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SEASONAL IMPACT ON BIOMASS PRODUCTION OF *CENCHRUS CILIARIS* GRASS

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ABSTRACT:

Grasslands occupy approximately 45 million Sq. km area in the tropic, temperate and alpine regions throughout the world. Buffel grass (*Cenchrus ciliaris.*L) also known as African foxtail is a palatable nutritious warm season grass naturally occurring in drier parts of the world. The study was conducted at GEER foundation, Gandhinagar, India during 2006-2007 to evaluate biomass production of *Cenchrus ciliaris* . The various growth parameters studied for all sets were shoot length, above ground biomass (AGB), below ground biomass (BGB) and number of leaves. Meteorological parameters were recorded. Seasonal changes in biomass were observed in *Cenchrus ciliaris* over a year (2007). Statistical analysis revealed significant intra seasonal variation in biomass. Maximum biomass was found in rainy season followed by summer and least biomass was recorded in winter.

KEY WORDS: Seasonal impact, Biomass, Production, *Cenchrus ciliaris,* Grass.

INTRODUCTION:

Plants have many diverse uses, which have a direct or indirect bearing on the civilization of human society. Range lands or grazing lands are extensive tracts of arid and semi-arid lands that are essentially unsuited to rain fed crop cultivation, industrial forestry, protected forests or urbanization. The best use of range lands is for livestock and wild life production; excluding irrigation systems or other technology. Range lands are those renewable resources, which require little or no commercial energy input to produce milk, meat, wool hides and other animal products (R.Dennis Child *et al*., 1984). More than 200 million people use range lands over the world for some pastoral production, where as 30 to 40 million of these people are wholly dependent on livestock. Although, no comprehensive global assessment of the extent of rangeland exists, the best estimates are from U.N. Food and Agriculture Organisation (FAO, 1980-2000)-Data analysis by Eleonora Panunzi, economist (2008).

Grasslands, including sown pasture and rangeland, are among the largest ecosystems in the world. They are a source of goods and services such as food and forage, energy and wildlife habitat, prevents soil erosion and also provide carbon and water storage and watershed protection for many major river systems. Grasslands are important for *in situ* conservation of genetic resources. Of a total of 10,000 species, only 100 to 150 forage species have been cultivated, but many more hold potential for sustainable agriculture. 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 (M.P.Rajora, 2002). Perennial grasses are major components of tropical pastures providing bulk of herbage to animals. The grass and grazing are important constituents of fodder resources in India. Out of the total land area of 3.2 million sq. km of this country, about one-third falls under arid and semiarid zone. (Vora & Bhatnagar, 2003).

Cenchrus ciliaris also known as buffel grass or African foxtail is a palatable nutritious and warm season grass naturally occurring in the drier parts of the world. It is a valuable tufted perennial grass in arid and semi arid areas characterised 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 set in. Buffel grass (*Cenchrus ciliaris* Linn.), a perennial pasture grass species, has wider adaptability in varied edaphic habitats all over the country. It is one of the prominent species of *Dichanthium-Cenchrus-Lasiurus* grass cover type of tropical India.

MATERIAL AND METHODS:

The experimental site was located at the Botanical Garden of GEER Foundation, Gandhinagar,Gujarat. India. (latitude 23˚ 13’00” and longitude 78˚42’00”). Gandhinagar has a monsoon climate with three main seasons: summer, monsoon and winter. Other than during monsoon the climate is generally dry and hot. The soil of the experimental site 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 water was suitable for irrigation as its electroconductivity is 0.98, pH is 7.8 and Ca+Mg is 5.57 M.e/L. The palatable fodder grass which was selected for the experiment was *Cenchrus ciliaris*. The material was sown in the experimental plots in randomized block design in five replications. The Plots size was 3m×3m and distance between the adjacent plots was 2 m and hundred tussocks were planted in each plot according to the row method, where row-to-row spacing was 30 cm and plant to plant spacing was 25 cm. Routine agronomic practices of fertilizer and irrigation were followed.The meteorological data namely average maximum temperature, minimum temperature, humidity, photoperiod and rainfall were noted during the field experiment

