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DYNAMICS OF BIOMASS GROWTH AND DRY MATTER ACCUMULATION IN SUDANGRASS AND SORGHUM X SUDANGRASS HYBRIDS

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Abstract

It has been studied the growth of biomass and the dry matter accumulation during the stages of brooming, flowering, milky-wax maturity and technical maturity of Sudangrass and Sorghum x Sudangrass hybrids. The tests were performed in the Agricultural Institute – Shumen, Bulgaria during 2010 and 2011. The parameters of development and the intensity of dry matter accumulation were determined by biometrical analysis.
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.Theshortened vegetations due to the extreme agroclimatic deviations are compensated by intensive dry matter accumulation.
The parameters of biomass and dry matter accumulation are manifested with different levels depending on the genotype, as with the Sorghum x Sudangrass hybrids the high productivity is combined with intensive dry matter accumulation.

Key words: *accumulation, biomass, dry matter, Sorghum x Sudangrass hybrids.*

INTRODUCTION

The often appearing during the last years droughts are preconditions for a larger use of the Sudangrass and the Sorghum x Sudangrass hybrids in the production of green mass for fresh forage, silage and hay. Thanks to its strongly developed root system these crops ensure high yields in drought conditions and if cultivated on poorer soils, as well as the possibility of numerous grow-ups and the receipt of green mass in the hottest and dry moths of the vegetation. (Smith and Federiksen, 2000; Kikindonov et al., 2008).
The Sudangrass (*Sorghum vulgare* var. *Sudanensis* Piper) is used traditionally for green mass. The productivity of this crop is higher compared to other annual forage plants, reacts very well to nutrition and irrigation, use more effectively the available moisture quantities (Moga et al., 1996). Their water requirements are the same as corn but they have the ability to go dormant during extended drought periods. Growth will begin when the rains come. 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. (Beurlein et al., 1968). Sorghum-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).
The green mass yield is a result of the interaction between the hereditary features and the surrounding media conditions, where the dynamics of biomass growth and dry matter accumulation are determinative (Gumaniuc and Varga, 1988; White et al., 1989).
The aim of the research is to assess the parameters of growth and asccumulation of dry matter in Sudangrass and Sorghum x

Sudangrass hybrids depending on the genotype and the agroclimatic conditions in Agricultural Institute – Shumen, Bulgaria during 2010-2011.

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 Sudangrass variety Verkor and the Sorghum x Sudangrass hybrid Susu have been tested, as well as a stabilized Sudangrass population and a Sorghum x Sudangrass hybrid from the breeding program of the Agricultural Institute – Shumen.

The weight of 15 plants of each repetition is measured with the mowings at brooming, flowering, milky-wax and technical grain's maturity phases. Afterwards, the dry matter content is determined by drying at 70^{o}C for 48h. The intensity of dry matter accumulation is counted by absolute growth index (AGR-g/ plant per day).

RESULTS AND DISCUSSIONS

2010 is characterized as a mean favorable year for the development of Sorghum and Sudangrass. The total rainfalls sum is extremely high. The conditions in July, August and September favoured the realization of productive grow-ups of green mass with mowings at brooming and flowering stages.

The spring of 2011 is continuous and cool, just after 15th of May the air temperature exceeded 15^{o}C, which forced late sowing – on 12-15th of May. The low temperatures caused the development delay. The rainfalls are unevenly distributed during the vegetation, which could also proof the year to be unfavorable.

Data given on Table 1 represent the dynamics of growth of the biomass and the dry matter during the development of the tested in 2010-2011 varieties. We have chosen the phases brooming, flowering, milky-wax and technical maturity, when in the practice mowings are made for fresh forage and silage.

An intensive growth of the biomass goes to the technical maturity stage, and it strongly depends on the genotype, and not so strongly – on the agroclimatic conditions. During the favorable 2010 the mean weight increases from 104 g at brooming stage to 235 g at milky-wax maturity stage. The lack of enough rainfalls in 2011 does not affect substantially on the weight, as the mean values increase from 93 to 242 g. More significant are the differences between the different genotypes. The Sorghum x Sudangrass hybrid has the highest values of plants weight, which increases from 159 to 316 g in 2010. It is impressive the intensive increase of the other tested sorghum x Sudangrass variety – from 70 to 255 g. In technical maturity phase, in both years, as a result of drying the vegetative mass a decrease of the green mass begins.

