OBTAINED RESULTS REGARDING THE OPTIMIZATION OF GRAIN SORGHUM TECHNOLOGY IN PEDOCLIMATIC CONDITIONS FROM CENTRAL OF MOLDOVA

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Abstract

In recent decades in Romania and in many other regions of the world, there is a high frequency of drought years, to three years out of every five. This climate negatively affects the productivity of agricultural crops, and agricultural research must find solutions to diversify the assortment of crops that in tougher environmental conditions guarantee the stability and profitability of agriculture. One of the safest solutions is the cultivation of sorghum, whether for grain or biomass, which due to good drought resistance, the ability to withstand high temperatures and capitalize on poorly fertile land is superior by the yields of all crops and especially, cereals and fodder plants. In the pedoclimatic conditions from the Center of Moldova, starting with 2018 year, were initiated some researches regarding the optimization of the cultivation technology for grain sorghum, in order to create a technology in relation to the new climatic conditions and in relation to the protection of the environment. The results obtained on average over two agricultural years, 2018 and 2019, indicated a very large variation of grain production depending on the sowing density provided and on the applied mineral fertilizers, this being between 4074 kg/ha and 10234 kg/ha. The best results were obtained in the variants sown with 30 g.g./sqm and fertilized with N150P80 with and without the application of the biostimulator Aminosol. From the point of view of economic efficiency, the variant sown with 30 g.g./sqm and fertilized with $N_{150}P_{80}$ was the most profitable.

Key words: grain quality, economic efficiency, mineral fertilization, production, sorghum

The phytotechnical group with the largest distribution in the world, and including in Romania, is represented by cereals (Roman Gh. *et al*, 2011). Of these, lately, one of the species that is gaining importance is sorghum. This species is very important, especially in dry areas, where it can be a good alternative to growing corn. This is due to the fact that sorghum is the species that withstands high summer temperatures and achieves high yields even under conditions of water stress. Although sorghum is a plant with a high consumption of nutrients, it does not always react favorably to the application of chemical and organic fertilizers. This is because its root system is extremely effective in extracting nutrients from the soil (Maranville J. *et al*, 1980).

There are many studies on the influence of nitrogen, phosphorus or potassium on grain sorghum productivity (Mamo S. *et al*, 2007), but these refer to each mineral element administered separately and not to the combination of these (Kayuki C. *et al*, 2007).

Mineral fertilizers applied to sorghum grown in different densities positively influence the dry matter, ash and nitrogen content (Drăgici I. *et al*, 1998). In the drier areas of Romania, the fertilization of sorghum crops is of great importance (Rotar and Chircă, 1995), and in the context of sustainable agriculture, establishing the optimal sowing density and optimal fertilizer doses is imperative (Drăghici I., 2003).

Some authors have undertaken important research aimed at establishing the optimal epoch and density for sowing sorghum. Studies abroad have shown that sorghum is grown at a distance between rows of 38 cm and 76 cm between rows (Jones O. and Johnson G., 1997). Plant density greatly influences the dry matter content and has a slight influence on the sugar content of sorghum (Ferraris R., 1986).

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According to data from the literature, a good harvest can be considered at a density at harvest between 100000 and 200000 plants/ha. On fertile lands a density of 150000 - 200000 harvestable plants/ha is recommended, and on lands with low fertility, the recommended density is 100000 harvestable plants/ha.

Taking into account the existing data in the literature, the research conducted at A.R.D.S. Secuieni were to determine the influence of mineral fertilization with the combination of N, P and K on sorghum grown in different densities and to establish the economic efficiency of sorghum according to them.

MATERIAL AND METHOD

In order to achieve our proposed objectives, in the experimental field of S.C.D.A. A two-factor experience was placed in Secuieni.

The type of experiment was A x B, and its placement in the field was performed according to the method of subdivided plots with the placement of factor A in strips, in three repetitions. The experiment was performed on the Albanus hybrid (Euralis Seeds), and the factor A was represented by the sowing density with three graduations: a_1 - 20 germinating grains (g.g./sqm), a_2 - 25 g.g./sqm and a_3 - 30 g.g./sqm. Factor B was represented by fertilization with five graduations: b_1 - Unfertilized, b_2 - $N_{75}P_{80}$, b_3 - $N_{75}P_{80}$ + Aminosol, b_4 - $N_{150}P_{80}$ and b5 - $N_{150}P_{80}$ + Aminosol. Mineral fertilizers with NP were applied at the preparation of the germination bed, and the biostimulator Aminosol when the sorghum had formed six leaves.

