Effect of Season and Fertilizer on Species Composition and Nutritive Value of Native Grasses

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ABSTRACT : Effect of three major cropping seasons and five fertilizer treatments on botanical composition, nutritional composition and *in sacco* digestibility of native grasses grown in 30 experimental plots of a medium fertile land was determined. It was observed that all the major grass species were grown in all seasons but their predominancy of growth was different. During the study the predominant grass species were *Panicum repens* (Angta), *Fimvristylis miliacea* (Joina), *Cyanolis axillaris* (Kanainala), *Cynodon dactylon* (Durba) and *Cyperus iria* (Phulchaise) which contributed about 27, 20, 13, 11 and 9% of the total grass yield, respectively. Dry matter (DM) contents was higher in dry followed by monsoon and summer seasons ($p<0.05$). Crude protein (CP) content in the summer and monsoon appeared to be higher ($p<0.05$) than that of dry season. Organic matter (OM) and neutral detergent fibre (NDF) were higher ($p<0.05$) in dry and monsoon than in summer season. Application of urea fertilizer and cowdung increased 28.2% of CP content of the grasses, but decreased 19.5 and 9.8% of DM and NDF contents, respectively. The potential degradation of DM and CP of the grasses grown in summer were 4.1 and 8.4%, and 3.9 and 5.8% higher than those of monsoon and dry seasons, respectively, and both of these increased (11.3 and 5.9%, respectively) with the application of cowdung and urea fertilizer. (*Asian-Aus. J. Anim. Sci. 1999. Vol. 12, No. 8 : 1222-1227*)

Key Words : Native Grasses, Seasons, N-Fertilizer, Nutrients, *In Sacco* Degradability

INTRODUCTION

Naturally grown grasses, available in fallow land, playgrounds and way sides are the main source of green forage for most of the ruminants of Bangladesh. Most of the farmers are small landholders and landless share-croppers and it is not possible for them to earmark any land exclusively for fodder cultivation. Therefore, any attempt to improve qualitative and quantitative availability of natural pasture has to be based on existing resources for improving forage and livestock productivity.

Though the native grasses are the main source of roughage for feeding ruminants, there is a dearth of information on the nutritional quality of grasses at different times of the year. The nutritive value of the native grasses was reported in some studies (Amin and Alam, 1991; Islam and Alam, 1996), but in the majority of the studies, type of grass species, stage of maturity, method of cultivation and time of harvesting have not been reported which make comparisons difficult. It is assumed that the yield as well as quality of native grasses might be influenced by season (Castellanos et al., 1990; Islam and Alam, 1996). A negative correlation was observed between daily temperature and dry matter digestibility of grasses (Minson and McLeod, 1970). Nitrogen fertilizer has been shown to increase crude protein (CP) content in various high yielding fodders (Akbar et al., 1976; Gargano et al., 1990) and tropical grasses (Minson, 1973; Carver et al., 1975). It was also reported that nitrogen fertilizer increased dry matter digestibility of some tropical grasses by 9% (Skerman and Riveros, 1990), but its effect on native grasses of Bangladesh has been unknown.

The composition of grass species and the effect of N fertilizer on nutritive value of grasses grown at different seasons were studied to obtain information essential for good feeding of livestock in Bangladesh.

MATERIALS AND METHODS

The experiment was conducted in 30 experimental plots (4×4 m^2) of native grassland on a medium high land with medium fertility level (Khan et al., 1996) belonging to the Old Brahmaputra Flood plain Agroecological Zone of the Sonatola series of Bangladesh. Species composition, nutritional composition and *in sacco* digestibility of naturally grown grasslands were determined in three major cropping seasons with different levels of cowdung and urea fertilizer.

Season

On the basis of major cropping seasons, the experimental period was divided into summer (16th March ~ 15th July), monsoon (16th July ~ 15th Nov.) and dry (16th Nov. ~ 16th March) seasons. The climatological observations of different seasons during the experimental period collected from the weather yard of the Bangladesh Agricultural University are given in table 1.

