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STUDIES ON THE NUTRITION OF THE SORGHUM PLANT FOR GRAINS BY APPLYING NON-POLLUTING FERTILIZERS FOR THE ENVIRONMENT

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ABSTRACT

This study presents the research conducted in the period 2020-2021 on the cultivation of sorghum for grains, aiming at foliar fertilization with environmentally friendly products, in order to promote sustainable agriculture in the area of sandy soils. The highest grain production (6192.3 kg / ha) was recorded by foliar fertilization with the product Maturevo 3.35.35 + ME, applied in a dose of 3.5 kg / ha, in the phase of 6-8 leaves of the plant sorghum, on an agrofund of N150P80K80. The production of sorghum grains was correlated, distinctly significantly positive, with the leaf area, the weight of a thousand grains and the hectoliter weight of the grains. The protein content of sorghum grains was between 11-15.1%, depending on fertilization, correlating positively with root and foliar fertilization, the maximum being recorded at foliar fertilization with the liquid biopreparation Biohumussol, in a concentration of 1% , on the agrofund of N150P80K80.

INTRODUCTION

Results obtained from sorghum for grains grown in Romania highlighted the specificity of the plant for areas with water deficit, given the increased resistance to drought, given primarily by the ability to reduce or even interrupt its physiological functions in harsh climatic conditions and to resumed them with great intensity when they become favorable (Cosmin O., 1987, Antohe I, et al., 2002, Drăghici Reta et al., 2012). International studies have shown that elements of technology, such as crop rotation, fertilization and density, have significantly influenced the production potential of sorghum for grains (Kaufman RC, 2013, Drăghici Iulian et al., 2020). The research conducted by J. S. B. Dembele et al. (2020), in the Sudan-Sahelian area of Mali, highlighted the significant influence of the fertilization-density-variety interaction on sorghum grain production. Sorghum makes good use of sandy and salty soils and can be cultivated on land with a pH between 4.5 - 8.5. Research in Egypt has highlighted the importance of foliar fertilization with phosphorus and potassium in counteracting the stress caused by excessive soil salinity (Mohamed Moursy Husse et al., 2010). Having a well-developed root system, with which it can extract from the soil the nutrients necessary for the normal development of plant metabolism, sorghum is a less demanding plant in terms of nutrients (Simona - Florina Isticioaia et al., 2018, Narges Zand and Mohammad Reza Shakiba, 2013). Research on sorghum in Ethiopia has shown that fractional nitrogen application has increased production yields by 28.4% compared to single-dose application to sorghum (Workat Sebnie et al., 2020). Due to the low organic matter content of sandy soils, the success of most crops requires large amounts of chemical fertilizers, which can often lead to pollution of groundwater with nitrates, given the poor hydrophysical properties in terms of chemical retention (Gheorghe D. et al., 2003, Nicolescu M. et al., 2008). In order to preserve and increase soil fertility and to prevent soil and groundwater contamination with nutrients, it is necessary that the fertilization be in a controlled manner so as to ensure the optimal use by the cultivated plants of the nutrients in the soil and those from applied mineral and organic fertilizers. In this regard, research has been initiated on grain sorghum in order to increase the quantity and quality of production, by applying foliar fertilizers with a high content of trace elements and with implications for reducing the effects of stress of abiotic origin.

MATERIAL AND METHODS

Researches were conducted in sorghum grain, grown in irrigated in a three year rotation: cowpea - rye - sorghum. The experiment was placed, according to the method of plots subdivided with 2 factors, on a sandy soil with low natural fertility, having an organic carbon content between 0.38% and 0.66%, indicating a state of soil supply in the matter. reduced organic and a pH that ranged from 4.87 to 6.25, values that show a moderately acidic to slightly acidic reaction. The experimental factors studied were:

Factor A: Rut fertilization (Basic fertilization)
a1 - N75P40K40 (1/2 of the technological dose of NPK)
a2 - N150P80K80 (technological dose of NPK)
Factor B: Foliar fertilization
b1 - Unfertilized foliar
b2 - Basfoliar 36 Extra, in a dose of 8 l / ha
b3 - Maturevo 3.35.35 + ME, in a dose of 3.5 kg / ha
b4 - Biohumussol liquid, in a concentration of 1%
b5 - Polyactiv Mn, at a dose of 2.5 l / ha

