THE INFLUENCE OF VEGETATION STAGES ON PRODUCTION PER PLANT AT *SORGHUM BICOLOR* (L.) MOENCH

INFLUENTA STADIULUI DE VEGETATIE ASUPRA PRODUCTIEI PER PLANTA LA *SORGHUM BICOLOR* (L.) MOENCH

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Abstract: *Cultivated in forager purpose, Sorghum bicolor can be utilized in feeding animals in green fodder form, or after a preparation and conservation through silo – as pickled forage. Starting from these considerate in this paper we proposed to approach a serial of quantitative aspects which determine the green fodder production/plant and the interdependence between those, in 3 phenophases: 4 – Flag leaf visible in whorl, 6 – Mid - Bloom, 7 – Soft dough, at Sorghum bicolor for forage. The knowing of agrobiologic particularities in relation with environmental factors, in different stages of vegetation at Sorghum bicolor for silo, offers practical information's especially in espouse some culture technologies.*

Rezumat: *Cultivat in scop furajer, Sorghum bicolor poate fi utilizat in furajarea animalelor sub forma de masa verde, sau dupa ce a fost pregatit sau conservat ca siloz – ca furaj murat. Incepand cu acest considerent, in aceasta lucrare dorim sa abordam o serie de aspecte referitoare la cantitate ce determina productia de furaj verde/planta si interdependenta intre acestea, in trei fenofaze: 4- Aparitia inflorescentei, 6 – mijlocul infloritului, 7 –faza de lapte – ceara a boabelor, la Sorghum bicolor pentru furaj. Cunoasterea particularitatilor agrobiologice in relatie cu factorii de mediu, in diferite etape de vegetatie la Sorghum bicolor pentru siloz, ofera informatii practice, in special abordeaza unele tehnologii de cultura.*

Key words: *perennial graminaes, allelopathy, lolinici acizi, crude protein,*
Cuvinte cheie: *Sorghum bicolor, growth stages, quantitative elements*

INTRODUCTION

Sorghum bicolor has a bigger production than corn silo and as fallows the forage need can be produced on a much smaller area, relative is possible the feeding with smaller costs.

From annual forage plats cultivated in Romania, *Sorghum bicolor* has the highest resistance at drought – and this thing permits to provide forage according to the schedule and a bigger stability of the obtained results. In silo form, *Sorghum bicolor* has the same value as corn silo and is silo very easy, thanks to the very high contain of carbohydrates (ANTOHI I. et all, 1991).

The introduction in culture of some new breeds can not be done without a previous testing of these breeds in different pedoclimatic conditions with the purpose of establishing the value from productive point of view.

MATERIALS AND METHODS

The experiences have been realized in the experimental field of The Experimental Didactic Station of The University of Agricultural Sciences and Veterinary Medicine of Banat Timisoara. The experience is placed in West Plane of Romania. The soil on which the experiences have been realized is chernoziom-chambic.

From a climate point view, we can see that during vegetation of the *Sorghum bicolor* temperatures were high, above the multi annual average during all experimental years, on the background of low rainfall, which led to different yields results.

As a biologic material have been used the breed Sucrosorgo 506, of *Sorghum bicolor variety saccharatum* – which is for forage, cultivated 2 consecutive years 2006-2007.

The quantitative characters appreciation, production components (height, number of leafs, leafs weight and stems weight), have been realized on the base of biometric measurements –in 3 phenophases (Flag leaf visible in whorl (4), Mid – Bloom (6), Soft dough (7) after VANDERLIP R.L., 1993). This permitted to get some conclusions on production capacity/plant and of adapting of the studied material, in our country climatic conditions.

In order to assess the significance of the differences between the genotypes we have studied, sampling of experimental data was done by variance analysis and by t test (student) CIULCA S., 2002.

RESULTS AND DISCUSSIONS

The plants weight importance for forage/plant production and of some other productivity (plant's height, number of leafs, the leaves surface, the leaf's weight, the stem weight) have been underlined in different phenophases at *Sorghum bicolor.*

In this context it was analyzed the characters variability which compete at the production/plant realization in Timisoara conditions.

The value of variability coefficient it was medium for the characters: plant's height, stem weight and the total weight in phenophase 4. In phenophase 6 the characters: the plant's height, the leaves surface and leaf's weight presents a small to medium variability and in phenophase 7 – all the analyzed characters present a small variability (table 1).

