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ANALYSIS OF THE GREEN MASS YIELD'S STRUCTURE OF SUDANGRASS AND SORGHUM X SUDANGRASS HYBRIDS

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Abstract

Analysis of the green mass yield's components of Sudangrass and Sorghum x Sudangrass hybrids was made, the yield obtained by mowing in brooming and flowering stages during 2010-2011.The results of the tests confirm the high productivity potential of the sorghum-sudangrass hybrids in conditions of optimum soil's water reserve and temperatures during the vegetation. The sorghum-sudangrass hybrids show excellent adaptive potential in conditions of more often going extreme deviations from the agro-climatic norms. The total and the relative productivity in the separate swaths does not differ substantially in the brooming and the flowering stages. The lack of enough moisture reflects most significantly on the productivity in the later swaths and on the intensity of dry matter accumulation. The agroclimatic conditions do not affect the favourable leaf part in the green mass.

Key words: *dry matter, green mass, Sudangrass, Sorghum x Sudangrass hybrids.*

INTRODUCTION

Sudangrass forages are grown extensively to provide supplementary forage for animals as pasture, greenchop, silage and hay (Moyere et al., 2004). They are known for their better tolerance to drought than other annual summer grasses and are more yielding than corn in areas with higher temperatures and lower and uneven precipitation (Friboarg et al., 1995)

The sudangrass *Sorghum sudanense* (Piper) is introduced in 1900's in the USA from Ethiopia and Sudan, and in 1930's its introduction in Russia and Eastern Europe begins (Haecker, 1992).

Since 1950's Sudangrass has been hybridized with other *Sorghum* ssp to increase forage productivity. The development of the CMS-system in Sorghum widens dramatically the possibilities of use of MS-lines as maternal component and lines and varieties of Sudangrass as pollinators for obtainment of F_1 hybrids (House, 1995). The study of the combining ability and the correlations of yield components with the concrete agro-climatic conditions multiplies the selection potential of great genetic diversity of Sorghum hybrids (Sotomayor Rios et al., 1984; Shon Yun et al., 1999; Paknejad et al., 2001).

The Sudangrass hybrids of Sudangrass MS-lines and restorers resemble the common Sudangrass in growth and quality characteristics however they tend to be taller, have an intermediate stem diameter and are higher yielding than Sudangrass. These hybrids recover rapidly after harvest and are very productive (Beurlein et al., 1968).

Sorghum x Sudangrass hybrids, *Sorghum bicolor* (L) Moench x *Sorghum sudanense* (Piper) Stapf, are more vigorous and taller than Sudangrass, have larger stems and coarser leaves, and give higher forage yield when harvested two or more times at the flower stage for green chop, or one time at the late milk stage for silage production (Snyman and Youbert, 1996; Paknejad et al., 2001).

The hybrids of Sudangrass show their high productivity potential in optimum conditions of cultivation, but owe their wide spreading to their high adaptability and resistance to extreme droughts, high temperatures and salt resistance, that's why it attains actuality in South-Western Europe (Antocha, 1994; Kertikov, 2007; Uzun et al., 2009).

In the article is made an analysis of the components of the green mass yield, obtained by mowings in the stages of brooming and flowering of Sudangrass and Sorghum x Sudangrass hybrids of the breeding program of the Agricultural Institute – Shumen, Bulgaria.

MATERIALS AND METHODS

This study was conducted at the Agricultural Institute-Shumen, located in North-Eastern Bulgaria, during the period 2010-2011. The soil type of the experimental fields was a carbonate black-earth with good mechanical structure and weakly alkaline reaction of the soil solution.

The used experimental design for the tests of the varieties and hybrids was a random complete block in 4 repetitions. The experimental plot was 10.8 m^2, in three rows with 8 m length, row spacing was 45 cm. Seeds were sown at 20 $kg.ha^{-1}$ seed rate, at 4-5 cm depth, in the period 25.04 – 05.05. The tested origins were harvested trice at brooming stage, twice at flowering stage and once at late milk stage.

Sudangrass variety Verkor and Sorghum x Sudangrass hybrid variety Susu were tested. A stabilized Sudangrass population and a Sorghum x Sudangrass hybrid from the breeding program of AI-Shumen, were also included in the tests.

Green mass yield was measured by reaping and weighing the fresh herbage in the plots. Afterwards, the dry matter content and dry matter yields were determined by drying (at 70°C for 48h).

RESULTS AND DISCUSSIONS

The vegetation rainfalls have the biggest effect on the productivity of the Sudangrass and its hybrids. The development of Sorghum and Sudangrass is strongly affected by the vegetation temperature sum. The significant differences in the agro-climatic factors of the years of our study (Table 1) allow reliable assessment of the productive potential and the adaptability of the sorghum x sudangrass hybrids in conditions of extreme deviations from the norm.

Table 1. Agroclimatic conditions of Sudangrass and Sorghum x Sudangrass hybrids cultivation during 2010 and 2011

	2010			2011		
	Days of vegetation	Sum of rainfalls	Temperature sum	Days of vegetation	Sum of rainfalls	Temperature sum
I swath brooming	70	250	1182	60	75	954
II swath brooming	35	41	793	30	49	796
III swath brooming	30	38	661	40	46	863
Total brooming	135	329	2636	130	170	2613
I swath flowering	85	285.0	1499	75	82.0	1058
II swath flowering	45	43.0	1116	45	68.0	1554
Total flowering	130	328.0	2615	120	150.0	2612

2010 is characterized as a mean favorable for the development of the Sorghum and the Sudangrass. The total rainfalls sum is extremely high. The conditions during July, August and September favoured realization of productive grow up of green mass by mowing in the brooming and flowering stages. The spring of 2011 is continuous and cool, the air temperature exceeded 15°C after 15th of May, which forced the late sowing (12-15th of May). The low temperature sum brought to the slow temps of development. The rainfalls were unevenly distributed during vegetation, which also proves the year to be unfavorable.

