărăcinele, Ştiubeiului, Verbicioara and Pleniţa.

Regarding the lepidopteran species, it was observed on the sunny and vegetated shores of Lake Ciutura, the Desnăţui and Terpeziţa.

REFERENCES

Andam, K. S., P. J. Ferraro, A. Pfaff, G. A. Sanchez-Azofeifa, and J. A. Robalino. 2008. Measuring the effectiveness of protected area networks in reducing deforestation. Proceedings of the National Academy of Sciences 105:16089–16094.

Hannah, L., G. Midgley, S. Andelman, M. Araujo, G. Hughes, E. Martinez-Meyer, R. Pearson, and P. Williams. 2007. Protected area needs in a changing climate. Frontiers in Ecology and the Environment 5:131–138.

Jenkins, C. N., and L. Joppa. 2009. Expansion of the global terrestrial protected area system. Biological Conservation 142:2166–2174.

Joppa, L. N., and A. Pfaff. 2009. High and far: biases in the location of protected areas. PLoS One 4:e8273.

Juffe-Bignoli, D., et al. 2014. Protected planet report 2014. UNEP-WCMC, Cambridge, UK.

Moeed, A. & Meads, M.J. 1985: Seasonality of pitfall trapped invertebrates in three types of native forest. Orongorongo Valley, New Zealand. New Zealand Journal of Zoology 12: 17-53.

Neumann, F.G. 1979: Beetle communities in eucalypt and pine forests in North-eastern Victoria. Australian Forest Research 9: 277-293.

Pimm, S. L., C. N. Jenkins, R. Abell, T. M. Brooks, J. L. Gittleman, L. N. Joppa, P. H. Raven, C. M. Roberts, and J. O. Sexton. 2014. The biodiversity of species and their rates of extinction, distribution, and protection. Science 344:1246752.

Tanaka, L.K & Tanaka, S.K 1982. Rainfall and seasonal changes in arthropod abundanc on a tropical oceanic island. Biotropica 14: 2, 114-123.

Tuca, O., Stan, C., Ciupeanu Călugăru, Eleonora Daniela. 2016. Anthropogenic threats on some insect species protected under the IUCN red list in the protected area Slvostepa Olteniei. Analele Univ. din Craiova seria Biol., Hortic., T.P.P.A., I. Med; Vol . XXI (LIX): 643 – 647.

Vina, A., Liu, J. 2017. Hidden roles of protected areas in the conservation of biodiversity and ecosystem services. Ecosphere Volume 8 Issue 6 e01864

ANNALS OF THE UNIVERSITY OF CRAIOVA

Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

STUDY ON FREQUENCY AND CAUSES OF ANEMIA

Carmen Vlădulescu[1*], Luminița Mariana Olaru[2]

[1,2]University of Craiova, Faculty of Horticulture
*Corresponce author: E-mail: carmen_vldl@yahoo.com

Keywords*: anemia, etiology, hemoglobin, hemoleucogram.*

ABSTRACT

This paper presents the study of the incidence of anemia cases. Both anamnesis and physical examination provide important data for anemia frames. The anamnesis has as major objectives: age of anemia according to laboratory data, patient profession, eating habits, alcohol abuse, drugs, the coexistence of chronic diseases and their treatment, performing pretreatment anti-anemic treatments, the existence of blood loss, etc. Anemia is not a disease itself, but a symptom or syndrome that always has one or more causes.

INTRODUCTION

Anemia is defined as the decrease in the values of the parameters that estimate the amount of erythrocytes in the circulation: their number, their volume (Ht) and their content in Hb. Anemia is not a disease itself, but a symptom or syndrome that always has one or more causes that need to be detected and if possible removed before initiating specific therapy.

Clinical signal that suggests the existence of anemia is the flaking of the skin and mucous membranes. Pallor is also present in conditions accompanied by increase in plasma volume (hyperhydration, pregnancy, splenomegaly, macroglobulinemia). Since red blood cells, in these situations, remain normal, they are called pseudoanemia or relative anemia.

Hemoleucogram is the primary investigation that is mandatory in all cases where anemia is suspected. The quantitative assessment of circulating erythrocytes allows the assessment of the degree of anemia.

After Hb values, anemia can be classified as follows: mild anemia Hb 10-12 g/dl; moderate anemia Hb 7-10 g/dl; severe anemia Hb 5-7g/dl; anemia Hb<5 g/dl.