Table 1

The variability of the main characters which do determine production per plant at Sorghum bicolour

Characters	Phenophasis 4		Phenophasis 6		Phenophasis 7	
	$\bar{x} \pm S\bar{x}$	S%	$\bar{x} \pm S\bar{x}$	S%	$\bar{x} \pm S\bar{x}$	S%
Height (m)	1.63±0.08	10.70	2.17±0.12	12.36	2.77±0.05	3.83
Number of leafs	7.80±0.20	5.73	11.00±0.32	7.42	10.75±0.22	6.58
Leafs surface (cm^2)	285.11±11.44	8.97	401.02±18.08	11.64	437.88±13.45	0.13
Leafs weight (g)	39.40±0.68	3.85	81.80±4.57	11.00	57.00±2.56	3.72
Stem weight (g)	92.40±8.18	19.80	298.00±9.03	4.94	532.50±19.10	5.31
Total weight (g)	129.80±7.26	12.51	383.07±15.46	7.48	602.13±22.58	5.05

Legend: Phenophasis - Flag leaf visible in whorl (4), Mid – Bloom (6), Soft dough (7)

In order to make an ensemble characterization referring the nature of the bond between different characters, at *Sorghum bicolor*, were determined the phenotypical correlation coefficients between different characters, in the three phenophases (tab.2.). From the study of correlation coefficient (tab. 2), we can observe that in phenophase 4, the number of leaves is directly correlated with the weight of the leaves, and the weight of the stem is directly correlated with the total weight.

In phenophase 6 at *Sorghum bicolor* exists positive correlation between the height of the plant, the weight of the leaves, the weight of the stem and the total weight per plant. This means that a bigger height of the plants, with big and heavy leaves, with heavy stems leads to a growth of the production per plant in this phenophase. It is also interesting to be noticed the

positive correlation between the height of the plant and the weight of the stem. Thus a height growth of the plants entails the growth of the weight of the leaves.

In the last harvesting phenophase (7), when the *Sorghum bicolor* grain is in the Soft dough, there is no positive correlation besides the one between the foliar surface and the weight of the leaves.

Table 2

Correlation between different quantitative characters studied in 3 phenophases

Phenophasis 4					
Characters	Number of leafs	Leafs surface (cm^2)	Leafs weight (g)	Stem weight (g)	Total weight (g)
Height (m)	0.790	0.023	0.510	0.513	0.436
Number of leafs		0.138	0.885*	0.562	0.647
Leafs surface (cm^2)			-0.036	0.820	0.794
Leafs weight (g)				0.227	0.390
Stem weight (g)					0.966**
Phenophasis 6					
Height (m)	0.343	0.536	0.714	0.896*	0.905*
Number of leafs		0.418	0.693	0.263	0.358
Leafs surface (cm^2)			0.223	0.450	0.232
Leafs weight (g)				0.792	0.885*
Stem weight (g)					0.933*
Phenophasis 7					
Height (m)	-0.755	0.298	-0.157	-0.170	-0.747
Number of leafs		-0.332	-0.029	0.647	0.830
Leafs surface (cm^2)			0.891*	-0.684	-0.678
Leafs weight (g)				-0.649	-0.347
Stem weight (g)					0.748

Throughout the regression we determined the simultaneous effect of many quantitative characters regarding the production per plant tab.3.

The greatest contribution in realizing the production per plant at *Sorghum bicolor* in phenophase 4 is due to the foliage surface, which presents distinctly significant values.

The height of the plant contributes cu 20.38% at the weight of the plant, and the weight of the stem with 14.74% in this phenophase.

The weight of the *Sorghum bicolor* plant in phenophase 6 is mostly influenced (81.08%) by the height of the plant and to a lesser extent by the foliage surface and the weight of the leaves.

Same characters were also studied in the phenophase 7 - Soft dough, when harvested for silo. In table 3 we can observe that the height of the plant contributes in a great measure 52.72% at the weight of the pant. The foliage surface has a positive influence in this phenophase on the weight per plant (24.28%) – followed by the weight of the stem which represents 22.72%.

