Indian J. Plant Physiol., Vol. 13, No. 2, (N.S.) pp. 172-176 (April-June, 2008)

GENOTYPIC DIFFERENCES IN GROWTH AND BIOMASS PRODUCTION IN SELECTED *STYLOSANTHES* SPECIES

R.K. TRIPATHI, H.S. TIWARI AND R.K. BHATT*

Indian Grassland and Fodder Research Institute, Jhansi-284 003 (U.P.)

Received on 16 April, 2008, Revised on 5 June, 2008

SUMMARY

Twenty promising genotypes of *Stylosanthes* belonging to *S. hamata, S. scabra, S. seabrana* and *S. viscosa* were studied for their growth and biomass production under semi arid conditions. *S. scabra* cv. seca attained maximum plant height followed by *S. seabrana* 110372 whereas minimum in *S. hamata* 110135. Maximum root length was recorded in *S. seabrana* 110372 being minimum in *S. hamata* 110135. The leaf length varied from 1.95 cm (*S. viscosa*) to 3.10 cm in (*S. hamata* 110123). Similarly the variation in leaf width ranged from 0.5 cm. (*S. hamata* 110135) to 1.20 cm (*S. scabra* RRR 94-97). The leaf area ranged from 2.220 cm^2 (*S. seabrana* 2523) to 3.873 cm^2 (*S. scabra* q 10042). The specific leaf weight (SLW) varies from 4.86 mg/cm^2 to 9.44 mg/cm^2 in different genotypes. However, maximum specific leaf weight was recorded in *S. scabra* RRR 94-100 followed by *S. scabra* q 10042, *S. seabrana* 2539 and lowest SLW in *S. hamata* 110123. Maximum fresh and dry biomass production was observed in *S. scabra* RRR 94-100 followed by *S. scabra* q 10042 and minimum in *S. hamata* 110123. On the basis of growth performance, *S. scabra* RRR 94-100, *S. seabra*na 110372 and *S. hamata* 110123 have been considered as high biomass producing genotypes under semi arid conditions.

Key words: **Biomass, germplasm, growth, leaf area, *Stylosanthes* species.**

INTRODUCTION

Among the range legumes, *Stylosanthes* has been found to provide good quality of fodder with rich in protein contents. The genus stylo has been recognised for its better adaptability and also enriches soil fertility in pasture lands. *Stylosanthes* is a genus of the sub tribe *Stylosanthirae*, tribe *Aeschynomeneae*, sub family *Papilionoideae* and family *Leguminaceae* with its natural distribution in tropical, subtropical and temperate regions of the Americas, in tropical Africa and South East Asia. *Stylosanthes* grows mostly in the zone 35^0 North and South of the equator. *Stylosanthes* have species and varieties suitable for different climatic and edaphic situations in grass covers (Burt *et. al*. 1980). In India in the past, mainly five species of *Stylosanthes* (*S. hamata, S. scabra, S. humilis, S. viscosa* and *S. guianensis*) has been introduced primarily from Australia and evaluated at different sites in India (Rai and Pathak, 1985, Chaterjee *et. al*. 1985, Rai and Patil 1985, Ramesh *et al*. 1997). Out of these species *S. hamata* (Rai and Pathak 1985) and *S. humilis* and *S. guianensis* (Magoon *et al*. 1974) have been found most desirable and adaptive to wide ecological amplitude. Recently one more promising species of stylo, i.e. *Stylosanthes seabrana* was also introduced in India (Chandra *et al*. 2006).Twenty genotypes of stylo belonging to *S. hamata, S. scabra, S. seabrana* and *S. viscosa* were introduced at IGFRI, Jhansi from Australia were studied for their growth and biomass production in semiarid tropics.

*Corresponding author, E-mail: researcher_rkb@yahoo.com

MATERIALS AND METHODS

Twenty promising genotypes of *Stylosanthes* (viz., *S. hamata 110123 , S. hamata 110135, S. hamata 61670, S. scabra 36260, S. scabra 93116, S. scabra cv. Fitzroy, S. scabra cv. Seca, S. scabra q 10042, S. scabra RRR 94-100, S. scabra RRR 94-86, S. scabra RRR 94-93 , S. scabra RRR 94-97, S. scabra RRR 94-96, S. seabrana 104710, S. seabrana 105546 B, S. seabrana 110372, S. seabrana 2523, S. seabrana 2534, S. seabrana 2539* and *S. viscosa*) have been studied for their growth and biomass production in natural rainfed field condition at Central Research Farm, Indian Grassland and Fodder Research Institute, Jhansi (U.P.) during 2002-2003. The experiment was laid out in randomized plots (3 X 3 m) with three replications. The healthy seeds of different genotypes of *Stylosanthes* were scarified through sand paper and sown in the plot at 1 cm depth at 25 cm row distance. The plots were fertilized with basal dose of 20 kg N/ha and 40 kg P_2O_5 /ha. Weeding and inter-culture operations were done at early stages.

