

## Effects of Defoliation on Plant Growth of Buffel Grass (*Cenchrus ciliaris* L.)

Nasir M Butt, Gary B Donart\*, Morris G Southward\*, Rex D Pieper\* and Noor Mohammad

National Agricultural Research Centre, Islamabad, Pakistan

\*New Mexico State University, USA.

**Abstract** The response of plant growth of buffel grass to cutting was studied during 1986 and 1987 at National Agricultural Research Centre, Islamabad. Sixteen possible combinations of four intervals of cutting; 3, 6, and 9 week and the control and four cutting heights; 10, 20, and 30 cm stubble heights and the control were applied in randomized complete block design with 4x4 Factorial arrangement. Data on morphological characteristics of plant growth were recorded at prescribed intervals. Clipping after 9 week interval produced comparable growth to control treatment. Clipping at 10 cm stubble height was found injurious to plant growth.

**Key words** Defoliation, *Cenchrus ciliaris*, Growth parameters

Buffel grass (*Cenchrus ciliaris* L.) locally called dhama grass is a warm season grass and is distributed over the hotter and drier parts of Pakistan, India, the Mediterranean region, Tropical and South Africa. The species has been introduced in Central America, Puerto Rico and Australia. In recent years it has become quite spread in Texas (USA) both on the coastal plain and along the Rio Grande Valley (Whyte et al. 1959, Asare 1970).

Buffel grass has been studied in Australia, India and Africa. Those studies have shown the effect of frequency of defoliation on dry matter production, nutritive value, non-structural carbohydrates and morphological characteristics (Taerum 1970, Paull & Lee, 1978). Garcia and Rodriguez (1980) demonstrated that plant height varied with age. Buffel grass showed the highest average mean value (96.7 cm) when cut every 84 days and the lowest average mean value (51.3 cm) when cut every 42 days. They found that cutting height has a significant effect on apical meristems. A cutting height under 10 cm removed 96% or more of apical meristems in buffel grass, suggesting that this grass must be cut above 15 cm. Khan

(1970) demonstrated that the percent of basal area of buffel grass varied due to different clipping heights, but the differences between different treatment groups were not significant. According to Brown (1966) buffel grass should not be grazed closer than two to three inches from the ground. A great increase in the number of tillers with clipping as compared to unclipped plants of little bluestem (*Andropogon scoparius* Michx.) has been reported by Jameson and Huss (1959).

Contrasting effects of clipping on buffel grass have been reported in relation to dry matter production, nutritive value and morphological characteristics. Thus it is necessary to continue these experiments to clarify the effect of defoliation on buffel grass. The objectives of the study were to determine the effect of cutting frequency, cutting heights and their interaction on plant growth characteristics of buffel grass.

### Materials and methods

This study was conducted in the forage and pasture research block at the National Agricul-

tural Research Centre, Islamabad, Pakistan. The average rainfall of the study area during the last 80 years is 940 mm, mostly received during mid and late summer monsoon season (Mohammad 1987). The soil of the study site is classified into Ustochrept (Government of Pakistan 1976).

Buffel grass was established in the forage and pasture research block during the spring of 1983 through tuft splits. The distance between plants and rows was 25 cm. Plot size was 1.5x 3.0 m. Treatments consisted of four harvesting intervals and four cutting heights. Harvesting intervals were; clipping after 3, 6 and 9 week intervals and the control, i.e. clipping at the end of the growing

periment was repeated in 1987. The desired data were collected in the same manner as in the first year of study. Clipping dates and number of clippings in two years of study are shown in Table 1. The differences between the means of the main effects were separated using Bonferoni's test of comparison. Tukey's test of comparison was used to compare the interaction means.

## Results and Discussion

*Year I (1986)* : Cutting interval by cutting height interaction was non-significant for all growth characteristics while, plant height and

Table 1 Treatment schedule for buffel grass during 1986 and 87.

Year	Clipping dates						
	Jun 16	Jul 09	Aug 25	Sep 17	Oct 09	Oct 30	Nov 20
1986			Aug 25	Sep 17	Oct 09	Oct 30	Nov 20
1987	Jun 16	Jul 09	Jul 29	Aug 19	Sep 10	Oct 04	Oct 25
<b>Treatment</b>							
Control	b		a				ab
3 Week	b	b	ab	ab	ab	ab	ab
6 week	b		ab		ab		ab
9 week	b		a	b		a	ab