In investigating anemia, the following are mandatory:

- complete blood count - provides information on hemoglobin, hematocrit, erythrocyte counts, if anemia is associated with leukopenia and / or thrombocytopenia;

- determining the number of reticulocytes - helps to divide into two major categories anemias: regenerative and hypo/aregenerative. The regenerative ones are generally peripheral (posthemorrhagic, haemolytic), hypo/aregenerative ones are generally central cause by affecting medullary production (aplastic anemia or iron, vitamin B12 and folic acid deficiency anemia) the appearance of peripheral blood smear - provides information on erythrocytic morphology, hemoglobin loading, the presence of erythrocytes precursors (erythroblasts in peripheral blood) or atypical cells.

MATERIAL AND METHOD

A number of 133 patients was taken into study, who have been presented to the specialized private clinic for various investigations the study lasted 3 months.

Of the approximately 133 patients, we chose a group of 42 heteromorphic patients - women and men, with age between 22 and 78 years old, to whom we found hemoglobin changes in a first stage. The study was conducted on a group of 42 patients, 18 men (42.9 % of the total) and 24 women (57.1 % of the total). For each case, hemoglobin values were determined.

Later, we searched for further investigations to maintain the suspicion of a diagnosis of anemia and allow its classification in one of the many known anemias.

Hemoleucogram is the first stage of the laboratory diagnosis.

Harvesting is done by venous puncture, using special hemoleucograms, dry anticoagulants type Na_2EDTA or K_3EDTA and 2 ml of venous blood is harvested.

The complete hemogram includes: determination of hemoglobin, determination of hematocrit (percentage of mass of erythrocytes in blood volume) and number of hematites/mm^3 (Manole Gh., 2004).

RESULTS AND DISCUSSIONS

The results obtained were corroborated with the age group of the patient, sex and background and hemoglobin values as follows:

Of the group of 42 patients, 35 came from urban areas (83.3 %) and 7 from rural areas (16.7 %).

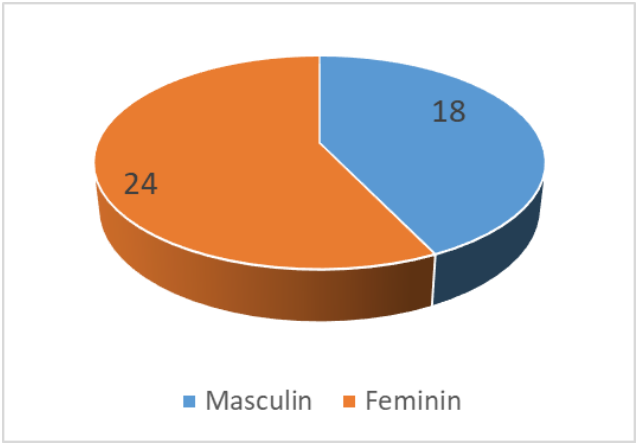


Figure 1. Distribution of cases by gender

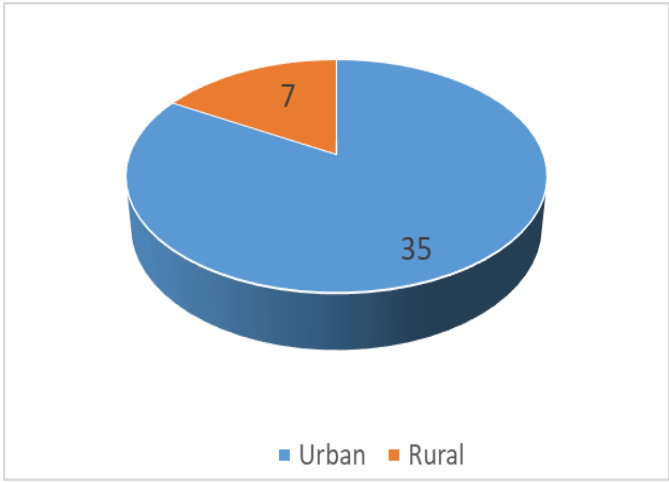


Figure 2. Distribution of cases according to the patient's home environment

It can be seen that the incidence of these anemias was higher in patients from urban areas, which is explained by their increased addressability to the doctor.