Table 3

Analysis of Variance (ANOVA) for Multiple Regressions

Phenophasis 4					
Variation source	Sum of square SS	Participation %	Degree of freedom DF	Mean square MS	F-ratio
Regression	983.2	100	4	245.8	17.16**
Height (X1)	200.34	20.38	1	200.34	13.99*
Leafs surface (X2)	577.58	58.74	1	577.58	40.33**
Leafs weight (X3)	60.36	6.14	1	60.36	4.21
Stem weight (X4)	144.92	14.74	1	144.92	10.12*
Rest	71.6		5	14.32	
Total	1054.8		9		
y = 6,70 – 32,75 x 1 – 0,15 x 2 + 2,89 x 3 +1,13 x 4					R^2 = 93,21
Phenophasis 6					
Regression	4586.53	100	4	1146.63	29.30**
Height (X1)	3719.15	81.08	1	3719.15	95.04**
Leafs surface (X2)	428.22	9.33	1	428.22	10.94*
Leafs weight (X3)	348.15	7.6	1	348.15	8.89*
Stem weight (X4)	91.04	1.99	1	91.04	2.32
Rest	195.67		5	39.13	
Total	4782.23		9		
y = 62.33 + 70.81 x 1 – 0.23 x 2 + 0.97 x 3 + 0.61 x 4					R^2 = 95.90
Phenophasis 7					
Regression	7526.76	100	4	1881.69	18.27**
Height (X1)	3973.47	52.79	1	3973.47	38.58**
Leafs surface (X2)	1828.05	24.28	1	1828.05	17.75**
Leafs weight (X3)	16.42	0.21	1	16.42	0.16
Stem weight (X4)	1708.82	22.72	1	1708.82	16.59**
Rest	514.92		5	102.98	
Total	8041.68		9		
y = 607.94 + 160.56 x 1 – 3.67 x 2 + 13.24 x 3 + 0.76 x 4				R^2 = 93.59	

Table 4

The differences significance between phenophases for different characters

		Phenophasis 6		Phenophasis 4	
	Characters	Difference	t	Difference	t
Phenophasis 7	Height (m)	0.60	4.61**	1.14	12.66***
	Number of leafs	-0.25	-0.65	2.95	9.96***
	Leafs surface (cm^2)	36.86	1.63	152.77	8.80***
	Leafs weight (g)	-24.80	-4.74^{00}	17.60	6.66***
	Stem weight (g)	234.50	11.10***	440.10	21.19***
	Total weight (g)	219.06	8.01***	472.33	19.92***
Phenophasis 6	Height (m)			0.54	3.85**
	Number of leafs			3.20	8.64***
	Leafs surface (cm^2)			115.91	1.98
	Leafs weight (g)			42.40	9.17***
	Stem weight (g)			205.60	16.88***
	Total weight (g)			253.27	14.83***

From the table 4 it can be observed that between phenophase 7 and 4 do exist differences very significant superior for all the analyzed characters, what demonstrates the fact that plants are in growth and are constant increasing the volume during the vegetation period.

Between phenophase 6 and 4 exist differences very significant superior for the majority of characters, excepting the leaves surface, which shows that in this phenophase, the basal leafs start to scorch, while some others are growing.

Between phenophase 7 and 6 there are no significant differences under the aspect of number of the leaves, leaves surface and leaves weight. This means that the leafs number remained constant.

CONCLUSION

From the study of the main characters which compete at production per plant at *Sorghum bicolor*, in 3 analysed phenophases in Timisoara conditions, we reached the fallowing conclusions:

- Exist direct correlations between number of leafs and leafs weight, also between stem weight and total weight in phenophase 4
- In phenophase 6 at *Sorghum bicolor* exists positive correlation between the height of the plant, the weight of the leaves, the weight of the stem and the total weight per plants.
- In the last harvesting phenophase (7), when the *Sorghum bicolor* grain is in the Soft dough, there is no positive correlation besides the one between the foliar surface and the weight of the leaves.
- The biggest direct contributions per plant in phenophase 4 are: leafs surface and in phenophase 6 and 7 at the production per plant the biggest contribution is represented of the plant's height
- Exist very big differences for all the characters in phenophase 6 and 7. Between phenophase 6 and 7 in which regards leafs surface there are no differences. So, we recommend the harvesting in phenophase Mid-Bloom for hay and in phenophase Soft dough for silo.

BIBLIOGRAPHY

1. ANTOHI I. et all, 1991 – Sorgul zaharat – cultivare, tehnologii alimentare, utilizarii, Ed. Helicon Banat S.A.
2. BLACK, J.R., L.O. ELY, M.E. MCCULLOUGH, AND E.M. SUDWEEKS, 1980 – Effect of stage of maturity and silage additives upon the yield of gross and digestibility energy in sorghum silage, J.Dairy Sci. 50: 617-624
3. CIULCA S., 2002 – Tehnica experimentala, Ed. Mirton, Timisoara
4. JOSEPH L. MOYER, JOHN O. FRITZ, JAMES J. HIGGINS 2003 – Relationships Among Forage Yield and Quality Factors of Hay-Type Sorghums, Online, Crop Management doi: 10.1094/CM-2003-1209-01-RS
5. PEDERSEN J.F., GORZ H.J., HASKINS F.A. AND ROSS W.M. 1982 – Variability for quality and agronomic traits in forage sorghum hybrids. Crop Sci. 22:853-856
6. VANDERLIP R.P. 1993 – How a Sorghum Plant Develops, Kansas State University