(Table 2 and 3). A trial was done to grow *Cenchrus ciliaris* grass in the month of September and its seeds were sown in the late September. In spite of irrigation and fertilization the seeds took very long to get established. Growth data of the individual *Cenchrus ciliaris* plant was calculated in different seasons. Data on height of plant, number of tillers, fresh weight of shoot and fresh weight of roots on individual *Cenchrus ciliaris* plant was calculated. 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 shawal. The individual plants were kept in polythene bags and labeled. Belowground biomass was assessed after washing thereby 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 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 the weight remained constant. The oven dried weight of shoot and roots were recorded in grams by using electronic balance. This was recorded as Dry- Above Ground Biomass and Dry- Below Ground Biomass respectively.

RESULTS:

It was observed that *Cenchrus cilaris* is a warm season grass and sprouts in February and becomes dormant at the end of September after seed dispersal (Umar Farooq et al., 2003). The average height of the *Cenchrus ciliaris* plant at the end of summer, monsoon and winter season is shown in Table 1. As *Cenchrus ciliaris* is a warm season grass the average height of the plant in the winter season is less due to less growth vigour. The *Cenchrus* plant in summer and monsoon season exhibits greater height as compared to same in winter. Similarly, the number of tillers decrease from summer to monsoon to winter.

The root biomass of *Cenchrus ciliaris* plant in summer, monsoon and winter season is also shown in Table 1. In winter the root biomass is less as the growth of the plant is restricted due to unfavourable season. The shoot biomass at the end of the summer was very high than the root biomass. This difference in shoot and root biomass may be due to the fact that most of the reserve food material in root was used for the initial of new shoots. The shoots gained less height in the beginning of the growing season. Therefore, the shoot biomass was significantly less than the root biomass. The non-significant differences between shoot and root biomass in monsoon season is attributed to the growth of both shoots and roots due to enhanced photosynthetic in shoot and allocation of more photosynthetic to the roots for storage and re-growth. The shoot weight increased more than the root of an individual *Cenchrus ciliaris* plant during the growing season and reached to the maximum in October. At the end of growing season the shoot and root biomass were at maximum. Re-growth of foliage and continued maintenance of the individual *Cenchrus* *ciliaris* plant after dormancy depends initially on the reserved food material in the roots. Reserved food material in the roots was used for the re-establishment of tillers/shoots (photosynthetic surfaces). Therefore a sustainable decrease may occur in shoot biomass. At the end of the growing season, more photosynthetase were allocated to the shoots and the roots to increase food reserves for future use for daily function i.e respiration. Apparently the *Cenchrus ciliaris* plant allocated more photosynthetase to increase the photosynthetic surface (leaf area).The shoot root ratio of *Cenchrus cilaris* plant substantially increased due to prolonged growing season in monsoon. The results are in agreement with (Heady 1975) and (Cook *et al;* 1986).This study showed that both shoot and root biomass of individual *Cenchrus ciliaris* are higher at the end of growing season than in the beginning of growing season. The numbers of tillers/shoots reduced were less in October compared with that of May. Shoot root ratio increased with the progression of the growing season and an increase in shoot biomass, because the shoot height was maximum. It can be concluded that number of tillers were higher in summer followed by monsoon and winter.

DISCUSSION:

In the present study it is observed that 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 weather than many other tropical grasses (Humpherys; 1967). Cool weather exerts a negative impact on growth in buffel grass, in addition 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. Under controlled conditions and different management systems, buffel grass has shown yields of up to 80 kg $ha^{-1.}$ Under seasonal conditions, reported growth rates for both raining and dry seasons were 81 and 20 kg ha^{-1} respectively (Eduardo Gomez de la Fuente *et al.,* 2007). The yield was reduced by 25% when water was excluded during vegetative growth, 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 *Cenchrus ciliaris*, which kept on flourishing well in such conditions. *Cenchrus ciliaris* has been considered as a highly drought resistant grass species. It is adapted to a wide range of soil and climatic conditions.

