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Biomass productivity of selected palatable grasses

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Abstract

Palatable grasses such as *Cenchrus ciliaris, C. setigerus, Dichanthium annulatum, Sehima nervosum etc.* are the main source of fodder for the cattle. An experiment was conducted in 2006 to study the effect of biomass production of three palatable grasses *i.e., C. ciliaris, D. annulatum and S. nervosum* in pure and mixed stands at Geer Foundation, Gandhinagar, India. All three grasses were grown separately in pure stands, in combination of two and all three together. The monthly maximum and minimum temperatures, relative humidity and sunshine hours were recorded. The various growth parameters studied for all sets were the above ground fresh weight, above ground dry weight, number of leaves, below ground fresh weight and below ground dry weight. The results showed that *C. ciliaris* flourished vigorously and was dominant over *D. annulatum* in mixed stands. *S. nervosum* could not sustain harsh summer conditions and failed to get established

Key Words : *Cenchrus ciliaris, Dichanthium annulatum, Sehima nervosum,* Buffel grass, palatable, biomass production, allelopathy

Introduction

The grasses assume importance not only as livestock feed, but also as soil builders and binders and aid in soil conservation. In their principal role, the tropical grasses stand as the highest potential yielder of starch and proteins equivalent to any other crop plants and further being the dominant component of tropical pastures, as the cheapest sources of animal feed (Rajora, 2002; Rajora *et al.,* 2002). Perennial grasses are the major component of tropical pastures providing bulk herbage to animals. The grass and grazing are important constituents of fodder resources in India. However, fodder grasses are cultivated very marginally on a negligible scale and most of the grass is obtained from natural grasslands occurring in forest areas, and other uncultivated land which include permanent pastures grazing land, land under miscellaneous tree crops and groves, cultivable waste lands, fallow land *etc.*. Out of the total land area of 3.2 million sq. km of this country, about one-third falls under arid and semi-arid zone. (Vora and Bhatnagar, 2003). Perennial grass species like *C. ciliaris, C. setigerus, L. sindicus, D. annulatum, Panicum antidotale, S. nervosum* are grouped as 'High Perennial' species as they give high forage yield under natural rainfed conditions.

Buffel grass (*C. ciliaris* L.) also called as buffel grass or African foxtail, is a palatable nutritious and warm season grass naturally occurring in the drier parts of the world. It has also been widely introduced in the Australian rangelands for its value as productive grazing. *C. ciliaris*, a perennial pasture grass species has a wider adaptability in varied edaphic habitats all over the country. It is a valuable tufted perennial grass in arid and semi-arid areas characterized by severe drought, high temperature, low rainfall and sandy soil. It is an excellent grazing perennial suited to pasture and rangelands. Its high soil binding capacity is due to its clustered root system in the upper 8 to 10 cm layer of soil. It survives extreme and prolonged drought but grows vigorously when favourable conditions are set in. It is one of the prominent species of *Dichanthium-Cenchrus-Lasiurus* grass cover type of tropical India (Dabadghao and Das, 1960).

S. nervosum and *D. annulatum* are major components of *Sehima - Dichanthium* grass cover of India (Dabadghao and Shankarnarayan, 1973). *C. ciliaris, D. annulatum* and *S. nervosum* when grown alone or in combination show significant variation in biomass productivity. *D. annulatum* gives high forage yield on heavy soils with annual rainfall above 380 mm. *Sehima nervosum* yields good forage on hilly terrain

Material and Methods

The experimental site is located at the Botanical Garden of GEER Foundation, Gandhinagar, Gujarat. India. (latitude 23° 13'00" and longitude 78°42'00"). The study was conducted during the months of April to June, 2006. The meteorological data namely average maximum temperature, minimum temperature, humidity, photoperiod and rainfall were recorded during the field experiment.

The average minimum and maximum temperature recorded during the field experiments was 28.8°C and 38.3°C respectively. Peak minimum and maximum temperatures were 21.8 °C in April and 44.3°C in May. Average Relative humidity was 53.3% and mean photoperiod of 13.14 hours was observed, 80.2 mm rainfall was recorded in the month of June.

The soil was sandy loam and slightly alkaline (pH 7.5) with 0.36% organic carbon, electrical conductivity-0.16mmho, available Nitrogen – 285 kg/ha, available Phosphorus- 24 kg/ha, available Potash – 356 kg/ha.

The palatable fodder grasses selected for the experiment were *C. ciliaris, D. annulatum* and *S. nervosum*. Tussocks of *C. ciliaris* and *D. annulatum* were collected from Main fodder research centre, Anand. *Sehima nervosum* was collected from Grassland Research Centre, Dhari. The material was sown in the experimental plots laid down at the Botanical garden, GEER Foundation, Gandhinagar, India in randomized block design in five replications. The plot size was 3×3m and distance between the adjacent plots was 0.6m. One hundred tussocks were planted in each plot according to row method, where row-to-row spacing was 30 cm and plant to plant spacing was 25 cm. All the three grasses were sown individually and in combination of two and all three together in separate plots. Routine agronomic practices of fertilizer and irrigation were followed. Urea, Superphosphate and Muriate of potash was used for N, P and K sources respectively. N and P were applied as a top dressing whereas K was applied in 2.5 to 5 cm wide bands on each side of the row at a depth of 10 cm. The application of fertilizers was followed by irrigation. The treatment was repeated after one month.