The distribution of cases by hemoglobin showed that:

- 1 patient had values between 6-7 g/100 ml;
- 5 patients had values between 7-8 g/100 ml;
- 5 patients had values between 8-9 g/100 ml;
- 12 patients had values between 9-10 g/100 ml;
- 8 patients had values between 10-11 g/100 ml;
- 7 patients had values between 11-12 g/100 ml;
- 4 patients had values between 12-13 g/100 ml.

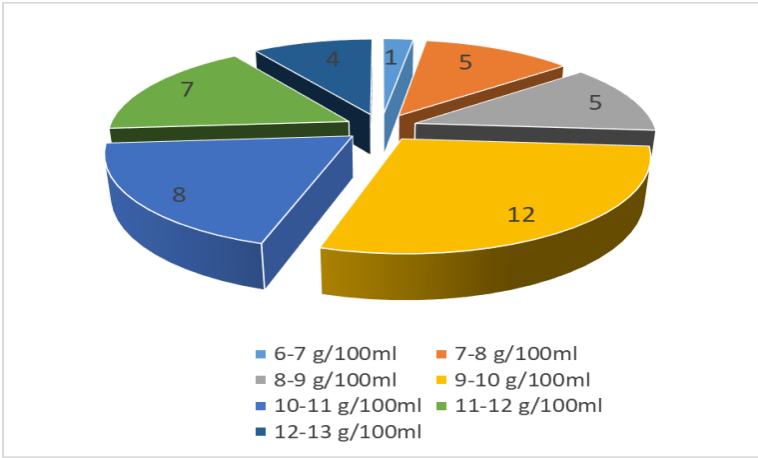


Figure 3. Case distribution based on hemoglobin value

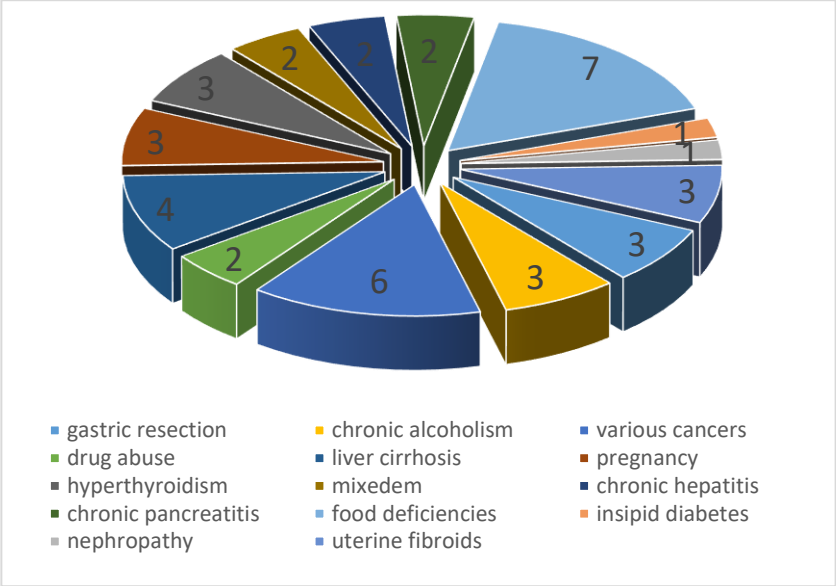


Figure 4. Case distribution according to pre-existing pathology

The study group, consisting of 42 patients, had a history of various personal pathologies. For 3 patients, anemia was associated with pregnancy, this being the most common form of anemia present during pregnancy. In other 3 cases, anemia was caused by prolonged bleeding caused by the presence of a benign tumor, respectively uterine fibroids.

CONCLUSIONS

Anemia has a very high incidence in the general population and can be determined by a number of particularly serious conditions, even cancers. Therefore, it is very important that every person performs at regular intervals, at 6 months, analyzes such as blood counts, which allow a rapid diagnosis.

Anemia is very common among pregnant women. Once anemia is determined, it is very important to determine the cause and therapeutic course. Due to hemodilution in pregnancy, anemia is determined at hemoglobin levels below 11 mg/% (Vlădăreanu R., 1999).

This should be treated given the loss of blood that occurs at birth or cesarean, which can aggravate a pre-existing anemia. Tests for anemia are reimbursed by the National Health House (www.cnas.ro), it may be prescribed by the family doctor himself.

REFERENCES

Manole Gh., Galatescu E.M., Mateescu M., 2004; Laboratory tests. Ed. Coresi, Bucharest, pp. 162-169.