a - clipping dates in 1986, b - clipping dates in 1987

season. The cutting heights were 10, 20, 30 cm stubble heights and the control, i.e., clipping at the end of the growing season at ground level. The sixteen possible combinations of treatments were applied in three replications in a randomized complete block design with 4x4 factorial arrangement. Three plants in each plot were selected and tagged with hard paper to record the data regarding plant height to the end of the tallest leaf, number of tillers per plant and basal plant circumference. Two tillers from each selected plant were removed to determine the number of live leaves and number of nodes per tiller. Cumulative leaf and internodal length starting from the base to the top of the tiller was also measured on these tillers. All the measurements on plant growth characteristics were done just before the application of clipping treatments at each cutting date. The research data were collected throughout the growing season. The ex-

number of tillers per plant were influenced significantly by the main effect of clipping interval ( $P < 0.05$ ) (Table 2).

The Control plants defoliated only once at the end of the growing season produced taller plants (73.80 cm) bearing maximum number of tillers (Table 3). Among the frequently defoliated plants, taller plants having a higher number of tillers were produced with 6 week interval of clipping. The greater values for the 6 week interval when compared to the 3 week interval of clipping was due to the longer vegetative growth period. Lower growth values for the 9 week clipping intervals was because of the fact that the data recorded for this treatment at the end of the growing season was actually recorded 3 weeks after the previous cutting for this treatment.

**Table 2** Probability values for growth characteristics (height, circumference and number of tillers plant<sup>-1</sup>, number of live leaves, nodes, total leaf and internodal lengths tiller<sup>-1</sup>) of buffel grass at the end of the growing season 1986.

Source	Plant height	Plant circum	Plant tillers	Live leaves	Nodes/tiller	Leaf length	Internodal length
Interval	0.0001	0.0871	0.0008	0.1588	0.2609	0.2190	0.0567
Height	0.0001	0.6782	0.6268	0.0375	0.0004	0.0007	0.0001
Int height	0.0687	0.9505	0.6404	0.8855	0.9300	0.8762	0.8340

**Table 3** Least square means of growth parameters (height, circumference and number of tillers plant<sup>-1</sup>, number of live leaves, nodes and total internodal lengths tiller<sup>-1</sup> and the treatment means of the total leaf length per tiller<sup>-1</sup>) of buffel grass at final cutting of 1986.

Treatment	Plant height (cm)	Plant circum* (cm)	Plant tillers (#)	Live leaves (#)	Nodes/tiller (#)	Leaf length (cm)	Internodal length (cm)
<b>Cutting Interval (Week)</b>							
Control	73.80 <sup>a,c*</sup>	45.29	35.17 <sup>a</sup>	1.46	12.50	85.85	23.55 <sup>a</sup>
3	38.78 <sup>c</sup>	34.46	21.28 <sup>b</sup>	1.99	12.07	57.25	17.61 <sup>b</sup>
6	48.13 <sup>b</sup>	39.86	27.44 <sup>ab</sup>	2.67	13.17	81.60	21.11 <sup>ab</sup>
9	44.80 <sup>bc</sup>	37.78	22.72 <sup>b</sup>	1.48	12.24	54.84	20.06 <sup>ab</sup>
<b>Cutting Height (cm)</b>							
Control	90.69 <sup>a</sup>	41.21	26.53	3.02	15.24 <sup>a</sup>	98.73 <sup>a</sup>	35.39 <sup>a</sup>
10	29.26 <sup>c</sup>	41.10	28.94	1.51	11.04 <sup>b</sup>	46.45 <sup>b</sup>	10.36 <sup>c</sup>
20	37.07 <sup>c</sup>	37.28	26.53	1.42	11.99 <sup>b</sup>	62.63 <sup>b</sup>	16.55 <sup>b</sup>
30	48.48 <sup>b</sup>	37.81	24.61	1.64	12.25 <sup>b</sup>	71.71 <sup>ab</sup>	20.02 <sup>b</sup>

\* Circum - circumference.

\*\* mean with different letters in the columns are significantly different at (P &lt; 0.05).

The effect of clipping height averaged across all cutting intervals was significant at 95% level of significance on all growth characteristics except plant circumference and number of tillers per plants (Table 2). Maximum growth values were obtained from the control treatment. Among frequently defoliated plants clipping at high stubble height (30 cm) produced taller plants than the other treatments (Table 3). The limited difference in plant heights between low and medium clipping heights could be due to injurious effect of intensive clipping. The results indicated that clipping even at 20 cm stubble height restricted plant growth. This might be due to the removal of apical meristem at high percentage as explained by Garcia and Rodriguez (1980).