On Table 2 are given the results from the analysis of the green mass yield's components from the tested in 2010 origins of Sudangrass and Sorghum x Sudangrass hybrids. The total productivity from three swaths during brooming exceeds insignificantly the productivity from two swaths in flowering stage. The first swaths are most productive and vary from 34 to 41% of the total yield in brooming stage and from 48 to 67% of the total yield in the flowering stage. The second and third swaths in brooming stage are equalized. The low variation of the leaves: stems ratio for the three swaths in brooming stage is impressive. The part of the stems is increased for the swaths in flowering stage (83 to 86%).

Table 2. Analysis of green mass yield's components for Sudangrass and Sorghum x Sudangrass hybrids in brooming and flowering stages, 2010

Origin	Green mass (t/ha)	Proportion in %:		Share of the swath in the total yield (%)	Dry matter (%)	Dry mass per day (t/ha)
		Leaves	Stems			
I mowing at brooming						
Susu	44.4	24	76	34.3	33.9	0.251
Verkor	38.9	16	84	38.0	38.7	0.215
SVE	41.1	19	81	41.4	34.9	0.239
AxSVE	45.5	19	81	41.2	49.3	0.374
II mowing at brooming						
Susu	30.0	25	75	35.0	25.0	0.250
Verkor	35.5	29	71	32.0	21.7	0.256
SVE	34.4	30	70	29.0	21.3	0.244
AxSVE	39.6	27	73	34.9	21.3	0.282
III mowing at brooming						
Susu	33.3	20	80	30.7	44.4	0.369
Verkor	32.2	13	87	30.0	50.0	0.402
SVE	26.6	15	85	29.6	35.7	0.237
AxSVE	38.9	17	83	23.9	35.3	0343
I mowing at flowering						
Susu	66.6	14	86	57.1	41.0	0.364
Verkor	41.1	15	85	48.5	42.3	0.232
SVE	52.2	17	83	50.8	38.4	0.267
AxSVE	63.3	14	86	67.8	38.4	0.324
II mowing at flowering						
Susu	50.0	15	85	42.9	38.8	0.431
Verkor	42.2	15	85	51.5	39.3	0.369
SVE	47.7	16	84	49.2	39.2	0.415
AxSVE	53.3	15	85	32.2	38.9	0.461

Table 3. Analysis of green mass yield's components for Sudangrass and Sorghum x Sudangrass hybrids in brooming and flowering stages, 2011

Origin	Green mass (t/ha)	Proportion in %:		Share of the swath in the total yield (%)	Dry matter (%)	Dry mass per day (t/ha)
		Leaves	Stems			
I mowing at brooming						
Susu	45.6	21	79	49.2	29.7	0.193
Verkor	38.6	23	77	45.1	28.4	0.157
SVE	48.3	23	77	44.0	29.9	0.206
AxSVE	69.2	19	81	43.2	29.1	0.288
II mowing at brooming						
Susu	33.3	24	76	34.9	28.1	0.267
Verkor	30.3	26	74	36.3	25.9	0.222
SVE	30.6	21	79	35.5	24.1	0.211
AxSVE	40.6	24	76	38.1	32.5	0.377
III mowing at brooming						
Susu	15.0	27	73	15.9	27.0	0.135
Verkor	16.4	27	73	18.6	32.0	0.175
SVE	18.6	31	69	20.5	29.0	0.180
AxSVE	18.1	30	70	18.7	32.0	0.193
I mowing at flowering						
Susu	49.7	24	76	59.9	25.7	0.150
Verkor	41.1	14	86	59.1	26.7	0.129
SVE	55.6	19	81	54.6	30.7	0.201
AxSVE	75.3	16	84	59.7	30.7	0.271
II mowing at flowering						
Susu	39.2	23	77	40.1	28.1	0.245
Verkor	30.3	25	75	40.9	25.9	0.174
SVE	31.7	20	80	45.4	24.1	0.170
AxSVE	43.3	23	77	40.3	32.5	0.313

The dry matter content is relatively stable – from 30 to 50%. There is an exception from that rule for the second swath in brooming stage, where a significant decrease to 21-25% has been measured.

The intensity of green mass accumulation, given as a production for a day of the vegetation of each of the swaths, in 2010 is remarkably high. The highest values are registered for the last swaths, and for the second swath in flowering stage the value reaches 0.470 $t.ha^{-1}$.

The analysis of the yield's components during 2011 is given on Table 3. The total productivity is significantly lower than the yields obtained in 2010 as a result of the late sowing, cool spring and extreme drought. This decrease is due also to the lower productivity in the later swaths of the shortened vegetation and the combination of low rainfalls quantities and high temperatures during this period. The part of grow up for the third swath in brooming stage is decreased to 15-20% of the total productivity.

The relative part of the leaves in the green mass is insignificantly increased, at the later swaths reaches 25-32%. The unfavorable conditions affect the lower values for conten

CONCLUSIONS

The results of the tests confirm the high productivity potential of the sorghum-sudangrass hybrids in conditions of optimum soil's water reserve and temperatures during the vegetation. The sorghum-sudangrass hybrids show excellent adaptive potential in conditions of more often going extreme deviations from the agro-climatic norms.

The total and the relative productivity in the separate swaths do not differ significantly for mowings in brooming and flowering stages. The negative affect of the water deficiency is the strongest for the productivity in the later swaths and for dry matter accumulation.

The agroclimatic conditions do not affect the favorable share of the leaves in the green mass.

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