Research Regarding the Influence of some Technological Factors on Sorghum Capacity to Form Shoots, under the Center of Moldavia Conditions

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ABSTRACT

Sorghum can be an excellent source of starch, protein, sugar, fiber, being cheaper than corn, because the costs/ha are lower than corn. It has a great development due to its use in food industry, especially in semi arid areas of the world where the climatic conditions offer limited conditions for agriculture. In this paper, we managed to prove how important is the proper fertilization with nitrogen and phosphorus in forming the number of shoots/field and how important is the ensuring of an optimal seeding density on the formation of main plant in the sorghum field.

Considering the importance of plants number in field, the main objective of the researches conducted during 2013 – 2014, was to study the sprouting ability of sorghum plants and the influence of some technological factors on it, knowing their direct influence in forming the field and indirect influence on grain production. In the experimental field of Agricultural Research – Development Station Secuieni, we placed an experience of 3 x 4 x 4 type, where we study at three hybrids of sorghum for grain, the influence of sowing density and nitrogen and phosphorus fertilization on *Sorghum bicolor* L. plantlets ability to sprout.

The obtained results highlight the fact that the nitrogen and phosphorus fertilization contribute to the increasing of the shoots number/plant, but the sowing density negatively influence their formation. The correlation between nitrogen and phosphorus fertilization and the shoots number/ha was direct, the correlation coefficients were statistically ensured and interpreted as very significant, while that between sowing density and shoots number/ha was indirect, in this case, the correlation coefficients were interpreted as negative very significant.

Keywords: *density, mineral fertilization, shoots, plants, sorghum.*

INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench) is an important cereal in the world, the fourth major cereal in terms of production, and fifth in acreage following wheat, rice, maize and barley.

It has a great development and because its use in the alimentation especially in the semi-arid areas of the world where the climatic conditions gives limited conditions for agriculture. Such situations predominantly in Africa, Asia and Latin America, which are frequently drought-prone. India grows the largest acreage of sorghum in

the world followed by Nigeria and Sudan, and produces the second largest tonnage after the US (FAO, 1995; ICRISAT, 2004; Nadia *et al.*, 2009).

Sorghum can be an excellent source of starch, protein, sugar, fiber, being cheaper than corn, because the cost/ha are lower than the corn (Claver *et al.*, 2010; Shinde, 2005; Singh *et al.*, 2009; Singh and Sandhu., 2007). The climatic evolution towards heating and aridization in the Balkan area, where Romania is also found, compels to a reconsideration of the sorghum as: alimentary cereal, fodder plant, technical plant (stationary and

textile celluloses, plastic material), the industry of construction materials and the handicraft industry (brushes of domestic and industrial use, brooms, nettings) (Volf, 2009). Improvement of some technology links of cultivation of sorghum sequences is a matter of great importance for our country, in order to obtain high yields for providing the necessary food, feed feedstock in the production of bioethanol - considered a fuel of the future.

MATERIALS AND METHODS

To clarify the issues proposed, during 2013 – 2014, was organized a trifactorial experience, in which were applied different technological sequences at certain genotypes of sorghum.

The placement of the experiences was made in the experimental field of the Agricultural Research – Development Station – Secuieni, Neamt, after the subdivided parcels method, in three repetitions.

The placement was made on a typical faeoziom soil type, middle texture, acid: $\text{pH}_{\text{H}_2\text{O}}$ – 5.98, characterized as: well stocked in phosphorus (77.6 ppm P_{AL}), Ca (13.6 meq/100 g soil Ca) and Mg (1.8 meq/100 g soil Mg); middle stocked in active humus (1.88 %) and nitrogen (16.2 ppm N-NO_3) and poorly stocked in potassium (124.6 ppm K_2O).

The technological parameters concerned in this paper are sowing density and fertilization, because it is well known that the sowing density, present importance due to its positive correlation with the number of plants present which forms

Tab. 1. The influence of the interaction of the studied factors on the ratio between the number of main plants/ ha and the number of shoots/ha at *Sorghum bicolor* L., 2013

Fertilization	Hybrid	Density (g.s./ha)	Total plants at harvest (thousands)	Of which:				
				Main plants		Shoots		Average no./pl
				thousands	%	thousands	%	
N_0P_0	Fundulea 32	150000	233	108	46	125	54	1.16
		200000	239	147	62	92	38	0.63
		250000	272	193	71	79	29	0.41
		300000	297	232	78	65	22	0.28
	Alize	150000	233	114	49	119	51	1.04
		200000	246	156	63	90	37	0.58
		250000	270	199	74	71	26	0.36
		300000	303	241	80	62	20	0.26
	Armida	150000	234	120	51	114	49	0.95
		200000	245	161	66	84	34	0.52
		250000	272	202	74	70	26	0.35
		300000	304	243	80	61	20	0.25
$\text{N}_{40}\text{P}_{40}$	Fundulea 32	150000	261	125	48	136	52	1.09
		200000	263	162	62	101	38	0.62
		250000	294	206	70	88	30	0.43
		300000	330	258	78	72	22	0.28
	Alize	150000	261	130	50	131	50	1.01
		200000	263	166	63	97	37	0.58
		250000	300	215	72	85	28	0.40
		300000	334	267	80	67	20	0.25
	Armida	150000	261	134	51	127	49	0.95
		200000	270	178	66	92	34	0.52
		250000	303	222	73	81	27	0.36
		300000	341	276	81	65	19	0.24