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Table 1. Climatological observations of different seasons during the experimental period

Observation	Season		
	Summer	Monsoon	Dry
Air temperature (℃)			
Max.	31.94	32.02	32.17
Min.	20.67	18.24	9.58
Av.	27.44	26.73	20.74
Humidity (%)	85.16	84.07	73.78
Rainfall (cm)	1.42	0.77	0.30
Sunshine (h)	605.90	684.30	832.10
Pan evaporation (mm)	593.90	439.10	354.80
Soil temperature (℃)	28.90	28.98	22.13

Source: Weather yard, Bangladesh Agricultural University, Mymensingh.

Cowdung and urea

The five cowdung and urea treatments applied in each season were: T_1=control; T_2=cowdung 3000 kg/ha (15 kg N/ha) applied during land preparation; T_3=T_2+urea 21kg/ha, top dressed after first harvest i.e. 25 kg N/ha; T_4=T_2+urea 21 kg/ha, top dressed after first and second harvest i. e. 35 kg N/ha; T_5=urea 42 kg/ha (20 kg N/ha) as basal dose during land preparation. Cowdung and urea contained 0.516% and 46.5% N, respectively.

Collection and preparation of sample

The grasses were harvested three times in each season by cutting approximately 2 cm above the soil. Samples were collected randomly from six different places of 0.5×0.5 m^2 area and dry matter (DM) of the respective samples were determined immediately by drying to constant weight 100℃. Before first harvest the grasses were allowed to grow for 6 weeks and thereafter 4 weeks for the subsequent harvest. Samples of each season were well mixed and subsampled for taxonomical study for identifying the predominant species. The samples were sun-dried, and sub-sampled for grinding through a 40 mesh sieve for chemical analysis. The rest was chopped into 3~5 mm size and used for degradability trial.

Chemical analysis

Chemical analysis of samples were for organic matter (OM), crude protein (CP) and neutral detergent fibre (NDF) according to the methods of Van Soest (1975) and AOAC (1980). All determinations were carried out in duplicate.

In sacco degradability

Rumen degradability of the grasses were determined by taking three grams of chopped sample into nylon bags of 7.5×10 cm size, made of polymide cloth with a pore size of 36 μm and 2400 holes/cm^2 tied to a nylon tube for incubation up to 96 h. Dry matter degradability (DMD) and crude protein degradability (CPD) were determined according to the method described by Bhargava and Ørskov (1987).

Statistical analysis

The data were analyzed statistically using analysis of variance (Steel and Torrie, 1980) for a 3×5 factorial experiment in Completely Randomized Design with six replications. Mean values were compared with Duncan's New Multiple Range test.

RESULTS AND DISCUSSION

Botanical composition

The botanical composition of the grassland plats in different seasons irrespective of fertilizer treatments are presented in table 2. During this experiment the predominant species in summer were *Fimbristylis miliacea* (Joina), *Cyanolis axillaris* (Kanainala), *Cyperus iria* (Phulchaise) and *Panicum repens* (Angta) which constituted 21.2, 20.8, 18.6 and 9.4% of the total grass DM production, respectively. In monsoon the main grasses were *Panicum repens, Fimbristylis miliacea* and *Cynodon dactylon* (Durba) and represented 43.6, 15.4 and 15.4% of DM, respectively. The predominant grass species observed in the dry season were *Panicum repens, fimbristylis miliacea, Cyanolis axillaris, Cynodon dactylon* and *Cyperus iria* in the order of 27.6, 22.0, 15.6, 15.0 and 6.6%, respectively. From table 2 it is observed that the availability of grasses varies at different seasons. *Panicum repens, fimbristylis miliacea, Cyanolis axillaris, Cynodon dactylon* and *Cyperus iria* contributed about 27, 20, 13, 11 and 9% of the total grass DM production, respectively. During the experiment *Echinochola crusgally* (Shama), *Dactyloctenium aegyptium* (Kakpaya) and *Scirpus mucromatus* (Chesra) were completely absent in dry but present in summer and monsoon seasons. *Chenopodium album* (Bathua) was found only in monsoon season. So, it appears that the botanical composition varied between seasons. Langer (1982) reported that agroclimatical conditions directly influence plant growth. This requires detailed investigation on the interactions between climate, soil condition and growth of different grass species.

