

Forage Yield and Quality of Different Genotypes of Buffel Grass (*Cenchrus ciliaris* Linn.) at Various Cutting Intervals

M. Patidar and M.P. Rajora

Central Arid Zone Research Institute, Jodhpur 342 003, India

Abstract: A field experiment was conducted at Jodhpur during kharif season from 2004 to 2006 under rain fed conditions to study the performance of four *Cenchrus ciliaris* genotypes (CAZRI 2171, CAZRI 2186, CAZRI 2226 and CAZRI 75) with three cutting schedules, i.e. 30, 45 and 60 days intervals for forage yield and quality. The results of three years revealed that maximum mean dry matter (1990 kg ha^{-1}) and protein yield (207 kg ha^{-1}) were with CAZRI 2171 followed by CAZRI 2226, whereas CAZRI 75 had minimum dry matter (846 kg ha^{-1}) and protein yield (64 kg ha^{-1}). Plants of CAZRI 2171 and 2226 were taller and flowered early while number of tillers were more with CAZRI 2186. Protein content was slightly higher in the foliage of CAZRI 75, but total protein yield was lower than CAZRI 2171 and CAZRI 2226. This indicated that CAZRI 2171 and CAZRI 2226 were superior for producing higher quality fodder under arid conditions. Cutting intervals did not show significant variation for dry matter production over the years, but green fodder yield and crude protein content were higher with 30 days interval in all the genotypes.

Key words: Buffel grass, *Cenchrus ciliaris*, genotype, cutting intervals.

Livestock play an important role in the rural economy of the arid zone of Rajasthan where the grasses and other fodder resources are limited to feed about 23.6 million livestock in spite of 53% of the total area available for grazing. The grazing lands contribute about 30% of total fodder available in the form of grasses, weeds, top feeds, etc. These lands are in degraded state due to excessive grazing without proper management. Palatable and nutritive perennial grasses lose their regeneration capacity due to constant exploitation reducing the productivity of these grazing lands. Improved grasses can be re-sown to restore productivity of rangelands or degraded lands, which are not suitable for arable cropping. Buffel grass (*Cenchrus ciliaris* Linn.) is a perennial, drought resistant, nutritive and palatable species to all kinds of grazing livestock. Its productivity and quality varies with different genotypes and management practices. Therefore, screening high yielding, drought resistant genotypes with good regeneration ability is utmost important for pasture establishment. Moreover, the effect of defoliation or cutting on plant growth and reproduction are least understood. Grazing or cutting of grasses results in loss of vegetative parts and thus reduces the accumulation of food reserve in the root system and in turn the regeneration and growth. Therefore, maximum forage yield is obtained by the lenient cutting or grazing, on the other hand, longer the grass is allowed to grow the lower will be the

quality of the produce due to drop in the crude protein content and digestibility. Thus, the main principle of ideal grazing or cutting management would be to utilize the herbage species at a growth stage when it is highly palatable and nutritious without interfering much with growth and reproduction. Keeping the above facts in mind, the present study was conducted to evaluate different genotypes and to determine the best cutting management schedule for higher forage of better quality of buffel grass under arid conditions.

Materials and Methods

The experiment was conducted from 2004 to 2006 at Central Research Farm of the Central Arid Zone Research Institute, Jodhpur. The treatments consisted of four *C. ciliaris* genotypes, viz. CAZRI 2171, CAZRI 2186, CAZRI 2226 and CAZRI 75 with three cutting schedules, i.e. cutting at 30, 45 and 60 days intervals. The base point for cutting intervals was sowing date in the first year and the dates of first effective rains in second and third years. The experiment was laid out in split plot design with three replications having genotypes in main plots and cutting intervals in sub plots. The climate of the area is typically arid, characterized by exceptionally hot dry summers, sub-humid monsoon and cold dry winters. The experimental site represents alluvial plains of the Thar Desert. The soil is coarse loamy sand, low

in organic carbon (0.17%), available nitrogen (143.0 kg ha⁻¹) and available phosphorus (11.5 kg ha⁻¹) with pH 8.2. The grass was sown during 2004 on 31st July with 50 cm row-to-row spacing using 5 kg seed ha⁻¹. A common dose of 20 kg P₂O₅ and 20 kg N ha⁻¹ was applied in all plots at the time of sowing in first year (establishment year) and at the onset of monsoon in subsequent years. Plant height was recorded from randomly selected five plants and number of tillers per meter row length was recoded at 30-day stage. The observation on 50% flowering was recorded in the treatment of 60 days intervals. The herbage was harvested as per cutting schedules at a cutting height of 10 cm from the ground. Green fodder yield was recorded from plots (3 x 4 m) and converted to hectare⁻¹. 100 g fresh sample was dried on hot air oven and weighed for dry matter determination. Samples were analyzed for nitrogen, and percent crude protein was calculated (N x 6.25).