The rut fertilization with N40P40K40 (a1) and N80P80K80 (a2) was applied in the preparation of the germination bed, and the difference of nitrogen dose, respectively N35 (a1) and N75 (a2), as well as foliar fertilization with the tested products were applied in the phenophase of 6 - 8 leaves of the plant. During the vegetation period, biometric determinations and the nutritional status of the plant were performed. In the flowering phase, leaf samples were collected, from which the state of supply of plants in macroelements was determined by the following methods: total nitrogen by the Kjeldahl method; total phosphorus by colorimetric method; total potassium by the flame emission photometry dosing method. Also, in the same phenophase, the leaf area was determined using the Area Metter AM 300 device. At harvest, the production obtained and its quality were determined, respectively the percentage of protein determined by the spectrophotometric method, with the NIR analyzer, INFRAMATIC 9200 model from Perten. The results were calculated and analyzed by the method of analysis of variance (ANOVA) and using mathematical functions.

RESULTS AND DISCUSSIONS

The results obtained for sorghum for grains grown on sandy soils underlined the correlation of plant growth and development with the technological factors studied (Table 1). There were differences in plant height, leaf area index (LAI), one thousand grain weight (TWG) and hectoliter weight (HW), depending on root and leaf fertilization. Thus, on the root fertilization agrofund with N75P40K40, which represents 1/2 of the technological fertilization dose, the sorghum by foliar fertilized in the phase of 6-8 leaves with Basfoliar 36 Extra, in a dose of 8 l / ha recorded the highest values of plant growth and development. On the rut fertilization soil with the technological dose of N150P80K80, sorghum reacted best to foliar fertilization with Maturevo 3.35.35 + ME, applied at a dose of 3.5 kg / ha (plant height = 120.3 cm; LAI = 6.6; TWG = 33 g, WG = 75 kg).

Table 1

The influence of root and foliar fertilization on biometric and productivity traits in grain sorghum cultivated in sandy soil conditions

The experimental variant		Plant height (cm)	LAI	TWG (g)	HW (kg)
Root fertilization	Foliar fertilization				
N75P40K40	Unfertilized foliar	110.8	4.7	30.5	71.5
	Basfoliar 36 Extra (8 l/ha)	115.5	4.9	31.5	73
	Maturevo 3.35.35 + ME (3,5 kg /ha)	115.5	5.1	31	72.5
	Biohumussol liquid (1%)	114.6	5.5	30.5	72
	Polyactiv Mn (2,5 l/ha)	113.0	5.1	31	71.5
N150P80K80	Unfertilized foliar	113.5	5.3	31	74
	Basfoliar 36 Extra (8 l/ha)	121.3	5.7	31.5	74.5
	Maturevo 3.35.35 + ME (3,5 kg /ha)	120.3	6.6	33	75
	Biohumussol liquid (1%)	117.2	5.8	32.5	73.5
	Polyactiv Mn (2,5 l/ha)	116.7	6.1	32	74.5

Determinations on the nutritional status of the sorghum plant, in the flowering phase, revealed a nitrogen content between 1.86% in the fertilized version 1/2 of the technological dose of NPK (N75P40K40), but not fertilized foliar and 2.97%, in the version fertilized with the technological dose of NPK (N150P80K80) and foliar fertilization with the liquid Biohumussol product, applied in a dose of 1% (Figure 1). Values increase with increasing dose of nitrogen administered, but the results indicate a reduced state of plant supply compared to the data in the literature (Răuță C.and Chiriac Aurelia, 1980). The total phosphorus content of sorghum plants showed the highest values in the variants fertilized with 1/2 of the technological dose of NPK and foliar fertilized with Basfoliar 36 Extra and Maturevo products 3.35.35 + ME (0.34-0.41%), values that indicate a good supply of sorghum plants in phosphorus. The potassium content of the leaves was quite low (1.42-1.84%), the optimal values being in the range of 3-4%. Potassium deficiency can occur primarily on soils poor in potassium, especially in conditions of low temperatures, which contribute to decreased potassium absorption. Fertilization with high doses of nitrogen, in the absence of the application of potassium, can have negative effects on potassium nutrition, through crop increases, and in some species and as a result of the negative N-K interaction.