In the laboratory, the starch and protein content was determined using the NIR DA 7250 analyzer, and biometric and specific measurements were performed during the sorghum vegetation period. The samples were taken when the grains reached a humidity of 18 %.

The data obtained were processed and interpreted statistically according to the method of analysis of variance (ANOVA, 2013).

RESULTS AND DISCUSSIONS

Figure 1 shows that the factors studied influenced the number of plants harvested, both the main and secondary (shoots). Thus, the number of main plants was higher at the sowing density of 30 g.g./sqm, as is normal, and the number of shoots evolved positively with the increase of the fertilizer dose and negatively with the increase of the sowing density.

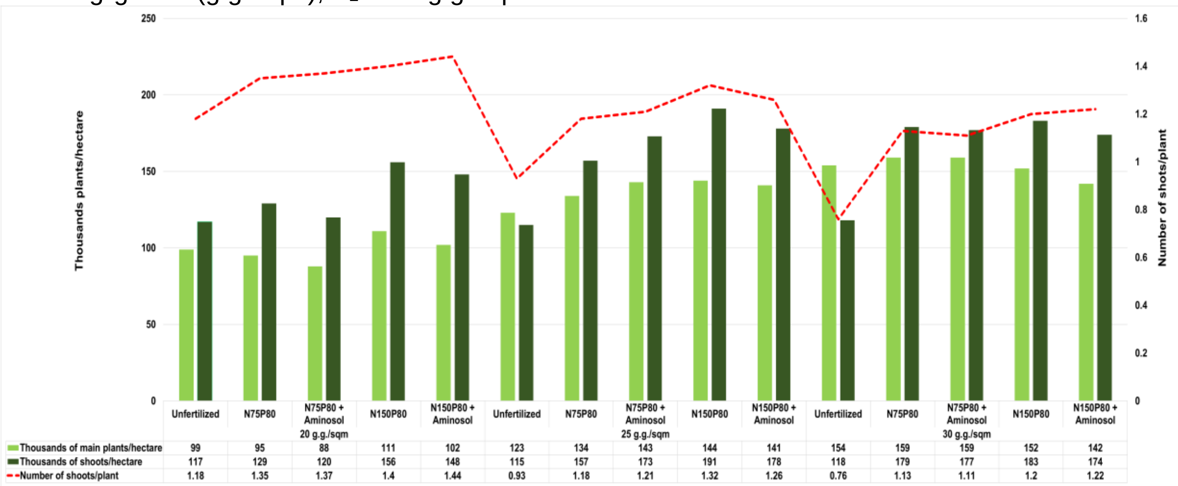

Figure 1 **The number of plants harvest under the A.R.D.S Secuieni pedoclimatic conditions, average 2018 - 2019**

The factors have greatly influenced the grain production achieved, this varying in very wide limits, between 4074 kg/ha (Unfertilized x 20 g.g./sqm) and 10234 kg/ha ($N_{150}P_{80}$ + Aminosol x 30 g.g./sqm). Compared to the control variant (average experience), the variants sown with 30 g.g./sqm achieved the highest production increases, these being between 1240 kg/ha and 2732 kg/ha. The production increases achieved rised with the fertilizer dose, the highest increase (2732 kg/ha) was achieved at the variant fertilized with $N_{150}P_{80}$ + Aminosol. The application of the Aminosol biostimulator broughtproduction increases between 273 kg/ha ($N_{150}P_{80}$ + Aminosol x 30 g.g./sqm) and 1245 kg/ha ($N_{75}P_{80}$ + Aminosol x 30 g.g./sqm).

In conclusion, it is noted that sorghum is a species that prefers large sowing densities of 30 g.g./sqm and is very receptive to mineral fertilization with high doses of nitrogen and phosphorus and the application of biostimulators during the growing season (*table 1*).

From an economic point of view, sorghum is a productive species, with modest needs to soil fertility, drought and involves minimal costs for cultivation.

