Research Concerning the Using of Sorghum x Sudan Grass Hybrid (*Sorghum bicolor* (L.) Moench × *Sorghum sudanense* (Piper) Stapf.) in the Fodder Plant Assortment for Fresh Matter Production in Transylvania

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Abstract
The establishment of a varied assortment of fodder plants which allows the obtaining of sustainable harvests in the context of the last year's weather and climatic evolutions has to be an important objective both for specialists and for farmers. The irregular distribution of rainfalls and the high temperatures during vegetative period determine a deficit of fodder production. In these conditions sorghum x Sudan grass hybrid was studied as complementary fresh matter (FM) source to the other fodder crops considered as traditional in Transylvania. The FM yield obtained with unfertilized sorghum x Sudan grass hybrid in the two cuttings was lower than yields obtained with grass and legume mixtures (oat and pea mixture, triticale and pea mixture) but the yield differences were not significant.

Keywords: fresh matter, fodder plants, yield.

1. Introduction

In order to adapt the agricultural production to the new weather changes, EU working commissions recommended to farmers the use of those plant species and cultivars which behave the best in the new conditions [1]. Appling of such solution is also necessary for animal breeders from Transylvania, which during last years (2003, 2007, 2009) recorded yield losses caused by drought. The limitation of negative impact of such phenomenon on the fodder production requires the cultivation of such species with physiological and [1]morphological activities [2, 3, 4] which confer them water deficit resistance during the summer. Regarding all those presented it was considered as important to study the behavior of sorghum x Sudan grass hybrid for fresh matter production in Transylvania's condition. The research concerning germination follows to establish the germination energy and the length of embryonic roots of young plantlets in different conditions of germination (humidity and temperature variation) which occur in soil immediately after sowing, respectively the behavior of the specie during cultivation.

2. Materials and methods

The research regarding the germination of seeds was done in the laboratory of Inspectorate for Inspection of Seeds and Planting Material from

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Cluj-Napoca. The research protocol was the following: seeds of sorghum x Sudan grass hybrid were put to germinate during 7 days at four different treatments, each treatment (variant) being placed in four replicates, each replicate containing 50 seeds. The four different treatments were: V1. standard conditions – 16 hours at 20°C and 8 hours at 30°C during 7 days; V2. imbibition for 24 h at 25°C followed by 7 days at 25°C; V3. 7 days at 25°C; V4. imbibition for 24 h at 25°C followed by thermal shock (2 h at 50°C) and germination during 7 days at 25°C. Paper towel was used as substrate for germination and the method used was that of folding paper towel. Four days after experiment beginning the germination energy and seven days after experiment beginning the length of embryonic roots for all four treatments were determined. The data obtained for the studied parameters were statistically analyzed by the ANOVA and Duncan test, taking into consideration the first treatment (standard conditions) as control. Sorghum x Sudan grass hybrid was also studied in field conditions by its cultivation in the experimental field of Cojocna, from Transylvanian Plain, in the perimeter of the Didactical Station of the University of Agricultural Sciences and Veterinary Medicine from Cluj-Napoca, on a luvic phaeozem soil. The experiment was set according to the randomized blocks method and included five variants (C1-C5) represented by fodder crops cultivated for fresh matter (oat and pea mixture, pea and triticale mixture, rape, millet and sorghum x Sudan grass hybrid), placed in three replications. The sowing was done in 25 of April in year 2000. Two cuttings were organized. The first cutting was done in the beginning of June, at 68 days from sowing with all crops, when pea was in bloom and sorghum x Sudan grass hybrid reached the average height of 60 cm. The second cutting was done at 37 days after the first one. The fresh matter harvest was determined gravimetrically by weighing of yield on each experimental plot. The obtained results concerning the FM were statistically analyzed by the ANOVA and Duncan test, taking into consideration the C1 variant (oat and pea mixture) as control.

3. Results and discussion

The results of analyses for germination energy (table 1) indicated the fact that the best conditions for rapid seeds germination were those with constant humidity and constant temperature of 25°C. In such conditions a significant higher number of germinated seeds than in standard conditions were obtained. Unfavorable conditions for germination in field usually appear if after sowing time, which for the temperature and humidity requirements of specie corresponded, the soil on the sowing depth rapidly loses the humidity owing to the high temperatures. Such situation was simulated in variant V4 and the results indicated a strong negative influence of it on the germination energy of seeds. The analysis of results obtained for germination energy performed by using the Duncan test (table 2) revealed no significant differences between the variant 2 and the variant 1 and 3. This indicates that the high temperature (25°C) and high humidity of soil kept for a short time (24 h for example) did not significantly influence the germination energy of seeds in comparison with standard variant. In those four treatments applied to seeds during the germination process it was observed that the length of embryonic roots of the young plantlets obtained with V2, V3, and V4 variants was higher in comparison with the length of embryonic roots of plantlets with standard variant, considered as control (table 3). The roots' length differences (cm) present distinct significant (V4) and very distinct significant (V2 and V3) statistical significance. The influence of temperature and humidity on the length of embryonic roots analyzed by the Duncan test clearly indicated that a very high humidity, even for a short time (24 h), determined a significant increase in length of embryonic roots of plantlets. This advantage could provide plants during vegetation period with an increased capacity of water absorption from the deep soil layers in comparison with the plants germinated in similar conditions with those of variants V1 and V4. Comparing the data regarding the FM yields obtained with studied fodder crops (table 5) it can be observed that the highest yield was obtained with triticale and pea mixture, while with all other crops, including sorghum x Sudan grass hybrid, lower yields than with control crop (oat and pea mixture) were obtained. The yield increase obtained with the triticale and pea mixture did not present statistical significance. Without statistical significance were also the yield differences recorded with sorghum x Sudan grass hybrid and