Ten plants were randomly selected and growth data such as number of leaves per plant, height of shoot, above ground fresh weight and dry weight and belowground fresh weight and dry weight per plant was recorded at monthly interval from all sets. Three cuts of grasses were taken. The maximum roots generally occur in upper 30cm, depth of soil. Therefore, from the base of each plant, 20cm radius was formed and each plant was excavated up to 30cm, depth with ball of earth with a shovel. The individual plants were kept in polythene bags and labeled. Belowground biomass was assessed after washing the excavated roots with a fine jet of water to remove the soil particles. The shoot portion was clipped up to ground level and green weight was recorded in grams. This was recorded as fresh above ground biomass and fresh below ground biomass. All the above ground and below ground samples so collected were dried in oven at 80°C till constant weight. The oven dried weight of shoot and roots were recorded in grams by using electronic balance. This was recorded as above ground dry biomass and below ground dry biomass respectively.

Results and Discussion

It was observed that *C. ciliaris* grows well in a pure patch as well as in a mixed patch. The growth data (Tables 1 & 2) shows gradual increase in height, number of leaves, fresh weight and dry weight in all samples. The average height of *C. ciliaris* at the end of 90 days was 82.8 cm, whereas in mixed patch it was 91.8 cm. The average number of leaves/plant was 28.3 and 31.2 in pure and mixed patch respectively. Mean fresh weight of shoot/ plant in pure and mixed patch was 100.6gm and 99.6gm respectively after 90 days of sowing. The data shows equally good growth of *C. ciliaris* in a mixed patch. Biomass productivity of *C. ciliaris* was not affected when grown with *D. annulatum* (Figs 1 & 2). Average height of *D. annulatum* after 90 days was 72.3 cm whereas in mixed patch it was 51.6 cm (Table 2). Average number of leaves per plant also decreased in mixed patch. Fresh weight of

Table 1: Growth parameters of *C. ciliaris* in pure and mixed patch

Name	Days	Height (cm)	Number of leaves	Fresh weight (gms)		Dry weight (gms)	
				Shoot	Root	Shoot	Root
C. ciliaris	30	26.7	8.3	72.90	25.84	14.60	6.58
(pure patch)	60	72.6	24.5	244.73	52.33	37.52	19.37
	90	82.8	28.3	476.12	100.60	110.45	25.80
C. ciliaris	30	25.3	7.2	70.12	24.23	9.70	5.66
(mixed patch)	60	70.4	22.1	240.66	50.17	32.13	18.13
	90	91.8	31.2	470.10	99.60	107.41	25.10

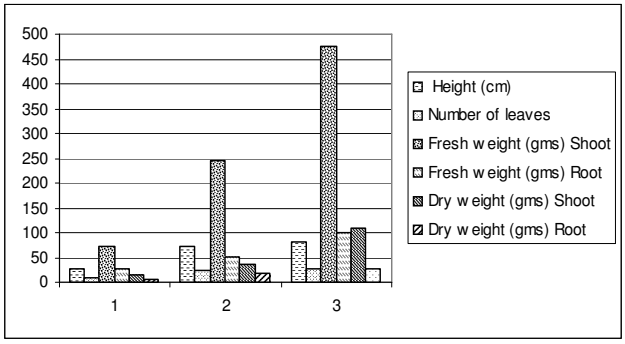

Fig. 1 : *C. ciliaris* in a pure patch

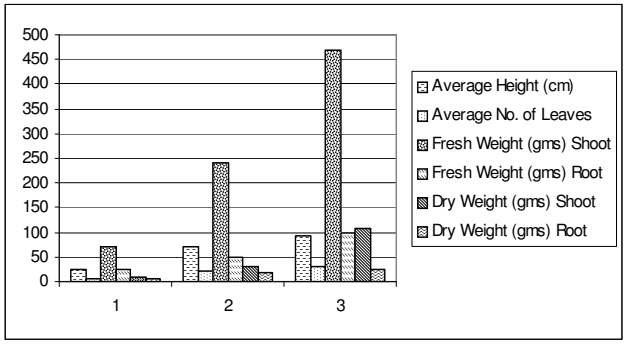

Fig. 2 : *C. ciliaris* in a mixed patch

Table 2 : Growth parameters of *D. annulatum* in pu*re and mixed* patch

Name	Days	Height (cm)	Number of leaves	Fresh weight (gms)		Dry weight (gms)	
				Shoot	Root	Shoot	Root
D. annulatum	30	12.4	4.2	16.30	6.50	4.31	2.05
(Pure Patch)	60	52.6	9.1	83.20	20.30	20.13	6.30
	90	72.3	12.3	110.40	24.10	30.20	8.20
D. annulatum	30	7.8	3.2	6.65	5.62	2.20	2.33
(Mixed Patch)	60	32.3	7.7	61.51	15.36	17.14	5.58
	90	51.6	9.3	94.80	21.40	23.60	7.20

