Chemical Composition, Herbage Yield and Nutritive Value of *Panicum antidotale* and *Pennisetum orientale* for *Nili* Buffaloes at Different Clipping Intervals

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ABSTRACT : This study was carried out to establish clipping interval of *Pennisetum orientale* (PO) and *Panicum antidotale* (PA) to get maximum biomass production with optimal nutritional value for *Nili* buffaloes. Two clipping intervals *i.e.* CI_1, and CI_2 (clipped after every one and two months, respectively) were studied for both grasses. The data on various parameters were compared with PO and PA each clipped at 4 months of age (control). Leaf to stem ratio in both PO and PA declined with increasing clipping interval. Concentration of dry matter (DM) and organic matter (OM) increased ($p<0.05$) whereas crude protein contents decreased with increasing clipping interval in both grasses. Crude protein and dry herbage yields in PO and PA increased ($p<0.05$) with increasing clipping interval. The DM and neutral detergent fiber (NDF) digestibilities of PO and PA in ruminally cannulated buffalo bulls decreased ($p<0.05$) due to more lignification with increasing clipping interval. Ruminal extent of digestion, rate of disappearance of DM and neutral detergent fiber of PO and PA decreased in buffaloes while ruminal lag time of these nutrients increased significantly ($p<0.05$) with increasing clipping interval. The results from the study imply that two month clipping interval for both PO and PA grasses favored higher biomass with greater nutritional value for *Nili* buffaloes and sustained grass vigor. ***(Asian-Aust. J. Anim. Sci. 2006. Vol 19, No. 2 : 176-180)***

Key Words : Re-growth, Interval, Plant Height, Leaf to Stem Ratio, Maturity, Plant Age, Digestibility

INTRODUCTION

Range and grasslands represent major ruminant production areas in the South Asian region (Sarwar et al., 2002; Sarwar et al., 2005). Proper management of range grasses can help shrink the increasing gap between supply and demand of nutrients for ruminants in the region. A common goal of pasture management is to maximize the yield of forage produced and harvested without inducing pasture deterioration and forage quality. Forage production is strongly affected by defoliation regimens (Warner and Sharrow, 1984). Therefore, knowledge of the effect of defoliation frequency on forage yield and its quality is crucial for successful pasture management and for sustainable animal agriculture.

The interval between harvests of grasses profoundly affects herbage production, nutritive value, re-growth potential, botanical composition and species survival (Crowder and Chheda, 1982; Nisa et al., 2005). The period of maximum forage production varied with different grass species (Haggar, 1970). Frequent defoliation reduced total forage yield and carbohydrate reserves and caused a decline in root development, favored weed invasion as well as adversely affected re-growth potential (Perez and Lucas, 1974). More nutritious herbage was obtained with reduced clipping intervals.

In grasses, digestibility depends mainly on the growth stage, growth cycle and the species (Van Soest, 1994; Sarwar et al., 2004). Digestibility of grasses and legumes generally decreased with advancing age, because of increased fiber concentration in plant tissues (Wilson et al., 1991; Khan et al., 2004), increased lignification (Morrison, 1980; Sarwar et al., 2003; Nisa et al., 2004) and reduced leaf to stem ratio (Hides et al., 1983).

Pennisetum orientale (PO) and *Panicum antidotale* (PA) are palatable deep-rooted perennial drought resistant grass species (Gohl, 1981). However, scientific evidence regarding their chemical composition, herbage yield, and nutritive value in buffaloes is limited. This study was, therefore, planned to determine the effects of clipping interval on chemical composition, biomass production, digestibility and digestion kinetics of PO and PA in ruminally cannulated *Nili* buffalo bulls.

MATERIALS AND METHODS

Establishment of grass plots

The experiment was laid out in a Randomized Complete Block Design with four replications at Punjab Forestry Research Institute, Faisalabad, Pakistan. Soil was sandy loam to loam. Nurseries of PO and PA grasses were raised separately through planting tuft splits in 1×3 m plots at 0.3×0.3 m spacing to maintain optimum plant density of 5 to 10 plants/m^2 (Butt and Ahmad, 1994). Two clipping

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Table 1. Influence of clipping interval[1] on leaf to stem ratio, nutrient composition and nutrient yields of *Panicum antidotale*

Parameters	Treatments			SE
	CI_1	CI_2	Control	
Leaf to stem ratio	0.68[a]	0.40[b]	0.26[c]	0.02
DM (%)	21.17[c]	30.01[b]	37.41[a]	1.51
OM (%)	89.21	89.47	92.78	4.49
CP (%)	9.59[a]	7.44[b]	4.52[c]	0.37
CP yield (Tons/ha)	0.33[b]	0.55[a]	0.54[a]	0.02
DM (Tons/ha)	2.88[c]	8.02[b]	11.88[a]	0.42

Means within a row with different superscripts differ significantly ($p<0.05$).
[1] CI_1 and CI_2 stand for monthly and bi-monthly clipping intervals, respectively and the Control stands for harvest at 4 months.
SE is the standard error.