Table 1

Results obtained regarding the influence of the interaction between sowing density and fertilization on grain production, average 2018 – 2019

Factor A Sowing density (g.g./sqm)	Factor B Fertilization (kg s.a./ha)	Yield			The meaning
		Kg/ha	Relative (%)	Difference from control kg/ha	
20	Unfertilized	4074	54	-3429	ooo
	$N_{75}P_{80}$	5881	78	-1622	ooo
	$N_{75}P_{80}$ + Aminosol	7065	94	-437	
	$N_{150}P_{80}$	8020	107	518	
	$N_{150}P_{80}$ + Aminosol	8333	111	831	*
25	Unfertilized	4882	65	-2620	ooo
	$N_{75}P_{80}$	6838	91	-664	
	$N_{75}P_{80}$ + Aminosol	7958	106	456	
	$N_{150}P_{80}$	8580	114	1078	**
	$N_{150}P_{80}$ + Aminosol	9100	121	1598	***
30	Unfertilized	5363	71	-2139	ooo
	$N_{75}P_{80}$	7497	100	-6	
	$N_{75}P_{80}$ + Aminosol	8742	117	1240	***
	$N_{150}P_{80}$	9961	133	2459	***
	$N_{150}P_{80}$ + Aminosol	10234	136	2732	***
Average experience (Control)		7502	100	Mt.	Mt.
LSD 5% (kg/ha)		675			
LSD 1% (kg/ha)		917			
LSD 0.1 % (kg/ha)		1215			

*LSD means Least significant difference (For positiv values - Differences larger than LSD 5% level are significant and are indicated with *, differences larger than LSD 1% level are distinctly significant and are indicated with ** and differences larger than LSD 0.1% level are verry significant and are indicated with **** and for negativ values the *, **, *** is replaced with o, oo, ooo.

Analyzing the economic efficiency of the culture calculated taking into account the technological sheet of the culture, we observe a large variation of the net profit depending on the applied technological variant.

We notice from the data in table 2 that all the experienced variants achieved a positive net profit, which emphasizes the fact that sorghum succeeds even in more precarious technological conditions. The most profitable variant proved to be the one sown with 30 g.g./sqm and fertilized with $N_{150}P_{80}$.

The application of the biostimulator Aminosol achieved slight increases of the net profit, the main increases coming from the risIng of the sowing density and from the growing of the doses with mineral fertilizers (*table 2*).

In conclusion, sorghum is a profitable species even in more precarious technological conditions, but the proper application of technological factors leads to significant increases in profit.

Table 2

Economic efficiency of culture, depending on the factors pursued, average 2018 – 2019

Factor A Sowing density (g.g./sqm)	Factor B Fertilization (kg s.a./ha)	Yield kg/ha	Value yield (lei/ha)	Total expenses (lei/ha)	Production cost (lei/kg)	Gross profit (lei/ha)	Net profit (lei/ha)
20	Unfertilized	4074	3666	2470	0.61	1196	1005
	$N_{75}P_{80}$	5881	5292	3090	0.53	2202	1850
	$N_{75}P_{80}$ + Aminosol	7065	6359	3318	0.47	3041	2554
	$N_{150}P_{80}$	8020	7218	3350	0.42	3868	3249
	$N_{150}P_{80}$ + Aminosol	8333	7499	3610	0.43	3889	3267
25	Unfertilized	4882	4394	2570	0.53	1824	1532
	$N_{75}P_{80}$	6838	6154	3190	0.47	2964	2490
	$N_{75}P_{80}$ + Aminosol	7958	7162	3418	0.43	3744	3145
	$N_{150}P_{80}$	8580	7722	3450	0.40	4272	3588
	$N_{150}P_{80}$ + Aminosol	9100	8190	3710	0.41	4480	3763
30	Unfertilized	5363	4827	2670	0.50	2157	1812
	$N_{75}P_{80}$	7497	6747	3290	0.44	3457	2904
	$N_{75}P_{80}$ + Aminosol	8742	7867	3518	0.40	4349	3653
	$N_{150}P_{80}$	9961	8964	3550	0.36	5414	4548
	$N_{150}P_{80}$ + Aminosol	10234	9210	3810	0.37	5400	4536
Average		7502	6751	3268	0.45	3484	2926
June sale price 2020: 0.9 lei/kg							

CONCLUSIONS

Following the results obtained for grain sorghum experienced in the pedoclimatic conditions in Central Moldova, the following were highlighted:

- the number of shoots evolved positively with the increase of the fertilizer dose and negatively with the increase of the sowing density;
- sorghum is a species that prefers large sowing densities, of 30 b.g./sqm and is very receptive to mineral fertilization with high doses of nitrogen and phosphorus and to the application of biostimulators during the growing season;
- sorghum is a profitable species even in more precarious technological conditions, but the proper application of technological factors leads to significant increases in profit.

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