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PRELIMINARY RESULTS REGARDING THE BEHAVIOUR OF DIFFERENT APRICOT VARIETIES UNDER DIFFERENT PLANTING DENSITY

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ABSTRACT

*Apricot cultivation and breeding have a long history in Romania. To keep up and maintain this tradition, continuous research is needed in order to identify the varieties and rootstocks that are able to generate high yields that are suitable for crop intensification and are aiming to reach the international standards, cultural trends and the actual economic context. During our study we have found that the planting distance influenced especially the average shoot length increase (ASLI - mm). The average trunk diameter increase (ATDI - mm) and average shoot length increase (ASLI - mm) are linked together and varied according to the genotype studied. Also, a correlation was found between ATDI - mm and ASLI - mm, described by the equation **y=0.8019x**. The related coefficients **R^2=0.8938***** and r=**0.9455*****, are statistically insured with a probability of 99.99%.*

INTRODUCTION

Apricot *(Prunus armeniaca* L.*)* is one of the oldest fruit species cultivated in mankind. For thousands of years, in different nations, these fruits have served not only as food but also as medicine (Miller et al., 1994; Chira, 1995). The spreading area of the cultivated apricot extends between the parallel 50° Northern latitude and 35° Southern latitude. Under certain conditions and localities with a favourable climate it can be cultivated further of the North (Gautier, 1988; Chira 1995). Apricot is an important fruit crop for the Southern and Western regions of Romania with a long tradition of cultivation (Bălan et al., 2008; Stănică et al., 2020).

During the past 30 years, orchard planting systems and tree canopies changed to the high and very high density planting. The different planting system have been successfully demonstrated in different fruit crops: peach and nectarine (Lal et al., 2018), apricot (Guerriero & Scalabrelli, 1989; Kumar et al., 2013), apple (Comănescu et al., 2012), pear (Machado et al., 2014), cherry (Stănică and Eremia, 2014). The availability of low or medium vigour rootstocks for the most fruit species offer the possibility to increase planting densities in apple and pear, to more than 4,000 trees per hectare and in stone fruits, to over 2,000 trees per hectare (Stănică, 2019).

Reducing planting distances is one of the strategies to increase yield in fruit (Auzmendi I. and Hanan, 2020). The main reason for its low productivity is non availability of high yielding varieties and lack of appropriate production technology especially planting density suiting to different climatic zones and region (Kumar et al., 2013) but high density orchards have been reported to have precocious and higher yield (De Jong et al., 1999; Lal et al., 2018).

The growth of shoots is a basic element to be considered in the relationship within growth and fructification, on which depends the fruit trees equilibrium respectively the production provision for year and next years (Enache et al., 2018).

The aim of this study was to determine the effect of planting density on properties of some apricot cultivars.

MATERIAL AND METHODS

The study was carried out at the Research and Development Station for Fruit Growing (RDSFG) Băneasa, Bucharest inside of the Experimental Base Moara Domnească, located N-E of Bucharest in Afumați, Ilfov County, in the Vlasiei Plain, a subunit of the Roman Plain.The site is located at 44°50’ Northern latitude and 26°24’ Eastern longitude and 70 m above the sea level. Continental temperate climate regime is specific for the area, with hot summers, frequent droughts and cold winters. The annual mean temperature is 12 °C and the total annual amount of precipitation is ranging between 550 and 600 mm, the maximum occurring between May and July, torrential rains being common. The dominant air circulation direction is from the East and North-East in winter and from the West in the rest of the year, with a maximum wind speed of 12.6-14.4 km/h. The zonal soil type is reddish luvisol. In the depressed areas and in the crevices there are reddish luvisols and stagnosols.

In 2019, four apricot varieties (‘Amiral’, ‘Elmar’, ‘Goldrich’, ‘Olimp’) with different ripening periods: were planted. All apricot varieties were grafted on rootstock: Constața 14 (C 14). The canopy that was considered adequate for testing is: Bi-Baum®. The apricot trees were planted at 4.0 × 1.5 m (1.666 trees ha^{-1}), 4.0 × 2.0 (1.250 trees ha^{-1}) m and 4.0 × 2,5 m (1000 trees ha^{-1}), upon a randomized block design. The irrigation system is provided by drip pipes, with a flow rate of 1.6 l/hour-1.75 l/hour. Between the rows, the soil was kept tilled and without grass.

Our experience is a bifactorial one and is carried out in order to observe the agrobiological potential of the varieties studied, aiming to intensify the cultivation technologies, through high density.

The chosen rootstock is Constanța 14 (C 14), a generative Romanian rootstock for apricots, obtained by selection in 1979 by Indreiaş Alexandra, approved in 1997. It has good affinity for grafting with all varieties in the assortment, induces high vigour, fruiting precocity and good fruit productivity and quality of grafted varieties.