Plant height, number of branches, number of leaves, leaf area, root length, fresh and dry weight was recorded at 50% flowering stage. For taking the fresh weight the plants were uprooted and washed properly in running water and blotted to remove extra surface water before weighing. The leaf area of fresh leaf was measured by using automatic leaf area meter (Model LI-3000, LICOR USA), before weighing. The samples of each plant part were dried in an electric oven at 80 ^{0}C for 48 hours and then the dry weight was recorded. Specific leaf weight was calculated by dividing the leaf dry weight by the leaf area.

RESULTS AND DISCUSSION

The plant height in different genotype of *Stylosanthes* ranged from 32.3 cm to 54.0 cm in the first year and 51.0 cm to 120.1 cm during second year (Table 1). On average of two years data, maximum height was recorded in *S. scabra* cv. seca followed by *S. seabrana* (110372) and minimum in *S. hamata* (110135). However, the plant height was higher in the genotypes of *S. scabra* and *S. seabrana* as compared to the genotype of *S. hamata*. The variation in root length ranged from 17.9 to 26.7 cm in the first year and 18.5 cm to 34.5 cm in second year. On average of two year data the maximum root length was recorded in *S. seabrana* 110372 (30.6 cm) and minimum in *S. hamata* 110135 (18.40 cm). Maximum number of genotypes were at par in their root length. The leaf growth was measured in term of length and width. On an average the leaf length varied from 1.95 cm (*S. viscosa*) to 3.10 cm in (*S. hamata* 110123). Similarly the variation in leaf width ranged from 0.5 cm. (*S. hamata* 110135) to 1.20 cm (*S. scabra* RRR 94-97). The genotypic variability in leaf width was higher as compared to the leaf length. Maximum leaf area was recorded in *S. scabra* q 10042 (3.87 cm^2) and minimum in *S. seabrana* 2523 (2.22 cm^2). The magnitudes of dependence of plant height growth on various morphological characters were positive as indicated by the values of correlation coefficient (Table 2). The higher correlation between leaf area and plant height was also reported by other workers (Muramato *et al*. 1965, Duncan and Hesketh 1968 and Hanson 1972). The root growth in all the genotypes of *Stylosanthes* species is synchronized with the shoot growth as apparent from the positive and significant correlation between plant height and root length (r = 0.5291). The fresh biomass production per plant ranged from 47.96 gm (*S. hamata* 110123) to 93.38 gm (*S. scabra* q 10042) in the first year while in the second year the maximum biomass production was observed in *S. scabra* RRR 94-100 (756.29 g/plant). On average of two years data the maximum fresh biomass accumulation was observed in *S. scabra* RRR 94-100 (421.98 gm/ plant) and minimum in *S. hamata* 110123 (87.31 g/plant). The biomass accumulation during the second year in all the genotypes was much higher because of regeneration of the plants which indicated the biomass production potential of each genotype after regeneration (Table 1).

Maximum dry matter production was observed in *S. scabra* RRR 94-100 (176.47 g/plant) followed *S. scabra* q 10042 (171.95 g/plant) being minimum in *S. hamata* 110123 (29.32 g/plant) (Table 1). In the first year the dry matter yield per plant ranged from 16.40 to 31.93 g/ plant where as in the second year it ranged from 42.24 gm to 321.02 g/plant. *S. scabra* RRR 94-100, *S. seabra*na 110372 and *S. hamata* 110123 have been

Table 1. Plant height, root length, leaf length, leaf width, leaf area, fresh mass and dry mass in different genotypes of *Stylosanthes*.