Results and Discussion

Rainfall

Variations in quantity, time and distribution of rainfall were observed in all three years with total rainfall of 220.4, 283.0 and 270.4 mm in 2004, 2005 and 2006 respectively. In 2004 sowing of grass was done at the end of July due to delayed monsoon, after that there were continuous rains in August (139.5 mm) but thereafter only 11.1 mm of rains were received in September. Therefore, during the establishment year, the short rainy period (1½ month) resulted in poor crop growth and yield. In 2005 the monsoon activated in the first week of July and July-August received 210.1 mm rainfall which resulted good harvest of *C. ciliaris* grass genotypes with an average yield of 2055 kg ha⁻¹ dry matter, while in the year 2006, monsoon conditions were again different. Only 27.7 mm of rainfall was received in July and grass regeneration took place, but dried due to long dry spell, whereas August was a good rainy month

with 185.5 mm rains followed by 29.2 mm in September. The variation in the quantity of rainfall resulted in variation in the fodder yield of grass genotypes at various harvesting stages.

Plant growth attributes

The genotypes differed for days to 50% flowering. Flowering was 1-2 days earlier in CAZRI 2171 as compared to CAZRI 2186 and CAZRI 2226, and 4-9 days than CAZRI 75 (Table 1). In general the early flowering during second and third years might be due to advantage of the establishment. Similarly, genotypes also varied significantly for plant height (Table 2). Plant height of CAZRI 2226 was at par with CAZRI 2171 and significantly higher than CAZRI 2186 and CAZRI 75 at 30 days cutting interval. The plants of CAZRI 2226 and CAZRI 2171 were taller due to faster growth rate. Similar results were reported by Patidar and Rajora (2006). However, genotypes did not differ significantly for number of tillers in first and second years, but in third year number of tillers were significantly different amongst genotypes, being maximum (150) in CAZRI 2186 and minimum in CAZRI 75 (67). Poor tillering in CAZRI 75 was due to poor survival of the genotype. Cutting intervals had no significant influence on plant height and tiller number in first and second years, while in third year these were maximum at 45 days cutting interval for all the genotypes except CAZRI 2186 which produced more tillers with increased plant height at 30 days cutting interval. CAZRI 75 failed to regenerate in the third year at 30 days cutting (Table 2). Higher cutting intensity had no adverse effect on mortality of *C. ciliaris* genotypes except CAZRI 75 which had 100% mortality in third year with 30 days cutting indicating CAZRI 75 to be more susceptible to frequent cuttings.

Forage yield

Genotypes varied significantly for green and dry fodder yields (Table 3). The maximum mean

Table 1. Tillers and days to 50% flowering in different genotypes of *Cenchrus ciliaris*

Genotypes	Days to 50% flowering			Tillers/mrl		
	2004	2005	2006	2004	2005	2006
CAZRI 2171	29	15	21	49	107	115
CAZRI 2186	31	14	22	50	122	150
CAZRI 2226	29	17	23	49	112	100
CAZRI 75	38	19	25	45	112	67
CD (P=0.05)	1.7	1.1	1.0	NS	NS	46

Table 2. Effect of cutting intervals on plant height, number of tillers and mortality of *Cenchrus ciliaris* genotypes during third year

Genotypes	Plant height (cm)			No. tillers/mrl			Mortality (%)		
	Cutting intervals (days)			Cutting intervals (days)			Cutting intervals (days)		
	30	45	60	30	45	60	30	45	60
CAZRI 2171	111	119	104	102	150	92	5	10	10
CAZRI 2186	88	82	78	163	154	132	27	32	45
CAZRI 2226	102	109	96	110	115	75	17	48	25
CAZRI 75	0	109	113	0	128	74	100	83	48
Mean	75	105	98	94	137	93	37	43	32
CD (P=0.05)*		15			40			29	

* Genotype x cutting intervals.