millet crops. With rape in spring crop the yield difference in comparison with control was significant negative. The analysis of yields performed with the Duncan test revealed that only with rape crop the yield difference was significant (table 6) in comparison with those two mixture crops (oat and pea as control, triticale and pea).

Table 1. The influence of temperature and humidity on germination energy of sorghum x Sudan grass hybrid seeds

Variant	Number of germinated seeds	% of germinated seeds	Difference of germinated seeds	Signification
V1	36.00	100.0	0.00	control
V2	38.50	106.9	2.50	-
V3	45.00	125.7	9.00	*
V4	25.00	69.2	-11.00	00
LSD (p 5%)			6.38	
LSD (p 1%)			9.18	
LSD (p 0.1%)			13.50	

Table 2. Synthesis of comparisons regarding germination energy of sorghum x Sudan grass hybrid seeds

Variant	Number of germinated seeds	Signification	Theoretic significant differences (5%)	
V4	25.00	A		
V1	36.00	B	2	7.35
V2	38.50	BC	3	7.67
V3	45.00	C	4	7.85

Table 3. The influence of germination temperature and humidity on the length of embryonic roots of sorghum x Sudan grass hybrid plantlets

Variant	Length of embryonic roots (cm)	%	Difference	Signification
V1	6.43	100.0	0.0	control
V2	8.68	135.0	2.25	***
V3	8.80	137.0	2.37	***
V4	7.55	117.5	1.13	**
LSD (p 5%)			0.65	
LSD (p 1%)			0.93	
LSD (p 0.1%)			1.37	

Table 4. Synthesis of comparisons regarding the length of embryonic roots in sorghum x Sudan grass hybrid

Variant	Length of embryonic roots (cm)	Signification	Theoretic significant differences (5%)	
V4	6.43	A		
V1	7.55	B	2	0.65
V2	8.68	C	3	0.68
V3	8.80	C	4	0.69

Table 5. Fresh matter (FM) yields* ($t \cdot ha^{-1}$)

Crop/Variant	FM yield ($t \cdot ha^{-1}$)	Yield increase (%)	Yield increase ($t \cdot ha^{-1}$)	Signification
C1. Oat + Pea	23.13	100.00	0.00	Mt.
C2. Triticale+ Pea	25.07	108.40	1.94	-
C3. Rape in spring crop	15.80	68.30	-7.33	0
C4. Millet	19.22	83.10	-3.91	-
C5. Sorg x Sudan grass hybrid c I* + c II*	21.32	92.20	-1.81	-
LSD (p 5%)			5.52	
LSD (p 1%)			8.03	
LSD (p 0.1%)			12.04	

c I - first cutting; c II - second cutting

Table 6. Synthesis of comparisons regarding the FM yields ($t \cdot ha^{-1}$)

Crop/Variant	FM yield ($t \cdot ha^{-1}$)	Signification	Theoretic significant differences (5%)
C3. Rape in spring crop	15.80	a	
C4. Millet	19.22	ab	5.51
C5. Sorg x Sudan grass hybrid c I* + c II*	21.32	ab	5.74
C1. Oat + Pea	23.13	b	5.88
C2. Triticale+ Pea	25.07	b	5.95

c I - first cutting; c II - second cutting

4. Conclusions

The research concerning the germination of sorghum x Sudan grass hybrid seeds revealed that low humidity related with high temperature immediately after sowing decreased the germination energy of seeds. A high temperature (25°C), higher that the standard temperature for germination (20°C), even in low humidity conditions, determined with sorghum x Sudan grass hybrid higher length of embryonic roots than those of plantlets in standard variant. Considering the weather conditions of Cojocna, respectively the sowing in the end of April of year 2010, sorghum x Sudan grass hybrid obtained the first FM harvest 68 days after the sowing and the second harvest 37 days later. The FM yield obtained with unfertilized sorghum x Sudan grass hybrid in the two cuttings was lower than yields obtained with grass and legume mixtures (oat and pea mixture, triticale and pea mixture) but the yield differences were not significant.

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