Genotypes	Plant height (cm)	Root length (cm)	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2/leaf)	Total fresh weight (g/plant)	Total dry weight (g/plant)
S. hamata 110123	50.75	21.65	3.10	0.55	2.92	87.31	29.32
S. hamata 110135	47.30	18.40	2.90	0.50	2.51	166.10	59.72
S. hamata 61670	60.30	25.60	2.65	0.75	2.75	142.96	64.83
S. scabra 36260	65.91	23.65	2.25	0.75	2.57	184.84	100.42
S. scabra 93116	72.70	26.60	2.30	0.70	2.40	170.09	80.35
S. scabra cv. fitzroy	80.15	25.80	2.50	1.15	3.27	153.01	68.65
S. scabra cv. seca	84.90	26.95	2.50	1.10	3.52	251.97	78.14
S. scabra q 10042	76.15	28.05	2.75	1.00	3.87	379.79	171.95
*S. scabra*RRR 94-100	81.00	26.55	2.25	1.05	3.16	421.98	176.47
S. scabra RRR 94-86	74.45	19.40	2.55	1.05	3.39	200.08	102.23
S. scabra RRR 94-93	66.05	19.50	2.30	0.85	3.26	249.05	101.21
S. scabra RRR 94-97	68.35	24.05	2.45	1.20	3.56	340.91	157.83
S. scabra RRR 94-96	78.75	23.60	2.55	0.85	3.13	323.41	155.80
S. seabrana 104710	73.85	20.70	2.25	0.55	2.26	168.12	94.70
S. seabrana 105546 B	71.40	23.95	2.45	1.00	3.20	209.59	81.10
S. seabrana 110372	84.35	30.60	2.10	1.05	2.98	248.99	115.59
S. seabrana 2523	73.80	20.75	2.15	0.65	2.22	123.34	62.66
S. seabrana 2534	74.00	21.25	2.40	0.65	4.47	186.01	75.45
S. seabrana 2539	68.60	23.15	2.30	0.65	2.31	197.29	76.90
S. viscosa	51.50	23.85	1.95	0.95	2.40	174.38	68.79
CD at 5%	5.72	NS	0.19	0.12	0.24	36.12	10.86

selected as high dry biomass producing genotypes among the genotype of *S. scabra*, *S. seabra*na and *S. hamata* respectively. As apparent from the data large genotypic variability exists in the dry matter accumulation in *Stylosanthes* genotypes. Dry matter production was found to be positively and significantly correlated with plant height, root length, stem diameter, leaf area and specific leaf weight revealing the simultaneous growth of all the plant parts (Table 2)as also reported by Bhatt *et al.* (2002). The strong and linear relationship of dry matter yield with leaf area indicates the dependence of biomass production on the assimilatory surface area (Fig. 1). The dry matter yield was also positively and significantly correlated with specific leaf weight (r = 0.64) (Fig. 2).

The biomass partitioning in above ground parts (leaves + stem + branches) was much higher indicating the potentiality of different genotypes for more foliage production. The specific leaf weight (SLW) which

Table 2. Correlation coefficient among various assimilatory and physiological characters.

	Plant height	Root length	Plant diameter	Total fresh wt.	Total dry wt.	Leaf area	SLW
Plant height	1.0000						
Root length	0.5291	1.0000					
Plant diameter	0.6961	0.2310	1.0000				
Total fresh wt.	0.4820	0.4176	0.5212	1.0000			
Total dry wt.	0.5039	0.3795	0.5304	0.9467	1.0000		
Leaf area	0.3784	0.3513	0.3125	0.6349	0.5660	1.0000	
SLW	0.4600	0.4910	0.5865	0.7294	0.6415	0.3873	1.0000

CRITICAL VALUE (1-TAIL, .05) = + Or - 0 .37911CRITICAL VALUE (2-tail, .05) = +/- 0.44260

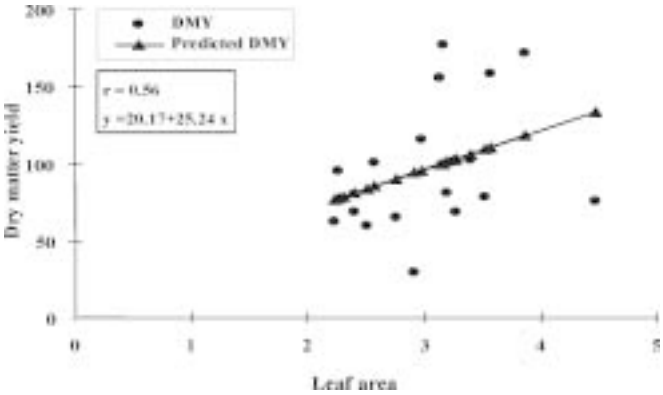

Fig.1. Relationship between dry matter yield (DMY) and leaf area in different genotypes of *Stylosanthes*

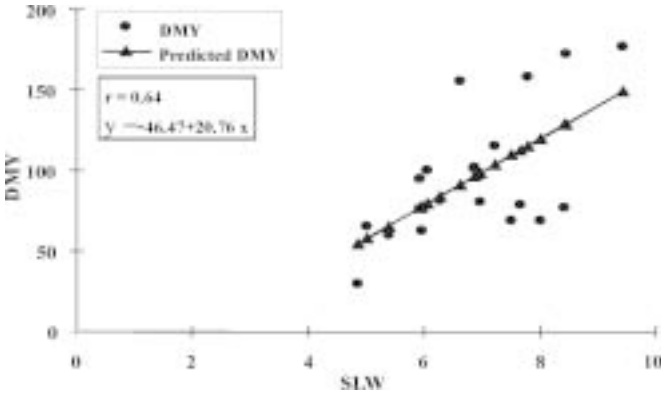

Fig. 2. Relationship between dry matter yield (DMY) and specific leaf weight (SLW) in different genotypes of *Stylosanthes*