$N_{80}P_{80}$	Fundulea 32	150000	272	128	47	144	53	1.13
		200000	283	171	60	112	40	0.65
		250000	312	215	69	97	31	0.45
		300000	354	264	75	90	25	0.34
	Alize	150000	270	132	49	138	51	1.05
		200000	283	178	63	105	37	0.59
		250000	318	227	71	91	29	0.40
		300000	360	276	77	84	23	0.30
	Armida	150000	269	134	50	135	50	1.01
		200000	282	181	64	101	36	0.56
		250000	327	236	72	91	28	0.39
		300000	362	282	78	80	22	0.28
	Fundulea 32	150000	291	130	45	161	55	1.24
		200000	300	178	59	122	41	0.69
		250000	327	222	68	105	32	0.47
		300000	367	271	74	96	26	0.35
$N_{120}P_{120}$	Alize	150000	290	124	43	166	57	1.34
		200000	300	175	58	125	42	0.71
		250000	314	214	68	100	32	0.47
		300000	365	274	75	91	25	0.33
	Armida	150000	277	135	49	142	51	1.05
		200000	307	186	61	121	39	0.65
		250000	330	234	71	96	29	0.41
		300000	362	282	78	80	22	0.28

the plants density in field and at harvesting, and the mineral fertilizers are of special importance in increasing production at grain sorghum.

The experimental factors studied in the experimental field were of the A x B x C type, where: A factor was represented by the hybrid (a_1 - Fundulea 32, a_2 - Alize, a_3 - Armida), B factor, by the insured sowing density (b_1 - 150000 germinate seeds/ha, b_2 - 200000 germinate seeds /ha, b_3 - 250000 germinate seeds /ha, b_4 - 300000 germinate seeds /ha), and C factor was represented by the nitrogen and phosphorus fertilization (c_1 - unfertilized, c_2 - $N_{40}P_{40}$, c_3 - $N_{80}P_{80}$, c_4 - $N_{120}P_{120}$). The experiences sowing was done on the same day (3.05), at a temperature in soil of 12°C, at a depth of 3-4 cm, and the application of the chemical fertilizers was done manually at the seedbed preparation. Previous plant was soybeans. To describe the degree of linear association between technological factors studied and the number of shoots in the field, we calculated the Pearson correlation coefficient (r), which takes values between +1 and -1, the positive values showing a

positive correlation and the negative ones showing negative correlations.

RESULTS AND DISCUSSION

Due to the made researches it was found that the experimented technological sequences had major influences on the plant phenological characters.

In the first year of experimentation (2013), it was observed that along with increasing the doses of nitrogen and phosphorus fertilizers increases and the number of shoots/ha, but increased the sowing densities determined the increase of main plants number/ha and the decrease of the shoots number/ha. The shoots number from field varied within very wide limits, between 61000 shoots/ha (Armida x 300000 g.s./ha x N_0P_0) and 166000 shoots/ha. The ratio between the number of main plants/ha and the number of shoots/plant revealed that the highest number of shoots/plant (1.34 shoots/plant) is realized at the variant sown with Alize hybrid at a density of 150000 g.s./ha and fertilized with $N_{120}P_{120}$, while the lowest (0.24

shoots/plant) at the interaction between Armida x 300000 g.s./ha x $N_{40}P_{40}$ (Tab 1).

From the results shown in Tab. 1 we can see that the nitrogen and phosphorus fertilization has contributed to increasing the number of shoots/plant, but, the sowing density negatively influenced their formation.

The climatic conditions of the 2014 agricultural year negatively influenced the sorghum field formation by the appearance on May 25 of the hail phenomenon that caused the loss of 15 % of the sorghum plantlets barely emerged.

The remaining plantlets after the incurred losses have covered the gaps by forming shoots, but of which few were productive (Tab. 2).