green fodder yield was obtained from CAZRI 2171 which was at par with CAZRI 2226, but significantly higher than rest of the genotypes. Green fodder of CAZRI 2226 and CAZRI 2186 was also significantly higher than CAZRI 75. The dry matter yield was also maximum with CAZRI 2171 followed by CAZRI 2226. Marked differences in growth attributes led to differences in fodder yields among the genotypes. Variability in fodder yield of *C. ciliaris* genotypes has also been reported by Yadav and Bhag Mal (1988). Although CAZRI 2186 produced more number of tillers, the fodder yields were lower due to its short stature. Genotype CAZRI 75 grows slow at early stage and remains green for longer duration, but the non-availability of soil moisture was limiting factor due to short rainy season resulting in less fodder production. The harvesting of different genotypes at various intervals revealed that two cuts were obtained when the fodder was harvested at 30 days interval while only one cut could be taken at 45 and 60

days intervals. Total green fodder yield of different genotypes was significantly higher at 30 days cut as compared to harvesting at 45 and 60 days intervals in all the years, except in second year where 45 day cut had maximum green fodder yield due to continuous rains up to 45 day leading to better plant growth. The mean data indicated that harvesting at 30 days interval produced higher green fodder (21 and 57% over 45 and 60 days intervals) due to more moisture content in plants and because of availability of two cuts. The mean of genotypes over the years revealed significant differences for dry matter production. Thirty days cutting had significantly higher dry matter production in first year and it was at par with sixty days cut in third year. In second year the dry matter production from 30 days cut was at par with 45 days cutting but less than 60 days cutting, however, the mean of three years showed non-significant difference in dry matter production from different cutting intervals. Subhash Chander

Table 3. Green and dry fodder yield of *Cenchrus ciliaris* as influenced by genotypes and cutting intervals

Genotypes	Green fodder yield (kg ha ⁻¹)				Dry matter yield (kg ha ⁻¹)			
	2004	2005	2006	Mean	2004	2005	2006	Mean
CAZRI 2171	1788	6650	8658	5712	682	2480	2808	1990
CAZRI 2186	1482	4920	5942	4114	600	1950	1979	1510
CAZRI 2226	1960	5880	6189	4673	818	2550	2092	1820
CAZRI 75	1645	3690	1602	2312	650	1240	647	846
CD (P=0.05)	378	1920	2910	1431	121	790	940	525
Cutting interval								
30 day*	1979 (1557+ 422)	5680 (4110+ 1570)	7703 (6220+ 1480)	5120 (3963+ 1157)	775 (602+173)	1510 (900+610)	1946 (1352+594)	1410 (951+459)
45 day	1585	6370	4693	4216	628	2230	1518	1459
60 day	1592	3810	4397	3266	659	2420	2180	1753
CD (P=0.05)	327	1330	1276	725	105	720	499	NS

*Fodder yield of two cuts.

Table 4. Crude protein content (%) of different *Cenchrus ciliaris* genotypes at various stages

Genotypes	2004			2005			2006		
	30 days	45 days	60 days	30 days	45 days	60 days	30 days	45 days	60 days
CAZRI 2171	11.40	9.45	9.43	12.25	9.78	9.66	8.56	8.12	7.39
CAZRI 2186	11.34	8.95	8.13	12.98	10.36	9.32	9.36	7.82	7.75
CAZRI 2226	10.56	8.61	6.89	11.90	9.9	8.29	8.98	6.81	5.99
CAZRI 75	10.10	11.63	11.02	10.95	11.46	11.66	–	7.96	6.76
CD (P=0.05)	0.41	0.74	0.56	0.53	1.4	0.9	NS	0.6	0.5

et al. (2004) reported that harvesting grass in two cuts in a year produced significantly higher dry matter yield than annual cutting schedule.

Forage quality

The protein content varied significantly in different genotypes at various stages of harvesting (Table 4). Protein content at 30 days stage was maximum (11.40%) with CAZRI 2171 in the first year, while in second and third years, protein content was maximum in CAZRI 2186 closely followed by CAZRI 2171. At 45 and 60 days growth stages, the protein content was maximum in CAZRI 75 in first and second years, while in third year protein content of this genotype was at par with CAZRI 2171. The protein content in all the genotypes was more at 30 days stage (10.76%) and decreased towards maturity (8.52%). In CAZRI 75 protein content did not vary much between growth stages as this genotype remains green for longer period (50% flowering on 38 days). This showed that CAZRI 2171 and 2186 had superior fodder when harvested early, while CAZRI 75 gave good quality fodder even at maturity stage. According to Arkcoll and Festenstein (1971), increasing leaves maturity is accompanied by a decrease in juice/fiber ratio whilst the fibrous structure became less susceptible to breakage under