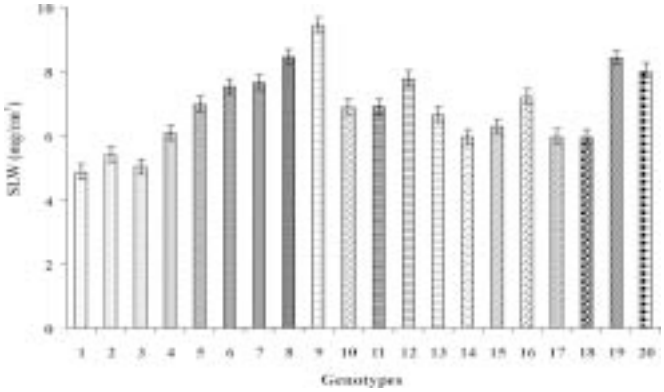

Fig. 3. Variation in specific leaf weight (SLW) in different genotypes of *Stylosanthes* (1. *S. hamata* 110123, 2. *S. hamata* 110135, 3. *S. hamata* 61670, 4. *S. scabra* 36260, 5. *S. scabra* 93116, 6. *S. scabra* cv. *f*itzroy, 7. *S. scabra* cv. seca, 8. *S. scabra* q 10042, 9. *S. scabra*RRR 94-100, 10. *S. scabra* RRR 94-86, 11. *S. scabra* RRR 94-93, 12. *S. scabra* RRR 94-97, 13. *S. scabra* RRR 94-96, 14. *S. seabrana* 104710, 15. *S. seabrana* 105546 B, 16. *S. seabrana* 110372, 17. *S. seabrana* 2523. 18. *S. seabrana* 2534, 19. *S. seabrana* 2539, 20. *S. viscosa*)

represents the accumulations of dry matter in per unit leaf area of all the genotypes ranged from 4.86 mg/cm^2 to 9.44 mg/cm^2 (Fig. 3). The SLW was found to be maximum *S. scabra* RRR 94-100 followed by *S. scabra* q 10042. Looking the species variation with respect to SLW the genotype *S. scabra* was maximum followed by genotype of *S. seabrana* and minimum in the genotype of *S. hamata*. The specific leaf weight was positively and strongly correlated with all the growth, morphological and biomass characters (Table 2) exhibiting it as preliminary trait for selecting of genotypes for higher biomass production under different environmental conditions.

ACKNOWLEDGEMENTS

The authors are thankful to the Director and Head of Division for providing the facilities.

REFERENCES

Burt, R.T., Edye, L.A. and Grof, B. (1980). *Stylosanthes*, structure, adaptation and utilization. In: Advances in Legume Science, pp. 533-558. Royal Botanical Garden, U.K.

Bhatt, R.K., Misra, L.P., Vandana, and Tiwari, H.S. (2002). Growth and biomass production in tropical range grasses and legumes under light stress environment. *Indian J. Plant Physiol*. **7:** 349-353.

Chandra, Amaresh, Pathak, P.S. and Bhatt, R.K. (2006). *Stylosanthes* research in India: Prospects and challenges ahead. *Curr. Sci.* **90:** 915-921.

Chatterji, B.N., Singh, R.D. and Matti, S. (1985). An agronomical appraisal of *Stylosanthes* in eastern region of India. *Indian J. Range. Manage.* **6:** 27-33.

Duncan, W.J. and Hesketh, J.D. (1968). Net photosynthetic rates, relative leaf growth rates and leaf numbers of 22 races of maize grown at eight temperatures. *Crop Sci*. **8:** 670.

Hanson, W.D. (1972). Selection for differential productivity among juvenile maize plants associated net photosynthetic rate and leaf area changes. *Crop Sci*. **11:** 334.

Magoon, M.L., Singh, A., Yadav, M. and Mehra, K.L. (1974). Stylos: New legumes on the forage science. *Indian Farming* **24:** 9-12.

Muramato, H., Hesketh, H.J. and E.L. Sharkway, M. (1965). Relationship among rate of leaf area development, photosynthetic rate and rate of dry matter production among American cultivated cotton and other species. *Crop Sci*. **5:** 163.

Rai, P. and Pathak, P.S. (1985). *Stylosanthes* and introduction. *Indian J. Range Manage.* **6:** 1-12.

Rai, P. and Patil, B.D. (1985). Production potential of *Stylosathes* in pure and mixed swards. *Indian J. Range Manage.* **6:** 35-37.

Ramesh, C.R., Hazara, C.R., Sukanya, D.H., Ramamurty, V., Chakraborty, S. and Bhagmal (1997). Status of *Stylosanthes* development in other countries. III. *Stylosanthes* development and utilization in India. *Tropical grasslands* **31:** 467-475.