Vlădăreanu Radu, 1999; Medical illnesses associated with pregnancy. Ed. InfoMedica, Bucharest, pp. 71-80.

*** www.cnas.ro

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

THE EFFECTS OF *CANNABIS SATIVA* FOLIAR TISSUES ON SOIL ORGANIC MATTER BIODEGRADATION AND OTHER SOIL CHEMICAL PROPERTIES

Wogiatzi Eleni[1], Gougoulias Nikolaos[1]*, Giannoulis Kyriakos[1]

[1]Department of Agronomy Technology, Technological Educational Institute of Thessaly, 41110 Larissa, Greece
*Correspondence author. email: ngougoulias@teilar.gr

Keywords*: Cannabis; soil chemical properties; soil organic matter biodegradation*

ABSTRACT

The effects of leaf Cannabis on soil organic matter biodegradation and on soil chemical properties in an incubation experiment 15 weeks were studied. The air dried cannabis plant tissues incorporated at five different rates (0, 0.2, 0.4, 0.6 and 0.8 g per 50 g of soil mixture with 9.74g of manure) resulted increase in organic carbon mineralization, nitrogen nitrate and exchangeable potassium. The levels of the available forms of P and Mn was increased at the two higher rates of the added cannabis. The level of the available forms of Cu and Zn did not show statistically significant differences in comparison with the control at the end of the incubation period. Also, the addition of leaf Cannabis resulted in a increase in total forms of Na, K, P and Mn. The results of this study indicated that the leafs of Cannabis could be applied to the soil without negative effects on the soil chemical and biological properties.

INTRODUCTION

The addition of organic materials on the soil, affects biological activity of microflora and the soil composition. When applying of organic fertilizers in the soil, dominate microbial nutrition (Riber et al. 2014). In biological agriculture is mandatory to replace chemicals with natural additives. Between them,and the plant debris for their role in the soil fertility (Gravanis et al. 2005).

Our previous studies have shown, the effect of oregano and basil on degradation of organic fertilizers, and it was found that the presence of foliar tissues of oregano, act a slowing effect on degradation of organic fertilizer, while the presence of basil, accelerate it (Chouliaras et al. 2007, Gougoulias et al. 2010).

The *Cannabis sativa* plant, contain over 60 different cannabinoids, with delta-9-tetrahydrocannabinol (∆9-THC) and cannabidiol (CBD) being the most prominent among them (Fairbairn and Liebmann 1974, Hillig and Mahlberg 2004).

The objectives of this research were to study in vitro, if the application of foliar tissues of the cannabis dry matter into soil has an effect on soil organic matter and on soil chemical properties.

MATERIAL AND METHODS

The collection of leaves *Cannabis sativa* took place at the end of the growing season from the experimental farm of Technological Educational Institute of Thessaly, Larissa, Greece.

Incubation experiment: In this study, 9.74 g of manure containing 3 g of organic matter, obtained from the farming establishments of TEI of Thessaly, was added to 50 g of air-dried soil that was poor in organic matter, derived from the same region (Table 1). Into 50 g of this soil plus 9.74 g of the manure, 0, 0.2, 0.4, 0.6 and 0.8 g of air-dried and well milled of leaf tissues *Cannabis sativa* were added. Thus an experimental unit is constituted by 50 g of soil, 9.74 g of manure and a variable amount of *Cannabis sativa*. In the incubator, the treatments kept at 28 ^{0}C for a period of 15 weeks and were prepared in four replicates. During the first three weeks of the incubation period, the moisture was maintained at two-thirds of field capacity, but for the next three weeks the soils were left to dry. This process was repeated until the end of the incubation period according to (Wu and Brookes, 2005) they reported that the alternation of drying and rewetting soil samples enhances mineralization of both soil biomass organic matter and non-biomass organic matter. At the end of the incubation period, soil samples were analyzed.

Methods of analyses: Samples were analyzed using the following methods which are referred by (Page et al. 1982).

Organic matter was analyzed by chemical oxidation with 1 mol/l $K_2Cr_2O_7$ and titration of the remaining reagent with 0.5 mol/l $FeSO_4$.

Exchangeable forms of potassium and sodium ware extracted with 1 mol/l CH_3COONH_4 and measured by flame photometer.

Organic phosphorus was measured after mineralization by combustion of the sample and subtraction of the mineral phosphorus amounts, which had previously been estimated in the laboratory. The mineral amounts were extracted with 1 mol/l H_2SO_4 and all forms were measured by spectroscopy.