The dry matter content is influenced at greatest extent by the agroclimatic factors. The mean values of the tested origins in 2010 start from 28% at brooming and flowering stages, by 56% at milky-wax and to 72% at technical maturity stages. In the dry 2011 the differences are manifested in the initial phases – brooming and flowering – 40% dry matter. After that the values equalize with those from 2010.

The information from Table 2 allows us assess the intensity of dry matter accumulation during the vegetation in dependence on the agroclimatic factors and the genotype. As a result of the later sowing and the following extreme drought in 2011 the phases of development are shortened with 5-15 days. The cool spring decreases the vegetation temperature sum with more than 200 degrees.

The most significant for the two years is the extreme drought from the sowing to milky-wax maturity in the middle of August. These differences strongly affect the dry matter accumulation. The mean values of accumulation intensity until technical maturity stage in 2011 increase with 0.20 g per day of the vegetation. The drying of the vegetative mass due to the continuous drought strongly

decreases the intensity after the milky-wax stage.

The productive potential is manifested in the parameters of biomass growth and dry matter accumulation intensity. Their interaction with the genotype compensates the unfavorable agroclimatic conditions, which makes the adaptivity of Sudangrass and the Sorghum x Sudangrass hybrids unique.

Table 1. Variability of weight and dry matter during the development of Sudangrass and Sorghum x Sudangrass hybrids, 2010-2011

Origin	2010				2011			
	Weight, g			Dry matter %	Weight, g			Dry matter %
	X	± Sx	C %		X	± Sx	C %	
Brooming								
Susu	69.5	9.36	42.6	24.9	70.7	6.83	37.4	41.0
Verkor	82.0	11.02	42.5	25.3	61.3	5.13	32.4	42.3
SVE	108.2	12.91	37.7	31.5	108.3	13.60	48.6	38.4
A x SV	158.5	16.66	33.2	31.1	130.3	10.33	30.7	38.4
Flowering								
Susu	122.0	9.97	31.6	29.7	118.9	14.43	47.0	33.9
Verkor	127.3	18.94	53.4	28.4	100.9	6.46	35.3	38.7
SVE	126.7	16.22	37.7	29.9	111.7	7.10	38.3	34.9
A x SV	274.3	25.55	36.0	29.1	239.3	26.05	42.2	49.3
Milky-wax maturity								
Susu	255.3	14.02	21.3	53.1	245.0	14.54	22.4	57.3
Verkor	223.3	15.09	47.4	54.9	226.5	18.09	27.7	53.1
SVE	147.0	12.26	32.3	64.4	196.0	12.25	19.8	51.1
A x SV	316.7	28.01	34.3	52.6	303.5	59.80	56.7	60.7
Technical maturity								
Susu	200.0	12.6	21.2	82.7	172.8	8.23	22.9	68.2
Verkor	149.0	15.0	39.5	78.5	124.1	5.29	14.6	73.3
SVE	138.9	8.53	20.9	76.7	118.0	7.94	22.9	75.9
A x SV	243.1	9.71	15.5	71.0	200.6	10.9	18.5	69.5

Table 2. Intensity of dry matter accumulation, measured by absolute growth index (AGR, g/ plant-1/ day-1), 2010-2011

Variant	2010				2011			
	Broom	Flower	Milky-wax maturity	Technical maturity	Broom	Flower	Milky-wax maturity	Technical maturity
Rainfalls sum	250	285	301	328	75	82	143	168
Temperature sum	1182	1499	2233	2929	954	1058	1863	2683
Days of vegetation	70	85	110	135	60	75	100	130
Susu	0.25	0.43	1.23	1.24	0.49	0.54	1.40	0.91
Verkor	0.30	0.42	1.11	0.87	0.43	0.52	1.20	0.70
SVE	0.49	0.45	0.86	0.79	0.69	0.52	1.00	0.69
SAxSV	0.70	0.94	1.50	1.28	0.83	1.56	1.85	1.08
Average	0.46	0.64	1.22	1.12	0.63	0.84	1.41	0.99

CONCLUSIONS

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 shortened vegetations due to extreme agroclimatic deviations are compensated by intensive accumulation of dry matter.

The significant differences in the agro-climatic factors of the years of our study allow reliable assessment of the productive potential and the adaptability of the sorghum-sudangrass hybrids in conditions of extreme deviations from the norm.

The parameters of biomass and dry matter accumulation are manifested with different levels depending on the genotype, as with the Sorgum x Sudangrass hybrids the high productivity is combined with intensive accumulation of dry matter.

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