The control treatment resulted in a significantly greater number of nodes per tiller, how-

ever, there was no difference between the other treatments (Table 3). The significantly smaller total internodal length per tiller with the most intensive clipping treatment (10cm stubble height) indicates the injurious effect of intensive clipping. Analysis of variance showed the significant effect of clipping height on number of leaves per tiller but Bonferoni's test of comparison could not distinguish any significant difference among the treatment means. Total leaf length per tillers was significantly greater for control plants but there was non-significant difference between the designated clipping heights.

*Year II (1987)* : The two year study on buffel grass was terminated on Oct. 25, 1987, after recording final data. Except for plant circumference and number of tillers per plant, all growth characteristics showed significant response to cut-

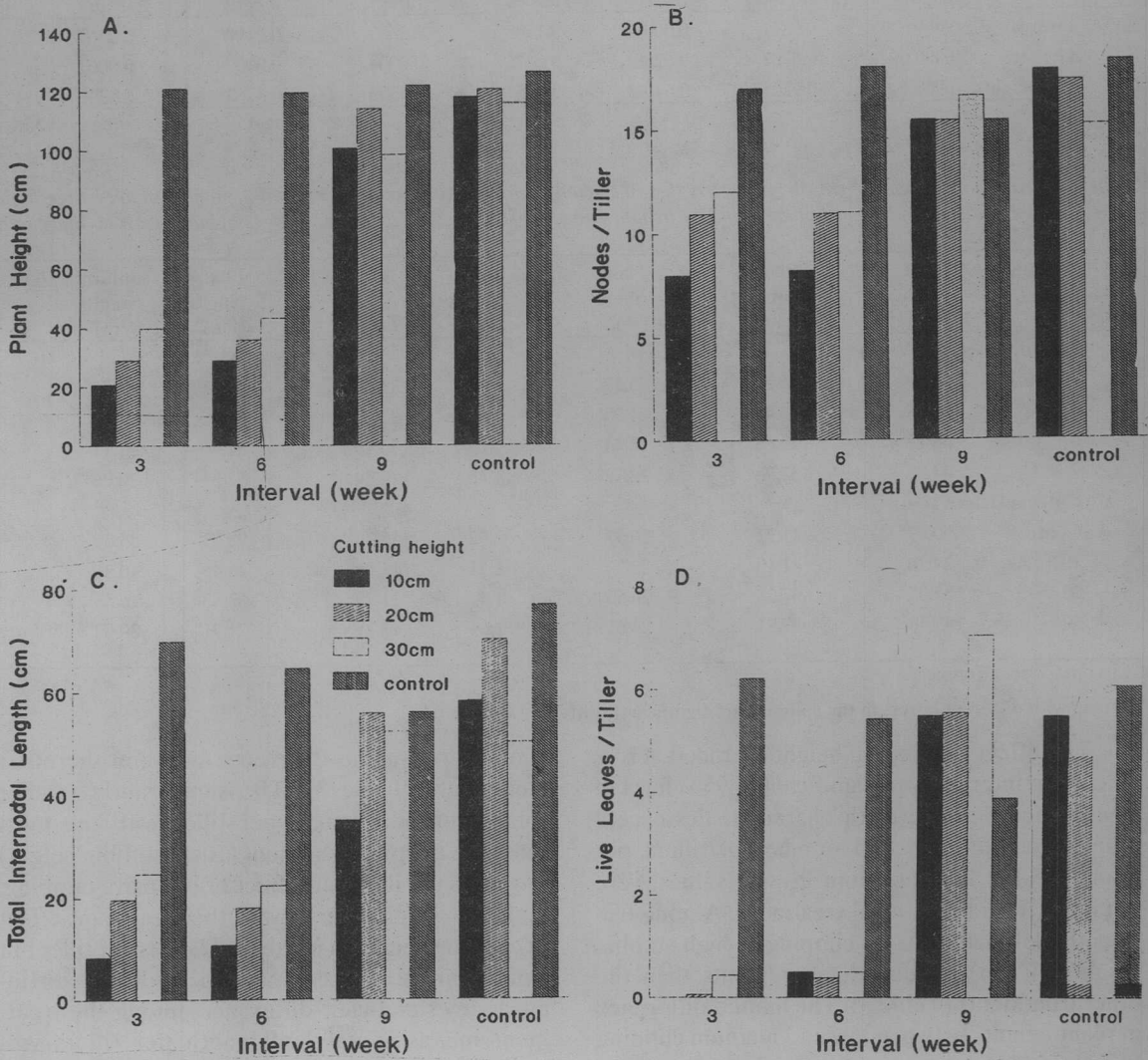


Fig 1 Effect of defoliation on, (A) plant height, (B) number of nodes per tiller, (C) Internodal length, and (D) live leaves per tiller of Buffel grass, (*Cenchrus ciliaris*), at the end of growing season of 1987, defoliated at 3,6 and 9 weeks cutting interval to stubble height of 10,20 and 30 cm.

ting interval, cutting height and their interaction (Table 4).