Both ammonium and nitrate nitrogen were extracted with 0.5 mol/l $CaCl_2$ and estimated by distillation in the presence of MgO and Devarda's alloy, respectively.

Available P forms (Olsen P) was extracted with 0.5 mol/l $NaHCO_3$ and measured by spectroscopy.

Available forms of Cu, Zn, and Mn were extracted with DTPA (diethylene triamine pentaacetic acid 0.005 mol/l + $CaCl_2$ 0.01 mol/l + triethanolamine 0.1 mol/l) and measured by atomic absorption.

For the determination of total metals 1 g of material, digestion at 350 ^{0}C + 10 ml HNO_3 + 5 ml $HCLO_4$. According to the method described by (Varian, 1989), the samples were analyzed by Atomic Absorption (Spectroscopy Varian Spectra AA 10 plus), with the use of flame and air-acetylene mixture.

Statistical analysis: Data analysis was made using the MINITAB (Ryan et al. 2005) statistical package. Analysis of variance was used to assess treatments effect. Mean separation was made using Tukey's test when significant differences (P=0.05) between treatments were found.

Table 1

Chemical properties of soil samples, manure and leaf Cannabis used in the experiment

Property	Soil	*Manure	*Cannabis sativa* (Air dried material)
Texture	Sandy Loam		
pH	7.94 ± 0.3	8.35 ± 0.33	
EC, dS/m	0.29 ± 0.05	2.97 ± 0.16	
Organic matter (%)	0.79 ± 0.05	30.8 ± 1.4	
$CaCO_3$ (%)	7.58 ± 0.6		
N -Total (g/kg)	1.21 ± 0.06	11.22 ± 0.61	25.76 ± 1.1

$N\text{-}NH_4^+$ (mg/kg)	39.2 ± 3.8		
$N\text{-}NO_3^-$ (mg/kg)	98.4 ± 8.2		
K-exchangeable (mg/kg)	219.6 ± 6.7		
K-Total (g/kg)	4.66 ± 0.22	19.23 ± 0.98	16.79 ± 0.80
Na-exchangeable (mg/kg)	112.3 ±4.6		
Na-Total (g/kg)	0.28 ± 0.01	8.20 ± 0.39	0.16 ± 0.02
CEC (cmol/kg)	20.7 ± 1.3		
P -Olsen (mg/kg)	11.6 ± 3.3		
P -Total (g/kg)	0.36 ± 0.09	6.97 ± 0.39	3.33 ± 0.25
Cu –DTPA (mg/kg)	0.72 ± 0.06		
Zn -DTPA (mg/kg)	0.73 ± 0.08		
Mn -DTPA (mg/kg)	2.15 ± 0.11		
Cu –Total (mg/kg)	10.13 ± 0.48	29.27 ± 1.39	4.78 ± 0.23
Zn -Total (mg/kg)	37.45 ± 2.68	198.5 ± 9.02	27.9 ± 1.27
Mn -Total (mg/kg)	522 ± 37.3	75.3 ± 4.14	42.6 ± 2.14
Fe-Total (mg/kg)		5290 ± 289	129.0 ± 7.59
Mg-Total (mg/kg)			8748.0 ± 460.4

* Digested manure four months; Electrical conductivity, (EC) and soil pH is determined in (1:5) soil/water extract; Data represent average means and SE deviation. (n)=4.

RESULTS AND DISCUSSIONS

Decomposition of organic matter was increased with the increase of the leaf Cannabis concentration in soil, as compared with the control (soil plus manure). In particular, the decomposition of organic matter in soil where the three higher rates of the leaf cannabis were incorporated, were higher from 28.8 to 73.03 %, compared to the control (Figure 1). However, was not significantly affected by the smaller quantity addition of leaf cannabis.

The addition of dry plant tissues of Cannabis in the mixture (soil plus manure) increased nitrate nitrogen in comparison with the control, at all treatments at the end of the incubation period, while greater increase was observed with the addition of the highest rate. Contrast, ammonium was decreased by the addition of dry plant tissues of cannabis (Table 2).