shoot/plant was 110.4 gm and 94.8 gm in pure and mixed patch respectively. It was observed that *C. ciliaris* dominated over *D. annulatum* (Figs. 3 & 4). *Sehima nervosum* could not grow in the warm environment and so no data could be collected.

Dabadghao and Shankarnarayan (1973) have described five types of grass covers. Herbage yield of *Cenchrus - Dichanthium - Lasiurus* grass cover has been estimated as 3.3 t/ha. (Sureshkumar, 2002). Estimated air dried forage production on protected 'very poor', 'fair', 'good' and 'excellent' grasslands is 200, 500, 750, 1,000 and 1,500 kg/ha during normal years of rainfall (Bhimaya and Ahuja, 1969). In the present study, aboveground biomass productivity of *C. ciliaris* as a pure patch was found to be 9.5 t/ha while as a mixed patch with *D. annulatum* it was 9.4 t/ha.

Herbage yield is affected by various biotic and abiotic factors (Sureshkumar, 2002). Under irrigation and optimum fertilization conditions, a close relationship exists between temperature and dry matter production. The rate of leaf appearance in stems of graminaceous plants increases with high temperatures. Crop growth in buffel grass peaked at the time both high temperature and important precipitation events or sufficient soil moisture coexisted. Buffel grass grows at a slower rate during cooler climate than many other tropical grasses (Humpherys, 1967). Cool weather exerts a negative impact on growth in buffel grass and also, buffel grass will enter a dormancy stage (little or no growth) under low soil humidity/ no rainfall conditions. The soil dries off quickly hence stressing the plant. The yield was reduced by 25% when water was excluded during vegetative growth,

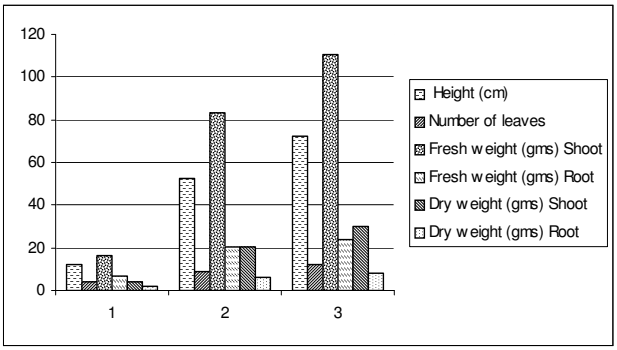

Fig. 3 : *D. annulatum* in a pure patch

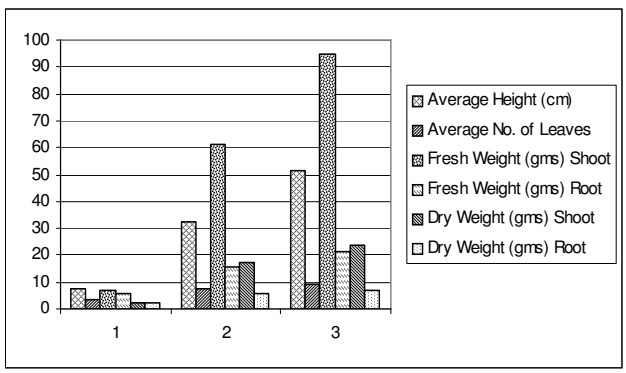

Fig. 4 : *D. annulatum* in a mixed patch

whereas yield was reduced by 59% when water was imposed at flowering stage. (Thomas *et al.,* 2004). Severe warm conditions of summer could not affect the growth of *C. ciliaris*, which kept on flourishing well in such conditions. *C. ciliaris* has been considered as a highly drought resistant grass species. It is adapted to a wide range of soil and climatic conditions (Sharma and Rajora, 2002). *D. annulatum* grows well in pure patch but in combination with *C. ciliaris*, its growth is affected due to profusely growing *C. ciliaris* (Figs 3 & 4). *C. ciliaris* is an aggressive grass, by virtue of its extensive root system competing with associated species for water and nutrients. It also appears to be allelopathic (Nurdin and Fulbright, 1990). Allelochemicals increasing in the roots exude and cause inhibition or arrest of growth of other plants (Vora and Bhatnagar, 2003). These interactions mainly in the rizhosphere, hence results in the better establishment of *Cenchrus* as against *Dichanthium* and *Sehima*. This observation needs to be further explored and experimented with to understand allelopathic interactions among various grasses.

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