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INFLUENCE OF VARIETY AND DENSITY ON CROP PRODUCTIVITY OF SORGHUM X SUDAN GRASS HYBRIDS IN FLOWERING STAGE

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Abstract

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The influence of the in-row sowing rate on the green mass productivity in flowering stage of different sorghum x Sudan grass hybrid varieties was studied in 2008-2009.

In conditions of significant agro climatic differences in 2008 and 2009 the denser sowings, form higher yield of green and dry mass, and the rainfalls' distribution is significant for the more favorable structure of yield.

The tested varieties and hybrids have high productive potential for stable yields of green mass in drought conditions.

Key words: sorghum x Sudan grass hybrids, varieties, sowing rate, productivity

Introduction

The application of the Sudan grass in our economy brings to greater possibilities for the design of schemes for steady agriculture. The main aim of its growth is to supply forage for the animals (Moyer et al., 2004). It is popular with its high resistance to droughts in comparison with other crops, and in regions with higher temperatures and lower uneven rainfalls gives higher yields than corn (Fribourg H.A., 1995). Although there were many attempts to introduce it in Bulgaria, the Sudan grass is still badly used forage crop. This is a result of lack of knowledge for the new varieties and technologies (Kikindonov et al., 2008).

The sudangrass - *Sorghum sudanense* (Piper.) Stapf. is a natural hybrid of S. bicolor and *S. arundinaceum* (Harlan and De Wet, 1972). In the 50's the Sudan grass is crossed with other grain and sugar forms of sorghum for increase of its productivity (House, 1995). The CMS application in sorghum increases the possibilities for use of sterile lines as a maternal component and lines and varieties of Sudan grass as pollinators for the receipt of F_1 hybrids. The studies on the combining ability and correlations between the components of yield and the agro climatic conditions increase seriously the breeding potential of the great genetic variation of hybrids (Sotomayor Rios et al., 1984; Shon Yun et al., 1999). The hybrids of Sudan grass owe their wide use to their good adoption and resistance to extreme droughts, temperatures and salting (Kertikov, 2007).

Two types of Sudan grass hybrids are grown worldwide. The clear Sudan grass hybrids of Sudan grass MS lines and restorers are close to the Sudan grass in growth and quality characteristics, but are taller, with thicker stems, and more productive. These hybrids form a very rapid grow up after cutting and are very productive. The sorghum x Sudan grass hybrids S.bicolor (L) Moench x S. Sudanese (Piper.) Stapf. differ with big stems and leaves and give satisfactory yield of forage with twofold or multifold cutting in flowering stage for green mass, but are most useful with a single cutting in late waxy milk maturity phase for the silage production (Snyman and Youbert, 1996).

The productivity of Sudan grass and sorghum x Sudan grass hybrids is influenced by the agro climatic factors and the conditions of growth (Beurlein et al., 1968). They are extremely plastic regarding the self-regulation of the density through the mechanisms of sprouting and reproductive development of the sprouts. In the recent years the gene fund widens dynamically with forms, which a resistant to drought, and cold resistant too (Dordevic et al., 1992; Zamfir, 2001). The range of varieties with differences in the vegetation periods, biometrical parameters, reproductive potential, increases the variation of the structure and the quantity of yield (Lioveras et al., 2006; Samuil, 2007; Rajcakova et al., 2010).

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The aim of the present study is to clarify the influence of the in-row sowing rate for a list of sorghum x Sudan grass varieties in the conditions of severe droughts in 2008 and 2009 on the productivity with a cutting in flowering stage.

Material and Methods

The present study is carried out in 2008-2009 on the experimental fields of the Agricultural Institute – Shumen. The soil type is carbonate black soil with good mechanical structure and weekly alkaline reaction of the soil solution. The forerunner crop is sugar beet. The varieties Super Sweet and Susu are tested, which are Standard for simultaneous use for production of fresh forage and row material for silage. The hybrids F_1SA and SC are also tested, as well as the stabilized hybrid populations SGB and SZB from the breeding program of Agricultural Institute – Shumen.

The long plots method is used with 4 repetitions for each variety and variant. The area of the harvest plot is 10.8 m^2. The sowing is mechanized, at 45 cm between rows, with a high sowing rate – 80000 seeds per 0.1 ha.

The three density variants are formed in the following way. After the sowing, in third leaf phase, is made a rarefying by hand in two of the three rows of each plot, and is registered the number of the germinated plants. In the 5 - 6 leaves phase is made a second rarefying of the one of the rarefied rows, and again is registered the number of the plants left.

A manual cutting is made when the plants reach the flowering phase. In two repetitions are registered the green mass yield, the percentage of dry matter and the yield of dry mass. The dry matter is determined through drying in 70°C for 24 hours in two repetitions from the mixed sample. A dispersion analysis of results is made according to Lidanski (1988).

In regards of the climate 2008 and 2009 years were warm, and with significantly below the normal vegetation rainfalls-respectively 162 mm and 170 mm while the norm is 310 mm. In 2008, the insufficient humidity in the beginning of the vegetation affects negatively the germination and the initial growth, and the lack of rainfalls in July-August hinders the formation of reproductive sprouts.

The total sum of rainfalls in 2009 is not enough for the optimum development of the Sudan grass and the sorghum x Sudan grass hybrids. The correctly spread and heavy rainfalls in June and the start of July (150 mm) created optimum conditions for development and flowering. The difference between the two years is that there is a more favorable distribution of the otherwise insufficient rainfalls in 2009, which brings to normal germination and initial development, sprouting and flowering.

The observed droughts in the years allow seeing the biological potential of all forms of Sudan grass and sorghum x Sudan grass hybrids as drought-resistant crops and the possibilities of receipt of good yields of green and dry mass from them.