mechanical stress, thus hindering protein extraction. Kathju *et al.* (1979) also reported that the foliage protein concentration generally increased with increase in the number of cuts in *Cenchrus ciliaris*. Further total protein yield was also varied with genotypes and cutting intervals. Frequent cutting reduces yield, but increases the forage quality. Half yearly cutting schedules provided significantly superior quality of dry fodder than annual cutting schedules under limited irrigation condition on coarse sandy soil at Bikaner (Subhash Chander *et al.*, 2004). Based on the mean of the three years, protein yield of different genotypes at various cutting intervals ranged from 207 kg ha⁻¹ to 64 kg ha⁻¹ (Fig. 1). Protein yield was higher at 30 days cutting interval as compared to harvesting at 45 and 60 days intervals. The total protein yield was the maximum in CAZRI 2171 at all the stages followed by CAZRI 2226 and 2186 and minimum in CAZRI 75. Genotypes CAZRI 2171 and 2186 produced higher protein yield at 30 days cutting interval and CAZRI 75 at 60 days interval while protein yield of CAZRI 2226 was not much influenced by cutting intervals. Though CAZRI 75 has good quality of foliage yet the forage and protein yields were less. This genotype requires more soil moisture for growth, therefore less suitable for arid region where the availability of soil moisture for longer duration is a limiting factor.

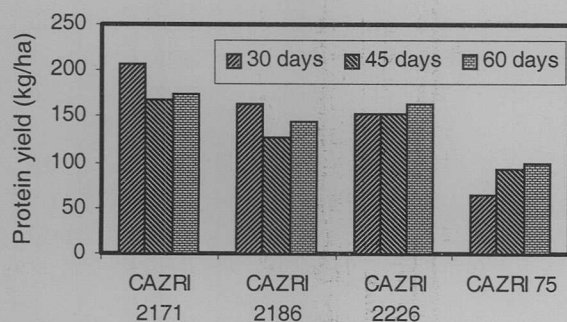


Fig. 1. Protein yield of different *Cenchrus ciliaris* genotypes at different intervals (mean of 3 years).

The results revealed that forage yield and quality of grasses depend on genotype, stage of cutting and season. *Cenchrus ciliaris* genotypes CAZRI 2171 and CAZRI 2226 were found superior for producing higher green and dry fodder yield, and cutting the grass at 30 day had maximum green fodder, maximum crude protein content and crude protein yield, and mostly high dry matter yield. Thus it can be concluded that genotypes CAZRI 2171 and CAZRI 2226 provide higher yields of quality fodder when harvested at 30 days interval even in low rainfall years. This could be useful for

supplementing protein deficient diets under drought situation in arid zone.

References

- Arkcoll, D.B. and Festenstein, G.N. 1971. A preliminary study of agronomic factors affecting the yield of extractable leaf of protein. *Journal of Science Food and Agriculture* 22: 49.
- Kathju, S., Shankarnarayan, K.A., Lahiri, A.N. and Vyas, S.P. 1979. Effect of fertilizer and clipping on protein in leaves of desert grasses. *Experimental Agriculture* 15: 103-106.
- Lahiri, A.N., Kathju. S. and Vyas S.P. 1988. Effect of nitrogen and defoliation on productivity, water use and nutrient status of *Lasiurus indicus* Linn. In *Proceedings 3rd International Rangeland Congress*, pp. 221-223. Range Management Society of India and IGFRI, Jhansi, India
- Patidar, M. and Rajora, M.P. 2006. Forage yield of buffel grass (*Cenchrus ciliaris*) genotypes at different row spacing and nitrogen levels under hot arid conditions of Rajasthan. In *Extended Summaries Golden Jubilee National Symposium on Conservation of Agriculture and Environment*, pp. 85-86. BHU, Varanasi, India.
- Subhash Chander, Sharma, K.C. and Toor, G.S. 2004. Effect of cutting schedules and varieties on growth, yield and quality of perennial pasture grasses grown in hot arid region. *Indian Journal of Agronomy* 49(2): 131-133.
- Yadav, M.S. and Bhag Mal 1988. Genotypic response to defoliation stress and nitrogen on the fodder yield, quality and underground biomass of buffel grass (*Cenchrus ciliaris*). In *Rangelands Resource and Management* (Eds. Panjab Singh and P.S. Pathak), pp. 203-208. Range Management Society of India, IGFRI, Jhansi.