There is non-significant difference in root biomass in summer and monsoon season due to the allocation of more photosynthates to root by the end of the growing season to enhance reserved food material for respiration during dormancy and its re growth during growing season. Similar results were obtained in *Cenchrus ciliaris* grass (Umar Farooq, 2003). The root biomass decreases, when re growth occur in the early growing season. The reserved food in the root is used for shoots re growth and there is decline in root biomass. After the formation of 8-10 leaves on stem the reserved food of root is not used for shoot re-growth. As the growing season progresses the leaves manufacture sufficient photosynthates and send extra food material for day to day life requirement to the root, to enhance the reserve food material. Health of an individual plant depends upon its ability to synthesise food in leaf area and enhance food reserves in the roots decrease in beginning of the growing season because it is used for shoot growth. At the end of growing season both shoots and roots have maximum biomass because of maximum photosynthetic activity due to prolonged growing season. All grasses produce more abundantly during wet season, but the variation in productivity according to season differs among plant species (Lemeziene et al., 2004).

CONCLUSION:

It was observed that *Cenchrus ciliaris* could grow well in the mixed patches as well and dominates over *Dichanthium annulatum*. Severe warm conditions of summer had no effect on the growth and biomass of *Cenchrus ciliaris* , which kept on flourishing under such adverse climatic conditions. *Cenchrus ciliaris* has been considered as a highly drought resistant grass species. It is adapted to a wide range of soil and climatic conditions. During the seasonal study it was observed that crop growth in *Cenchrus ciliaris* peaked at the time when both high temperature and important precipitation events or sufficient soil moisture coexisted. Buffel grass (*Cenchrus ciliaris*) grows at a slower rate during cooler weather than many other tropical grasses. Cool weather exerts a negative impact on growth in buffel grass. Thus Seasonal changes in biomass revealed significant intra seasonal variation. Maximum biomass was found in rainy season followed by summer and least biomass was recorded in winter.

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Table 1 Growth parameters of *Cenchrus ciliaris* during different seasons

Parameters	**Summer (February-May)**	**Monsoon (June-September)**	**Winter (October-January)**
Height of plant (cm)	129	154	95.25
Number of tillers / plant	32.25	24.5	18.25
Above Ground Biomass (gm)	154.5	255.75	114.5
Below Ground Biomass (gm)	62.25	75.75	54.5

Table 2 Monthly Climatic Data, Source: (Station name- Gandhinagar, Year: 2006)

Month	Average Minimum Temperature (˚C)	Average Maximum Temperature (˚C)	Relative Humidity (%)	Rainfall (in mm)	Pan Evapo.	Photoperiod (in hours)
January	14.9	27.1	48.0	0.0	92.1	10.55
February	19.5	33.3	47.1	0.0	95.2	11.23
March	21.0	33.5	44.2	1.5	104.7	12.02
April	25.1	37.6	43.4	0.0	153.2	12.46
May	29.0	40.4	44.0	0.0	203.7	13.14
June	28	36.5	64.7	100.5	146.1	13.34
July	26.4	30.8	80.0	259.9	76.8	13.23
August	25.4	28.6	85.6	554.5	60.6	12.56
September	26.4	32.3	71.5	148.5	95.3	12.18
October	24.7	33.7	63.6	0.0	105.3	11.35
November	22.5	32.1	61.5	0.0	89.3	10.58
December	15.5	28.5	55.5	0.0	90.6	10.47

Table 3 Monthly Climatic Data, Source: (Station name- Gandhinagar, Year: 2007)

Month	Average Minimum Temperature (˚C)	Average Maximum Temperature (˚C)	Relative Humidity (%)	Rainfall (in mm)	Pan Evapo.	Photoperiod (in hours)
January	15.0	26.7	60.6	0.0	89.7	10.54
February	17.8	29.8	61.4	0.0	97.3	11.25
March	20.3	33.6	51.0	0.0	155.5	12.05
April	25.5	38.7	50.3	0.8	213.3	12.45
May	28.0	39.2	57.9	3.0	211.9	13.13
June	29.1	36.7	66.6	61.5	158.0	13.30
July	26.9	30.8	76.5	647.5	84.5	13.22
August	26.2	30.5	80.9	415.0	64.8	12.54
September	26.6	32.3	74.4	52.5	92.0	12.17
October	22.7	33.1	61.3	0.0	111.1	11.37
November	16.5	32.3	54.1	0.0	85.6	11.00
December	15.5	27.6	47.5	0.0	88.2	10.48