Results and Discussions

In Table 1 are given the results for green and dry mass yields from the hybrids tested in 2008. The unfavorable conditions because of lack of sufficient humidity, brought to less germinated plants, as for the unrarefied sowing more than 40% of them did not form reproductive sprouts. The sprouting was very poor for the rarefied sowings too – about a 1 reproductive sprout per plant.

With the decrease of the density decreases the green mass productivity with comparatively close values of the dry matter. With the first swath, the yield varies from 24 $t.ha^{-1}$ to 63 $t.ha^{-1}$, with mean yield of 53 $t.ha^{-1}$ for the non-rarefied sowings. The average green mass yield for the sowings, which has been rarefied once, is 42.5 $t.ha^{-1}$ and 29 $t.ha^{-1}$ for the twofold rarefied sowing.

Data of the table show that the tested origins have also high dry matter content. It is in the limits of 25% for SUSU to 36.4% for the SC hybrid. With the second swath the green mass yield is less, as it could be seen, and varies in the frames of 16 to 33 tones per ha. However, here is observed also an increase of the dry matter percentage, which reaches 43.8% for the hybrid SA. In the dry mass yield from a ha index is seen, that all the studied hybrids have comparatively high values, and from the SC hybrid are received 30 tones dry mass yield from ha.

In 2009, (Table 2) the well-distributed rainfalls affected the results for green and dry mass yields. With the first swath from the hybrid SA are received 79 tones green mass per ha. In addition, as a whole the yields of green mass are quite higher compared to those in 2008. The same could be said for the second swath too. Regarding the % of dry matter index for the hybrid SZB the dry matter is 51.5% during the first swath, and 41.0% for the second swath.

The yield of dry mass from ha in 2009 is also higher compared to the yield in 2008. With the hybrid SA it reaches up to 44 $t.ha^{-1}$. The average value of the dry mass yield is 33 $t.ha^{-1}$ for the variants without rarefying, 27.3 $t.ha^{-1}$ for those rarefied once, and 22 $t.ha^{-1}$ for the twofold rarefied sowings.

Conclusions

In conditions of water deficiency, the sorghum x Sudan grass hybrids show a high potential for green mass yield. The

Table 1
Testing Sorghum X Sudan grass Hybrids productivity of green mass in flowering stage for 3 variants of seed rate - 2008

Variety	Variant	Green mass yield				Dry mass production	
		I swath		II swath			
		Dry matter, %	t.ha^{-1}	Dry matter, %	t.ha^{-1}	t.ha^{-1}	Rel. %
Super Sweet	0	27.8	46	33.3	21	20	113.5
	1	29.8	38	36.1	21	19	106.8
	2	33.1	30	39.3	22	19	105.1
Su Su	0	25.0	63	32.6	32	27	151.0
	1	27.7	53	43.4	22	24	138.7
	2	28.8	24	37.9	16	13	73.8
SA	0	28.9	50	41.4	26	25	143.8
	1	35.7	39	43.8	21	23	131.9
	2	32.7	30	25.6	22	14	82.6
SC	0	31.8	57	35.8	33	30	171.7
	1	36.4	46	40.0	21	25	144.4
	2	27.6	32	40.3	30	20	116.7
SGB	0	26.1	52	32.0	20	21	116.3
	1	27.1	41	34.8	22	19	108.7
	2	25.0	27	40.3	20	15	85.0
SZB	0	32.7	52	36.4	17	24	133.6
	1	30.6	38	35.2	23	20	114.1
	2	35.4	31	34.7	22	19	107.2
GD 1%			9.2		5.82	3.85	
P %			5.07		6.15	5.06	

0-non-rarefied; 1-rarefied once; 2-rarefied twice

Table 2
Testing Sorghum X Sudan grass Hybrids productivity of green mass in flowering stage for 3 variants of seed rate - 2009

Variety	Variant	Green mass yield				Dry mass production	
		I swath		II swath			
		Dry matter, %	t.ha^{-1}	Dry matter, %	t.ha^{-1}	t.ha^{-1}	Rel., %
Super Sweet	0	40.0	63	34.0	40	39	161.4
	1	41.5	46	34.0	24	27	113.7
	2	43.0	37	34.0	26	25	102.8
Su Su	0	35.6	47	40.0	23	26	107.9
	1	38.0	34	36.0	25	22	91.1
	2	34.5	37	32.0	23	20	84.5
SA	0	41.1	79	32.0	36	44	184.8
	1	33.2	51	27.0	29	25	103.6
	2	38.5	43	33.0	27	26	106.3
SC	0	38.0	50	36.0	27	29	119.8
	1	36.5	43	36.0	31	27	110.4
	2	39.0	26	36.0	24	19	77.5
SGB	0	33.3	42	38.0	22	22	93.1
	1	37.0	38	39.0	59	25	105.3
	2	32.5	33	35.0	24	19	79.6
SZB	0	42.0	69	39.0	23	38	158.9
	1	51.5	51	41.0	27	38	156.3
	2	49.0	32	41.0	17	23	94.9
GD 1%			5.8		3.63	4.7	
P %			4.47		5.02	4.72	

0-non-rarefied; 1-rarefied once; 2-rarefied twice

total yield of green mass from two swaths in 2008 reaches 95 $t.ha^{-1}$, and in 2009 – 115 $t.ha^{-1}$.

The green and dry mass productivity increases with the increase of the sowing density.

The average hybrids' dry mass yield in 2009 is 33 $t.ha^{-1}$ for the non-rarefied variants, 27.3 $t.ha^{-1}$ for the variants rarefied once, and 22 $t.ha^{-1}$for the twofold rarefied sowings.

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