Table 2. Influence of clipping interval[1] on leaf to stem ratio, nutrient composition and nutrient yields of *Pennisetum orientale*

Parameters	Clipping intervals			SE
	CI_1	CI_2	Control	
Leaf to stem ratio	1.33[a]	1.34[a]	0.32[b]	0.05
DM (%)	21.01[b]	25.95[ab]	31.25[a]	1.32
OM (%)	88.19	89.39	90.82	4.47
CP (%)	7.31[a]	7.52[a]	4.47[b]	0.33
CP yield (Tons/ha)	0.10[b]	0.23[a]	0.29[a]	0.01
DM (Tons/ha)	1.49[c]	3.03[b]	6.52[a]	0.21

Means within a row with different superscripts differ significantly ($p<0.05$)
[1] CI_1 and CI_2 stand for monthly and bi-monthly clipping intervals, respectively and the Control stands for harvest at 4 months.
SE is the standard error.

intervals i.e. clipping every month (CI_1) and clipping after every two months (CI_2) were studied for each grass. The grass biomass was manually clipped with sickle at 5 cm stubble height. Leaf to stem ratio, dry matter (DM) and fresh biomass yield were determined at each defoliation date. Data of CI_1 and CI_2 were compared with control (PO and PA harvested at 4 months of age). On each clipping date, leaf to stem ratio was recorded. To determine leaf to stem ratio at each harvest, a sample (about 500 g) was taken from the innermost two rows of each sub-plot cut at a height of 5 cm. Tillers from this non-weed sample were divided into leaf blades and stem plus sheath fractions immediately after removal from the plot. The leaf and stem fractions were dried separately at 55°C to a constant weight. Leaf to stem ratio was calculated from the dry weights (Baron et al., 2000).

Chemical composition

The samples of both grasses were chopped in a locally manufactured chopper and then were ground through a Wiley mill (2 mm screen) and preserved in plastic bags for chemical analysis. These samples were analyzed for DM, crude protein (CP) and total ash by using AOAC (1990) method, neutral detergent fiber (NDF) by method of Van Soest et al. (1991).

In situ trial

Nylon bags measuring 10×23 cm, with an average pore size of 50 µm, were used to determine rate of disappearance, extent of digestion and lag time of DM and NDF *in situ* for PO and PA. Buffalo bulls were fed the same grass as was being incubated in their rumen. This was done to avoid the effects of diet on the ruminal fermentation of the feedstuffs (Nisa et al., 2004). For each time point, 10 g sample, in triplicate was poured into bags. Two bags were used to determine DM and NDF disappearance and the third bag served as a blank. The bags were closed and tied with nylon fishing line. Before incubation in the rumen, the bags were soaked in tap water for 15 minutes to remove the sample particles having less than 50 µm size. The weight loss while soaking was recorded as pre-ruminal incubation disappearance. The bags were incubated in the rumen for 1, 3, 6, 12, 24, 36, 48 and 96 h, in reverse order and were removed all at the same time to reduce variations associated with washing procedure (Sarwar et al., 2004). After removal from the rumen, bags were washed in running tap water until the rinse was clear. The bags were then dried in a forced air oven at 55°C for 48 h. After equilibration, the bags were weighed back and the residues were transferred to 100-ml beakers for NDF analysis. Digestion coefficient of DM and NDF were calculated at 48 h of incubation. Rate of disappearance, lag time and extent of digestion of DM and NDF from all feed samples were determined by the methods described by Sarwar et al. (1991).

Statistical analysis

The data collected for different parameters of grasses were separately statistically analyzed using analysis of variance technique and comparison of means was done by Duncan's multiple range test (Steel and Torrie, 1981). The SAS® (1996) was used for statistical analysis.

RESULTS

During experimental period mean daily minimum temperature ranged from 15 to 31°C while corresponding maximum temperature was 32 to 48°C.

Leaf to stem ratio of PO and PA grasses decreased ($p<0.05$) with increasing clipping interval (Tables 1 and 2). In both PO and PA higher leaf mass was observed with more frequent clipping interval (C_1) than with grass clipped at every two month or at four month age.

Chemical composition and nutrient yields of PO and PA is given in Table 1 and 2, respectively. Concentration of DM increased ($p<0.05$) with increasing clipping interval in PO and PA grasses however, OM contents of both grasses were not affected by clipping interval. The CP concentrations in PO and PA decreased ($p<0.05$) with

Table 3. Influence of clipping interval[1] on nutrient digestibility and digestion kinetics in *Panicum antidotale*

Parameters	Clipping intervals			SE
	CI_1	CI_2	Control	
Dry matter				
Digestibility (%)	52.8[a]	50.4[a]	38.1[b]	2.38
Rate of disappearance (%/h)	4.2[a]	3.6[a]	2.7[b]	0.18
Extent of digestion (%)	65.5[a]	61.0[a]	44.3[b]	2.88
Lag time (h)	0.8[c]	2.4[b]	4.8[a]	0.16
Neutral detergent fiber				
Digestibility (%)	50.2[a]	48.1[a]	36.3[b]	2.26
Rate of disappearance (%/h)	3.80[a]	3.4[a]	2.1[b]	0.16
Extent of digestion (%)	62.0[a]	57.1[a]	42.3[b]	2.72
Lag time (h)	1.20[c]	3.5[b]	5.8[a]	0.20

Means within a row with different superscripts differ significantly ($p<0.05$).