Harvesting the grass to any stubble height at the end of the growing season produced taller plants than the other treatments (Fig 1A). Among frequently defoliated plants, plant height increased with an increase in the interval between cuttings at all stubble heights but significant differences were observed between clippings after 3 and 9 week intervals at any stubble height. At a particular harvesting interval clipping height did not result in much difference in plant heights.

Number of nodes and the total internodal length per tiller showed similar response to cutting treatments (Fig 1B & C). Control plants produced maximum number of nodes and total internodal length per tiller while, clipping at low stubble height both at 3 and 6 week intervals resulted in a minimum number of nodes and internodal length. The values obtained at 10 cm clipping height for both 3 and 6 week clipping intervals were significantly lower than the control treatment. Similar results were obtained by Brown (1966) and Garcia and Rodriguez (1980).

Greater number of live leaves per tiller were obtained from control treatment than clipping to any stubble height for 3 and 6 week clipping intervals (Fig 1D). The 9 week clipping intervals at any stubble height produced more leaves than the control plants suggesting that the 9 week clipping interval was long enough to allow higher leaf production. Among frequently defoliated plants the difference in the number of live leaves per tiller between various stubble heights at any clipping

interval was not prominent. Significantly greater number of leaves were produced by increasing the interval from 3 to 9 weeks at all stubble heights. The differences in leaf length were not distinguished by Tuckey's test of comparison.

It is concluded from this study that plant growth of buffel grass was affected by clipping interval, clipping height and their interaction. Longer harvesting interval resulted in improved growth. Nine week clipping interval produced comparable growth to control treatments. Maximum number of tillers were produced from clipping the grass at low stubble height but the other growth attributes showed greater values at high stubble height. Clipping at 10 cm stubble height was found too intensive hampering plant growth. The significant interaction between harvesting intervals and cutting height revealed that plant growth of buffel grass was under the influence of both harvesting intervals and cutting heights.

## References

- Asare EO 1970 Effects of fertilization, height and frequency of cutting on herbage yield and nutritive value of *Cenchrus ciliaris* Linn. (buffel grass) in the forest region of Ghana. *Proceeding International Graasland Congress Surfers Paradise, Australia*, P 594
- Brown A Thomas 1966 University of Hawaii. Leaflet 100. Conservation Series
- Garcia R & Rodriguez V 1980 Productividade e características morfológicas do capim-buffel (*Cenchrus ciliaris* L.) CV. Gayndah. *Revista da Sociedade Brasileira de Zootecnia*. 9 329-342

Table 4 Probability values for growth characteristics (height, circumference and number of tillers per plant, number of live leaves, nodes, total leaf and internodal length per tiller) of buffel grass at the end of the growing season 1986.

Source	Plant height	Plant circum	Plant tillers	Live leaves	Nodes /tiller	Leaf length	Internodal length
Interval	0.0001	0.6231	0.4968	0.0001	0.0001	0.0001	0.0001
height	0.0001	0.4524	0.3293	0.0001	0.0001	0.0002	0.0001
Int. height	0.0001	0.7777	0.7334	0.0001	0.0001	0.0435	0.0014

- Government of Pakistan 1976 *Soils and Land Capability*, Pakistan Agriculture. Research Centre, Islamabad P 41
- Jameson DA & Huss DL 1959 The effect of clipping leaves and stems on number of tillers, herbage weights, root weights and food reserves of little bluestem. *Journal of Range Management* **12** 122-126
- Khan CMA 1970 Effects of clipping intensities on forage yield on *Cenchrus ciliaris* (Linn.) in Thal, Pakistan. *Pakistan Journal of forestry* **20** 75-78
- Mohammad N 1987 Pakistan experience in rangeland rehabilitation and improvement. Submitted to food and Agricultural Organization of the United Nations. p 71.
- Paull CJ & Lee GR 1978 Buffel-grass in Queensland. *Queensland Agricultural Journal* **104** 57-74
- Taerum R 1970 A study of root and shoot growth on three grass species in Kenya. *East African Agricultural and Forestry Journal*. **36** 155-170
- Whyte RO, Moir, TRG & Cooper JP 1959 *Grasses in Agriculture* F.A.O. Agricultural study No. 42 Rome, Italy

(Received July 1991, Accepted December 1991)