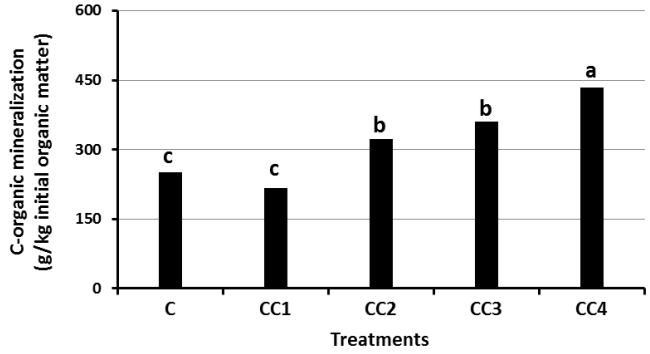


Figure 1. Effect of dry leaf Cannabis added rates on soil organic C mineralization. Columns in each characteristic of the graph with the same letter do not differ significantly according to the Tukey's test (P=0.05). C, control (soil plus manure); CC1, CC2, CC3 or CC4, control and cannabis 0.2, 0.4, 0.6 or 0.8g, respectively.

The available forms of phosphorus and manganese was increased by the addition of dry leaf tissues Cannabis in the two highest rates, and it was not significantly affected by the addition lower rates, of dry leaf tissues of Cannabis (Table 2). Furthermore, available forms of Cu and Zn by the addition of Cannabis in the mixture (soil plus manure), did not show statistically significant differences in comparison with the control at the end of the incubation period, at all treatments (Table 2).

Table 2

Effect of Cannabis dry matter concentration on soil available forms of elements

Treatments	Available forms			DTPA		
	P-Olsen	$N\text{-}NH_4^+$	$N\text{-}NO_3^-$	Cu	Zn	Mn
	(mg/kg soil)					
C	197.2b	93.8a	138.0d	0.95a	7.06a	2.28b
CC1	211.5b	16.7c	222.0bc	0.95a	6.59a	2.37b
CC2	204.3b	43.1b	234.2b	0.95a	7.19a	2.98ab
CC3	243.4a	32.3bc	269.2b	0.86a	6.47a	3.12a
CC4	242.9a	51.7b	317.5a	0.95a	6.95a	3.33a

For each chemical property of soil mixtures, columns of table with the same letter do not differ significantly according to the Tukey's test (P=0.05). C, control (soil plus manure); CC1, CC2, CC3 or CC4, control and leaf Cannabis 0.2, 0.4, 0.6 or 0.8 g, respectively.

The analysis of variance performed for the organic phosphorus and exchangeable form of potassium the data indicated that the organic phosphorus and exchangeable potassium was significantly increased by the added cannabis at the end of the incubation period at all rates (Table 3). However, exchangeable Na was not significantly affected by the addition of dry plant tissues Cannabis. In particular, the exchangeable form of sodium increased only from the highest rate of the added cannabis by 13.3 % in compared to the control. Electrical conductivity increased at the end of the incubation period from the two highest rates of dry plant tissues of the added Cannabis. In particular, the greatest increase was caused by the highest rate of the added cannabis by 53.6 % in compared to the control (soil plus manure), without any risk of soil salinity. This increase is due in conditions highest intensity biodegradation of soil organic matter. Contrary, the addition of the higher rate of Cannabis reduced the pH of the soil in compared to the control (soil plus manure) at the end of the incubation period. The decrease of soil pH at the end of the incubation period, probably is due to the stronger decomposition of soil organic matter, and in the oxidation of the $N\text{-}NH_4$+ to $N\text{-}NO_3$- (Table 3).

Table 3

Effect of Cannabis dry matter concentration on soil chemical properties

Treatments	Exchangeable forms		Organic	EC	pH
	Na	K	P	Extract (1: 5) soil/water	
	(mg/kg soil)			(dS/m)	
C	173.6b	698.1e	361.8c	0.82c	7.39a
CC1	173.6b	772.2d	617.2a	0.79c	7.42a
CC2	181.2b	867.4c	707.1a	0.90bc	7.38a
CC3	185.2ab	920.3b	673.4a	0.96b	7.36a
CC4	196.8a	1036.6a	647.0a	1.26a	7.28b

For each chemical property of soil mixtures, columns of table with the same letter do not differ significantly according to the Tukey's test (P=0.05). C, control (soil and manure); CC1, CC2, CC3 or CC4, control and leaf Cannabis 0.2, 0.4, 0.6 or 0.8 g, respectively.