[1] CI_1 and CI_2 stand for monthly and bi-monthly clipping intervals, respectively and the Control stands for harvest at 4 months.

SE is the standard error.

Table 4. Influence of clipping interval[1] on nutrient digestibility and digestion kinetics in *Pennisetum orientale*

Parameters	Clipping intervals			SE
	CI_1	CI_2	Control	
Dry matter				
Digestibility (%)	57.5[a]	44.1[b]	29.6[c]	2.26
Rate of disappearance (%/h)	3.7[a]	3.2[a]	1.7[b]	0.15
Extent of digestion (%)	67.1[a]	58.0[a]	39.9[b]	2.81
Lag time (h)	0.7[c]	1.5[b]	4.5[a]	0.14
Neutral detergent fiber				
Digestibility (%)	55.1[a]	42.8[b]	26.5[c]	2.15
Rate of disappearance (%/h)	3.3[a]	2.6[b]	1.2[c]	0.13
Extent of digestion (%)	62.0[a]	51.1[a]	38.7[b]	2.57
Lag time (h)	0.8[b]	1.5[b]	5.3[a]	0.16

Means within a row with different superscripts differ significantly ($p<0.05$).

[1] CI_1 and CI_2 stand for monthly and bi-monthly clipping intervals, respectively and the Control stands for harvest at 4 months.

SE is the standard error.

increasing clipping interval.

Yields of DM and CP increased ($p<0.05$) with increasing clipping interval in both PO and PA. *Pennisetum orientale* harvested at bimonthly clipping interval yielded 2.0 times, while the control plots of this grass produced 4.4 times more herbage than that of monthly clipping interval. *Panicum antidotal* dry herbage yield indicated that CI_2 and the control yielded 1.4 and 4.1 times more herbage than that of CI_1 clipping interval.

Ruminal DM and NDF digestibilities of PO (Table 3) and PA (Table 4) in buffalo bulls decreased ($p<0.05$) with increasing clipping interval. Ruminal rate of disappearance and extent of digestion of DM and NDF were decreased ($p<0.05$) in both PO and PA grasses in buffalo bulls with increasing clipping interval. However, the ruminal DM and NDF lag time increased ($p<0.05$) with increasing clipping interval in both grasses (Tables 3 and 4).

DISCUSSION

Decline in leaf to stem ratio of PO and PA with increasing clipping interval may be attributed to accumulation of more cell wall components in plant tissues as a result of stem development with advancing maturity. With increasing plant age, the leaf proportion of the old world bluestem grass was declined (Dabo et al., 1988).

Decreasing CP contents of both grasses with increasing clipping interval may be because of reduced leaf to stem ratio (Chaparro and Sollenberger, 1997) or by a dilution effect due to increased DM yield with less frequent grass clipping (Crowder and Chheda, 1982). The results of the present results were consistent with those of Mero and Uden (1998) and Fraser et al. (2001) who attributed decline in CP concentration to higher cell wall contents in more mature grasses. Crowder and Chheda (1982) reported that more frequent clipping stimulated plant development and sustained biological processes, thus there was a greater demand for N. They explained that as plants matured, these activities declined, resulting in low CP concentration in grass species.

Higher herbage yield in PO and PA grasses with longer clipping interval may be attributed to additional tillers and leaf formation (Cuomo et al., 1996), leaf elongation and stem development with increasing plant age (Crowder and Chheda, 1982). These findings were consistent with those of previous researchers (Pittman and Holt, 1983 and Mutz and Drawe, 1983). Low herbage yield at shorter clipping interval in both grasses may be attributed to their reduced photosynthetic area to the extent that photosynthate was not adequately available for re-growth after clipping.

Decreasing digestibility with increasing clipping interval of PO and PA may be due to accumulation of more indigestible fibre, increased lignification and reduced leaf to stem ratio with increasing grass maturity. Less frequently defoliated samples of these grasses might have provided more structural resistance to bacterial attachment from lignification (Sleugh et al., 2001), resulting in lower bacterial colonization and decreased digestibility (Sarwar et al., 2004). Terrill et al. (2003) also reported that *in vitro* DM digestibility of *Pueraria lobata* declined with increasing clipping interval. In the present study, higher DM and NDF digestibilities of both grasses at early clipping interval may be attributed to their shorter ruminal lag time and faster rate of disappearance (Tables 3 and 4) because of less lignification and high proportion of cell soluble material at early maturity.

CONCLUSIONS

In conclusion, the results from the study imply that two month clipping interval for both PO and PA grasses favored higher biomass yield with greater nutritional value for *Nili* buffaloes and sustained grass vigor compared with either of these grasses clipped at every month and/or at four month age.

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