In order to identify the most suitable variety and planting distance with the final goal of crop intensification, corroborated with the degree of maximization of the tree density, determinations were made on early stage growth of tree. The determination of observed characteristics was made in 2020 and 2021, at the end of the growth cycle, with electronic calliper and roulette for shoot length. Several tree growth indicators were analysed: the average trunk diameter increase (ATDI, mm), the average shoot length increase (ASLI, mm) and the trunk cross-sectional area of tree (TCSA, cm^2) was calculated by using formula $TCSA = Girth^2/4\pi$ (Westwood et al., 1963).

The collected data were processed with the facilities of MSExcel 2010 and are presented as tables and charts. The tables include statistical indicators as average, standard deviation and variation coefficients.

RESULTS AND DISCUSSIONS

A closer look in Table 1 reveals the influence of planting distance on the three synthetic growth indicators: the average trunk diameter increase (ATDI, mm), the average shoot length increase (ASLI, mm) and the trunk cross-sectional area of the tree (TCSA, cm^2).

When the apricot was planted at 1.5 m apart in the trees line, the ATDI - mm was 9.37 mm per season (STDEV=1.5445; VAR=16.4919), with the lowest increase 7.50 mm on 'Elmar' variety and the higher increase 11.27 mm on 'Goldrich'. Under similar conditions, ASLI - mm was 63.64 mm per season (STDEV=10.3350; VAR=16.2398), with the lowest increase 50.00 mm on 'Amiral' variety and the higher increase 75.00 mm on 'Goldrich' and TCSA - cm^2 was 31.52 per season (STDEV=5.6238; VAR=17.8403), with the lowest increase 23.06 cm^2 on 'Elmar' variety and the higher increase 37.36 cm^2 on 'Goldrich'.

When the apricot was planted at 2.0 m apart in the trees line, the ATDI - mm was 10.74 mm per season (STDEV=1.5290; VAR=14.2329), with the lowest increase 8.66 mm on 'Goldrich' and the higher increase 12.33 mm on 'Olimp' variety. Under similar conditions, ASLI - mm was 83.28 mm per season (STDEV=5.2839; VAR=6.3446), with the lowest increase 79.28 mm on 'Olimp' variety and the higher increase 90.55 mm on 'Elmar' variety and TCSA - cm^2 was 34.96 per season (STDEV=6.9459; VAR=19.8703), with the lowest increase 25.82 cm^2 on 'Goldrich' variety and the higher increase 40.43 cm^2 on 'Olimp'.

Finally, when the apricot was planted at 2.5 m apart in the trees line the ATDI - mm was 9.60 mm per season (STDEV=1.5464; VAR=16.1123), with the lowest increase 7.99 mm on 'Olimp' variety, and the higher increase 11.48 mm on 'Amiral'. Under similar conditions, ASLI - mm was 88.97 mm per season (STDEV=9.2034; VAR=10.3441), with the lowest increase 79.76 mm on 'Olimp' variety and the higher increase 101.21 mm on 'Amiral' variety and TCSA - cm^2 was 30.54 per season (STDEV=6.0945; VAR=19.9527), with the lowest increase 24.81 cm^2 on 'Goldrich' variety and the higher increase 38.57 cm^2 on Amiral'.

Based on the accumulated data a linear correlation between average trunk diameter increase (ATDI, mm) and average shoot length increase (ASLI, mm) was calculated (Fig. 1). This correlation is described by the equation **y=0.8019x,** and even for n=12-2=10 pairs of numbers, the correlation coefficients **R^2=0.8938** and **r**=sqrt(0.8938)=**0.9455**, are statistically insured, with a probability of 99.99%.

Also, a positive correlation between Annual Cross Trunk Section Area Increase [cm^2] and Annual Shoot Length Increase [cm], described by the equation **Y=0.0275x+6.9724** with the coefficients **R^2=0.0144**; **r**=sqrt(0.0144)=**0.1200**; n=12-2, but the coefficients are not statistically insured.

Table 1

Annual growth dynamic. Average trunk diameter, shoots and trunk cross-sectional area of tree increase related to the planting distance.