The results obtained in 2014 indicated the same thing as those achieved in the first year of experimentation, namely that the fertilization had positively influenced the shoots formation in field, and the sowing density had negatively influences on their formation (Tab. 2). The shoots were present in greater number in field due to the gaps caused by the hail. Thus, they ranged between 63000 shoots/ha (Armida x 300000 g.s./

Tab. 2. The influence of the interaction of the studied factors on the ratio between the number of main plants/ ha and the number of shoots/ha at *Sorghum bicolor* L., 2014

Fertilization	Hybrid	Density (g.s./ha)	Total plants at harvest (thousands)	Of which:				
				Main plants		Shoots		Average no./pl
				thousands	%	thousands	%	
N_0P_0	Fundulea 32	150000	226	96	42	130	58	1.35
		200000	222	126	57	96	43	0.76
		250000	247	165	67	82	33	0.50
		300000	266	199	75	67	25	0.34
	Alize	150000	224	99	44	125	56	1.26
		200000	231	134	58	97	42	0.72
		250000	246	171	70	75	30	0.44
		300000	272	208	76	64	24	0.31
	Armida	150000	224	103	46	121	54	1.17
		200000	225	134	60	91	40	0.68
		250000	249	175	70	74	30	0.42
		300000	273	210	77	63	23	0.30
$N_{40}P_{40}$	Fundulea 32	150000	244	100	41	144	59	1.44
		200000	248	141	57	107	43	0.76
		250000	267	174	65	93	35	0.53
		300000	296	221	75	75	25	0.34
	Alize	150000	252	106	42	146	58	1.38
		200000	242	140	58	102	42	0.73
		250000	272	182	67	90	33	0.49
		300000	299	228	76	71	24	0.31
	Armida	150000	245	112	46	133	54	1.19
		200000	249	153	61	96	39	0.63
		250000	275	190	69	85	31	0.45
		300000	302	234	77	68	23	0.29
$N_{80}P_{80}$	Fundulea 32	150000	258	106	41	152	59	1.43
		200000	264	146	55	118	45	0.81
		250000	286	184	64	102	36	0.55
		300000	317	225	71	92	29	0.41

ha x N₀P₀) and 175000 shoots/ha (Alize x 150000 g.s./ha x N₁₂₀P₁₂₀). The average number of shoots/plant had varied in this year from 0.29 shoots/plant (Armida x 300000 g.s./ha x N₄₀P₄₀) and 1.68

shoots/ha (Alize x 150000 g.s./ha x N₁₂₀P₁₂₀) (Tab. 2).

The correlation between nitrogen and phosphorus fertilization and number of shoots/

Tab. 2. The influence of the interaction of the studied factors on the ratio between the number of main plants/ ha and the number of shoots/ha at *Sorghum bicolor* L., 2014 - continued

Fertilization	Hybrid	Density (g.s./ha)	Total plants at harvest (thousands)	Of which:				
				Main plants		Shoots		
				thousands	%	thousands	%	Average no./pl
N ₈₀ P ₈₀	Alize	150000	253	109	43	144	57	1.32
		200000	260	152	58	108	42	0.71
		250000	287	192	67	95	33	0.49
		300000	323	236	73	87	27	0.37
	Armida	150000	254	112	44	142	56	1.27
		200000	261	156	60	105	40	0.67
		250000	299	204	68	95	32	0.47
		300000	323	241	75	82	25	0.34
N ₁₂₀ P ₁₂₀	Fundulea 32	150000	278	108	39	170	61	1.57
		200000	280	152	54	128	46	0.84
		250000	299	190	64	109	36	0.57
		300000	331	232	70	99	30	0.43
	Alize	150000	279	104	37	175	63	1.68
		200000	279	150	54	129	46	0.86
		250000	285	182	64	103	36	0.57
		300000	330	236	72	94	28	0.40
	Armida	150000	262	112	43	150	57	1.34
		200000	283	156	55	127	45	0.81
		250000	294	194	66	100	34	0.52
		300000	325	241	74	84	26	0.35

Fig. 1. The correlation between nitrogen and phosphorus fertilization and number of shoots/ha at *Sorghum bicolor* L. (2013-2014)

Fig. 2. The correlation between sowing density and the number of shoots/ha at *Sorghum bicolor* L. (2013-2014)

ha was direct and very close, the correlation coefficients were statistically ensured and interpreted as very significant (Fig. 1.).

Regarding the correlation between sowing density and number of shoots/ha, this was indirect, and the correlation coefficients were statistically ensured and interpreted as negative very significant (ooo)(fig. 2.).

CONCLUSION

From the results obtained it emphasizes the idea that the studied technological factors had influenced the formation of the sorghum field, both in terms of the number of main plants, as well as the number of shoots.

The climatic conditions during the analyzed period were favorable to the sorghum crop, in 2013 and unfavorable in 2014. The formation of grain production in the second year of experimentation was conditioned by the formed shoots which have managed to cover the gaps caused by hail.

The fertilization with nitrogen and phosphorus had major influences on the number of shoots, the correlation between these two variables was direct and tight.

The sowing density positively influence the number of main plants, but negatively the number of shoots/field, between these two variables the correlation was indirect.

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