The addition of dry plant tissues Cannabis in the mixture (soil plus manure) increased total form of phosphorus at the end of the incubation period at comparison to the control, at all rates (Table 4), while, total forms of sodium, potassium and manganese was increased from the addition of the two highest rates of dry plant tissues Cannabis. However, total forms of copper and zinc was not significantly affected by the addition dry plant tissues Cannabis at the end of the incubation period at comparison to the control.

Table 4

Effect of Cannabis dry matter concentration on soil total forms of elements

Treatments	Total forms					
	Na	K	P	Cu	Zn	Mn
	(g/kg soil)			(mg/kg soil)		
C	0.422b	5.74b	1.131b	19.22a	64.21a	643.4b
CC1	0.437b	6.11b	1.414a	18.75a	61.78a	631.7b
CC2	0.444b	6.32ab	1.461a	19.34a	66.64a	655.9b
CC3	0.489a	6.67a	1.459a	19.66a	62.89a	698.3a
CC4	0.498a	6.98a	1.433a	19.42a	67.56a	687.8a

For each chemical property of soil mixtures, columns of table with the same letter do not differ significantly according to the Tukey's test (P=0.05). C, control (soil plus manure); CC1, CC2, CC3 or CC4, control and leaf Cannabis 0.2, 0.4, 0.6 or 0.8 g, respectively.

CONCLUSIONS

Four different rates of leaf Cannabis biomass were applied into a soil amended with manure, and after an Incubation experiment 15 weeks the effects on the soil chemical properties were attested. These results confirm that, the leaf Cannabis biomass it is a valuable material for soil amendment as improves soil chemical and biological properties, while could be applied as an acceleration agent for soil organic matter biodegradation.

REFERENCES

Chouliaras N., Gravanis F., Vasilakoglou I., Gougoulias N., Vagelas I., Kapotis T., Wogiatzi E., 2007, The effect of basil (Ocimum basilicum L.) on soil organic matter biodegradation and other soil chemical properties. Journal of the Science of Food and Agriculture, 87(13), 2416-2419.

Fairbairn J.W., Liebmann J.A., 1974, The cannabinoid content of Cannabis sativa L grown in England. Journal of Pharmacy and Pharmacology, 26(6), 413-419.

Gougoulias N., Vagelas I., Vasilakoglou I., Gravanis F., Louka A., Wogiatzi E., Chouliaras N., 2010, Comparison of neem or oregano with thiram on organic matter decomposition of a sand loam soil amended with compost, and on soil biological activity. Journal of the Science of Food and Agriculture, 90(2), 286-290.

Gravanis F. T., Chouliaras N., Vagelas I. K., Gougoulias N., Sabani P., Wogiatzi, E., 2005, The effect of oregano as an alternative soiborne pathogen control, on soil organic matter biodegradiation and other soil chemical properties. In The BCPC International Congress, UK (pp. 105-108).

Hillig K.W., Mahlberg P.G., 2004, A chemotaxonomic analysis of cannabinoid variation in Cannabis (Cannabaceae). American Journal of Botany, 91(6), 966-975.

Page A.L, Miller R.H., Keeney D.R.,1982, Methods of Soil Analysis. Part 2, Chemical and Microbiological properties. Agronomy (9), ASSSA, Mad. Wisc. USA.

Riber L., Poulsen P.H., Al-Soud W.A., Hansen L.B.S., Bergmark L., Brejnrod A. and Sørensen S.J., 2014, Exploring the immediate and long-term impact on bacterial communities in soil amended with animal and urban organic waste fertilizers using pyrosequencing and screening for horizontal transfer of antibiotic resistance. FEMS microbiology ecology, 90(1): 206-224.

Ryan B.F., Joiner B.L., Cryer J.D., 2005, MINITAB Handbook: Updated for release 14, 5th edition. Brooks/Cole-Thomson Learning Inc., Kentaky, KY.

Varian M., 1989, Flama Atomic Absorption Spectroscopy. Analytical Methods. Varian Australia. Publ. N0: 85-100009-00.

Wu J., Brookes P.C., 2005, The proportional Mineralisation of Microbial Biomass and Organic Matter caused by air-drying and rewetting of a grassland soil. Soil Biology & Biochemistry, 37, 507-515.

ANNALS OF THE
UNIVERSITY OF CRAIOVA
Vol. XXIII (LIX) - 2018

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food produce processing technology*
✓ *Environmental engineering*

HORTICULTURE AND FOOD PRODUCTS PROCESSING TECHNOLOGY