Variant	Planting distance [m] / Variety	Average trunk diameter [mm] 01.10.2020	Average trunk diameter [mm] 04.08.2021	*Average trunk diameter increase [mm]*	Average shoots length [mm] 01.10.2020	Average shoots length [mm] 04.08.2021	*Average shoots length increase [mm]*	TCSA [cm^2] 01.10.2020	TCSA [cm^2] 04.08.2021	*Average TCSA increase [cm^2]*
V1	1.5 m / AMIRAL	18.25	27.44	9.19	28.28	78.28	50.00	26.15	59.11	32.96
	1.5 m / ELMAR	15.83	23.33	7.50	29.50	104.5	75.00	19.67	42.73	23.06
	1.5 m / GOLDRICH	15.48	26.75	11.27	29.50	95.45	65.95	18.81	56.17	37.36
	1.5 m / OLIMP	14.56	24.06	9.50	30.34	93.95	63.61	16.64	45.44	28.80
Indicators	**AVG**	**16.03**	**25.40**	**9.37**	**29.41**	**93.05**	**63.64**	**20.51**	**52.04**	**31.52**
	STDEV	*1.5739*	*2.0054*	*1.5445*	*0.8481*	*10.8907*	*10.3350*	*4.1094*	*6.7595*	*5.6238*
	VAR	*9.8187*	*7.8967*	*16.4919*	*2.8843*	*11.7048*	*16.2398*	*20.0337*	*12.9901*	*17.8403*
V2	2.0 m / AMIRAL	17.52	28.64	11.12	32.00	111.46	79.46	24.10	64.39	40.29
	2.0 m / ELMAR	14.09	24.95	10.86	18.50	109.05	90.55	15.58	48.87	33.28
	2.0 m / GOLDRICH	14.66	23.32	8.66	27.38	111.22	83.84	16.87	42.69	25.82
	2.0 m / OLIMP	14.72	27.05	12.33	29.00	108.28	79.28	17.01	57.44	40.43
Indicators	**AVG**	**15.25**	**25.99**	**10.74**	**26.72**	**110.00**	**83.28**	**18.39**	**53.35**	**34.96**
	STDEV	*1.5414*	*2.3350*	*1.5290*	*5.8046*	*1.5791*	*5.2839*	*3.8574*	*9.5276*	*6.9459*
	VAR	*10.1090*	*8.9842*	*14.2329*	*21.7239*	*1.4355*	*6.3446*	*20.9756*	*17.8600*	*19.8703*
V3	2.5 m / AMIRAL	15.66	27.14	11.48	25.25	126.46	101.21	19.25	57.82	38.57
	2.5 m / ELMAR	18.34	27.09	8.75	23.63	113.82	90.19	26.40	57.61	31.20
	2.5 m / GOLDRICH	14.65	24.82	10.17	**26.32**	111.05	84.73	16.85	48.36	31.51
	2.5 m / OLIMP	15.78	23.77	7.99	28.88	108.64	79.76	19.55	44.35	24.81
Indicators	**AVG**	**16.11**	**25.71**	**9.60**	**26.02**	**114.99**	**88.97**	**20.32**	**50.86**	**30.54**
	STDEV	*1.5722*	*1.6837*	*1.5464*	*2.2041*	*7.9325*	*9.2034*	*4.0892*	*7.9943*	*6.0945*
	VAR	*9.7610*	*6.5502*	*16.1123*	*8.4709*	*6.8983*	*10.3441*	*20.1267*	*15.7176*	*19.9527*

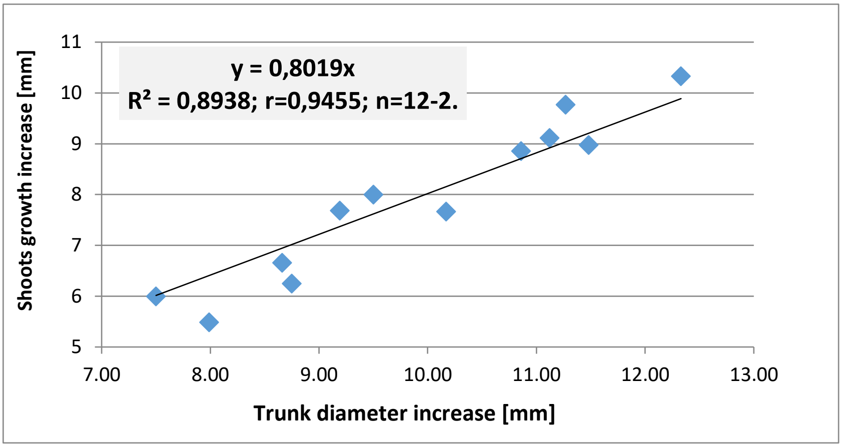

Figure 1. Correlation between average annual trunk diameter and average shoot length increase

CONCLUSIONS

The four varieties, grown by the Research and Development Station for Fruit Growing (RDSFG) Băneasa, Bucharest, under specific pedo-climatic conditions at Moara Domnească Experimental Base are adapting and performing well in the juvenile phase.

Based on the presented data we found that the planting distance influenced both, average trunk diameter increase (ATDI, mm) and average shoot length increase (ASLI, mm) of all four studied apricot varieties. In the juvenile phase of the apricots, the average trunk diameter increase (ATDI - mm) and average shoot length increase (ASLI - mm) are linked together and varied according to the genotype studied as well as have valorised the chosen rootstock C14 and the applied technological measures as well.

Regarding the synthetic growth indicator TCSA - cm^2 the highest value for: (4 × 1.5 m) planting distance is recorded by 'Goldrich' with 37.36 cm^2, (4 × 2 m) planting distance is recorded by 'Olimp' with 40.43 cm^2 and (4 × 2.5 m) planting distance is recorded by 'Amiral' with 38.57 cm^2. This indicator is of great importance for future studies, because by using it is possible to correlate the productivity of selected varieties with the planting distances in super-intensive cropping system.

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