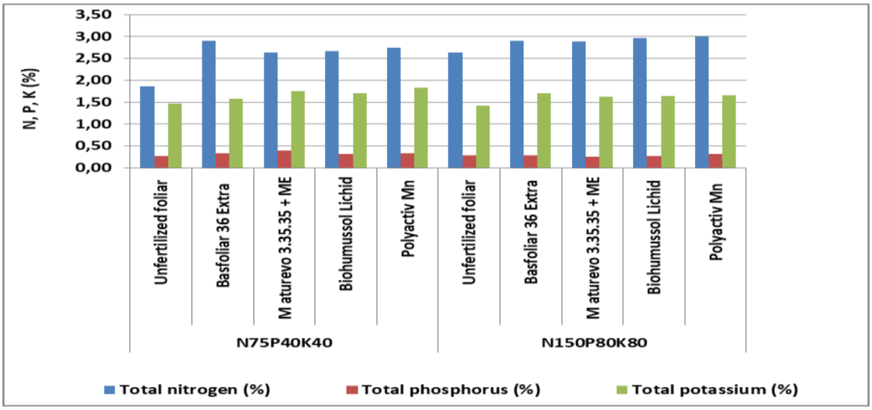

Figure 1. The nutrient supply status of sorghum plants in the flowering phase

Table 2

The influence of root and foliar fertilization on the quantity and quality of grain production obtained from grain sorghum

The experimental variant		Grain Yield			Protein	
Root fertilization	Foliar fertilization	kg/ha	Difference compared to the control kg/ha	Significance	%	kg/ha
N75P40K40	Unfertilized foliar	2913.1	Control	Control	11	320.4
	Basfoliar 36 Extra	3447.7	534.6	*	11,6	399.9
	Maturevo 3.35.35 + ME	3691.9	778.8	**	11,1	409.8
	Biohumussol Liquid	3324.3	411.2	-	12,8	425.5
	Polyactiv Mn	3210.4	297.3	-	11,2	359.6
N150P80K80	Unfertilized foliar	5093.8	Control	Control	12,4	631.6
	Basfoliar 36 Extra	5923.6	829.7	**	13,9	823.4
	Maturevo 3.35.35 + ME	6192.3	1098.5	***	13,7	848.3
	Biohumussol Liquid	5835.2	741.3	**	15,1	881.1
	Polyactiv Mn	5517.7	423.8	-	12,7	700.7
LSD 5%=517.9 kg/ha; LSD 1%=713.3 kg/ha; LSD 0.1%=982.0 kg/ha						
Correlation between grain yield and leaf area index		$y = 1E\text{-}07x^2 - 0{,}0006x + 5{,}9224$; r=0.857**				
Correlation between grain yield and thousand grain weight		$y = 2E\text{-}07x^2 - 0{,}0016x + 33{,}547$; r=0.836**				
Correlation between grain yield and hectoliter weight		$y = -2E\text{-}07x^2 + 0{,}0027x + 65{,}388$; r=0,937**				

Analyzing the production results obtained from grain sorghum, under the influence of root and foliar fertilization, the biopreparation Maturevo 3.35.35 + ME was highlighted, in a dose of 3.5 kg / ha, applied in the phase of 6-8 leaves of the plant, both on the agrofund of N75P40K40 (3691.9 kg / ha), as well as the agrofund of N150P80K80 (6192.3 kg / ha) (Table 2). The protein content of sorghum grains was between 11-15.1%, depending on fertilization, correlating positively with root and foliar fertilization, the maximum being recorded at foliar fertilization with the Biohumussol liquid biopreparation, in a concentration of 1%, on the agrofund of N150P80K80 (Table 2). The importance of foliar fertilization with various microelements was, also, highlighted by research conducted in the semi-arid agro-ecological subregion of Andhra Pradesh, India, which highlighted their positive influence on the yield and quality of sorghum and maize grains. The correlation coefficients calculated using mathematical functions show that there is a close link between grain production and the elements that contribute to its realization, namely leaf area, weight of one thousand grains and hectoliter weight of grains (Table 2).

CONCLUSIONS

Grain sorghum achieved the highest grain production at foliar fertilization with the product Maturevo 3.35.35 + ME, applied in a dose of 3.5 kg / ha, in the phase of 6-8 leaves of the plant on an agrofund of N150P80K80 (6192,3 kg / ha).

The production of sorghum grains was positively correlated, distinctly significant, with the leaf area, the thousand grain weight and the hectoliter weight of the grains.

The protein content of sorghum grains was between 11-15.1%, depending on fertilization, correlating positively with root and foliar fertilization, the maximum being recorded at foliar fertilization with the Biohumussol liquid biopreparation, in a concentration of 1%, on the agrofund of N150P80K80.

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