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COMPARATIVE PERFORMANCE OF THREE GREEN MANURES FOR BIOMASS PRODUCTION AND NITROGEN ACCUMULATION

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Abstract

The performance of three green manure plant species viz., *Sesbania aculeata, S. rostrata* and *Cyamopsis tetragonoloba* was studied at different growth stages under field conditions. All the green manures upto 45 days of growth produced shoot dry biomass and shoot nitrogen contents similar to plants grown for upto 60 days. *S. rostrata* was found superior to other species in terms of biomass production and nitrogen contribution.

Introduction

Fertilizers are generally used for increasing crop production. It is estimated that for the production of inorganic fertilizers approximately 45% of the energy is used worldwide, 73% of which is used for the manufacture of nitrogen fertilizer (McCune, 1984). The current energy crisis has revived the interest of scientists in the use of green manures as an economical substitute or supplement for mineral fertilizers. There are many advantages of green manures since they increase soil nitrogen (Pushpavalli *et al.*, 1994), maintain soil phosphorus, renew organic matter and improve the physical and chemical conditions of the soil (Jiao, 1983). The legumes used as green manure have high amounts of nutrients and lower C/N ratios (range 10-20); 1000 Kg of fresh matter contains about 5 kg N, 0.44 kg P and 3.3 Kg K (Lizhi, 1988). Studies were, therefore, undertaken to explore the possibilities of getting maximum biomass and nitrogen accumulation from three green manuring plant species viz., *Sesbania aculeata, S. rostrata* and *Cyamopsis tetragonoloba* commonly grown in Pakistan.

Materials and Methods

The experiment was carried out in the fields of the Soil Science Department, University of Agriculture, Faisalabad. The texture of soil was sandy clay loam having pH 7.8, ECe 1.4 dS m^{-1}, total N 0.04%, available P 5.78 mg Kg^{-1} and K 126 mg Kg^{-1}. Three green manuring species viz., *Sesbania aculeata, S. rostrata* and *Cyamopsis tetragonoloba* were grown in 5m x 4m plots during July, 1990 for 2 months in randomized complete block design with three replications. The distance among plants was maintained as 20 cm row to row and 10 cm plant to plant. The plants were harvested after 30, 45 and 60 days of sowing. Data on shoot and root biomass was collected by taking three sampling units from each plot in the manner that each unit was

Table 1. Fresh and dry biomass of *Sesbania aculeata, S. rostrata* and *Cyamopsis tetragonoloba* at different growth period.

Green Manure	Fresh Biomass (t/ha^{-1})								Dry Biomass (t/ha^{-1})							
	Shoot				Root				Shoot				Root			
Days	30	45	60	Av.	30	45	60	Av.	30	45	60	Av.	30	45	60	Av.
S. aculeata	4.5a	12.4a	13.8a	13.8B	0.4d	1.3cd	2.1c	1.3B	1.1a	3.7a	5.9a	3.6B	0.18d	0.47cd	0.75c	0.46B
S. rostrata	12.2a	26.5a	30.1a	22.9A	1.4cd	4.1b	6.0a	3.8A	2.6a	8.9a	10.4a	7.3A	0.52cd	1.5b	2.30a	1.40A
C. tetragonoloba	5.0a	13.8a	17.3a	12.0B	0.3bc	1.0cd	1.4cd	0.9C	1.3a	4.5a	3.8a	3.4B	0.14d	0.33cd	0.47cd	0.31B
Average	7.2C	17.5B	24.0A		1.7C	2.1B	3.2A		1.7B	5.9A	6.7A		0.28C	0.78B	1.2A	

Means/interactions among days sharing similar letter (s) are statistically alike at 5% probability, NS = Non significant

Table 2. Nitrogen accumulation of shoot and root portion of *Sesbania aculata, S. rostrata* and *Cyamopsis tetragonoloba* at different growth stages.

Green Manure	Nitrogen ($kg\ ha^{-1}$)							
	Shoot				Root			
Days	30	45	60	Av.	30	46	60	Av.
S. aculeata	31.4a	95.1a	130.5a	85.7B	2.4c	6.8c	9.7c	6.3B
S. rostrata	77.8a	235.9a	246.6a	186.8A	6.7c	22.8b	33.5a	21.0A
C. tetragonoloba	38.5a	130.9a	110.0a	93.2B	1.8c	4.6c	6.5c	4.3B
Average	48.1B	154.0A	162.3A		3.6C	11.4B	16.6A	

Means/interactions among days sharing similar letter (s) are statistically alike at 5% probability, NS = Non significant of 0.4 m x 0.5 m (0.2 m^2) area containing a total of 10 plants where three units made an area of 0.6 m^2, and then biomass was computed on hectare basis. For root biomass, all the plants from each of the above mentioned sampling unit were uprooted carefully after irrigation. Roots were washed in water, dried on blotting paper and after separation of the roots from the shoots their weight was recorded. A sub-sample from each unit was dried in the oven at 70°C for dry matter yield.

Samples of shoot and root were analysed for nitrogen using Kjeldahl method (Black, 1965). All the data were subjected to analyses of variance (Steel & Torrie, 1986) and Duncan Multiple Range Test (Duncan, 1955).

Results and Discussion

Fresh and dry biomass, and nitrogen accumulation data of both shoot and root are presented in Tables 1 and 2. *S. rostrata* showed a sharp increase in fresh and dry shoot biomass and N accumulation upto 45 days with not much increase at subsequent interval. *S. aculeata* gave the lowest fresh and dry biomass and N accumulation in shoot portion upto 45 days with significant increase at 60 days of growth and was greater than *C. tetragonoloba*. *C. tetragonoloba* showed a progressive increase in fresh biomass for both the shoot and root, and dry biomass in root portion with increasing growth period while dry shoot biomass and N content were found maximum after 45 days of sowing. Higher nitrogen accumulation in *S. rostrata* is presumably due to the presence of nodules on the stem (Dreyfus *et al.*, 1985). Higher biomass produced in *S. rostrata* could be due to the fact that the plant thrives best in marshy/damp places (Rinaudo *et al.*, 1983) and under moderate temperature with prevailing climatic conditions during July may be favourable for its growth. Joshua *et al.*, (1993) reported that *S. rostrata* cv. TSR-1 was significantly superior to *S. aculeata* for biomass and N $plant^{-1}$ when sown during the month of June-July. Such similar observations have been reported by Kalidurai & Kannaiyan (1989).

Fresh and dry biomass of root and N accumulation in root portion showed that *C. tetragonoloba* had the lowest values of these parameters throughout the study period. The fresh root biomass was highest in *S. rostrata* followed by *S. aculeata* and the difference among all the three green manures was statistically significant. However, the difference between *S. aculeata* and *C. tetragonoloba* for dry biomass and N accumulation in both root and shoot was statistically non-significant and their values were statistically lower than that of *S. rostrata*. Low values observed in *C. tetragonoloba* could be due to its short stature which upto 45 days showed vigorous growth, produced maximum biomass and accumulated more nitrogen which reduced as the plants attained its maximum height. A 45 and 60 days growth period was found statistically similar in nitrogen accumulation in shoot (Table 2), indicating a short period of 45 days required for green manuring crop.

The results of the present study showed that growing the green manures like *S. aculeata, S. rostrata* and *C. tetragonoloba* for 45 days produced shoot dry biomass and shoot nitrogen similar to plants grown for 60 days. The species of the plants grown upto 60 days may become hard to decompose which may hamper the objectives of green manuring.

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