Nutrient contents of the native grasses

Nutrient contents of grasses grown in different seasons and fertilizer treatments are shown in table 3. The highest DM content was found in the dry season (34.3%) followed by monsoon (30.1%) and summer (16.4%) seasons ($p<0.05$). OM and NDF contents were higher in dry and monsoon than in summer ($p<0.05$).

Table 2. Botanical composition (% on DM basis) of herbage from native grassland plats in different seasons

Name of grasses		Season			
Local name	Scientific name	Summer	Monsoon	Dry	Mean
Angta	*Panicum repens*	9.4±20	43.6±8.3	27.6±6.1	26.9±17.9
Joina	*Fimbristylis miliacea*	21.2± 2.6	15.4±4.0	22.0±5.1	19.5± 3.6
Kanainala	*Cyanolis axillaris*	20.8± 2.6	2.4±1.7	15.6±3.7	12.9± 9.5
Durba	*Cynodon dactylon*	1.4± 1.3	15.4±3.9	15.0±4.2	10.6± 8.0
Phulchaise	*Cyperus iria*	18.6± 2.5	1.4±1.1	6.6±2.4	8.9± 8.8
Shama	*Echinochloa crusgally*	9.8± 5.3	2.1±1.6	-	4.0± 5.2
Bilai langure	*Digitaria sanguinalis*	1.0± 0.4	7.4±2.1	1.4±0.8	3.3± 3.6
Mona	*Panspalum scrobiculatum*	4.6± 1.5	1.6±1.7	2.4±2.1	2.9± 1.6
Kakpaya	*Dactyloctenium aegyptium*	3.6± 1.1	1.8±1.5	-	1.8± 1.8
Haludmutha	*Cyperus rotendus*	2.2± 1.6	1.2±0.6	1.6±1.3	1.7± 0.5
Khudy shama	*Echinocloa colonum*	1.8± 0.4	1.1±0.8	2.0±1.3	1.6± 0.5
Chesra	*Scirpus mucronatus*	2.8± 1.5	1.6±1.2	-	1.5± 1.4
Bathua	*Chenopodium album*	-	1.0±0.4	-	0.3± 0.6
Others		2.8± 0.7	4.0±1.3	5.8±2.6	4.2± 1.8

±Standard deviation of six observations; Summer=March 16~July 15, Monsoon=July 16~Nov. 15, Dry=Nov. 16~March 15.

The CP contents in monsoon and summer seasons were higher (43.6 and 35.5%, respectively) than in the dry season ($p<0.05$). The favourable temperature, humidity and moisture content of soil, luxuriant growth, presence of more young grasses (Chakrabarti et al., 1988) and high water content in grasses during summer and monsoon seasons (Alam, 1993) may have contributed to these differences. Alam (1993) observed a similar trend of higher DM content in the order of winter, spring, autumn, monsoon and summer seasons. Castellanos et al. (1990) reported higher DM and CP contents in winter, while OM and fibre contents were higher in summer. The variable trends of OM, CP and fibre contents may be influenced by the differences in plant growth and its maturity (Chakrabarti et al., 1988). the difference in availability and growth of grass species may be an additional factor influencing nutrient content in different seasons (Rajput et al., 1991).

It was observed that the DM% of native grasses decreased with the increase of urea fertilizer and application of cowdung (table 3), though the differences between T_2 and T_5, and T_5 and T_3 treatments were not significant ($p>0.05$). Variations in DM% among the treatments were highest in dry followed by monsoon and summer seasons. Nitrogen fertilizer did not affect the mean OM% of native grasses.

Application of urea and cowdung increased (28.2%) the CP content of native grasses, though the effect of urea was more than that of cowdung. Similar CP contents were found in T_4 and T_5, T_5 and T_3, and T_3 and T_2 treatments ($p>0.05$). The trend of higher CP content with the use of N fertilizer was also observed in high yielding grasses by Akbar et al. (1976) and Gargano et al. (1990). With tropical pangola grass (*Digitaria decumbens*), a late application of nitrogen fertilizer increased the CP content from 4.1 to 9.9% (Chapman and Kretschmer, 1964). Urea fertilizer in soil produces nitrate (NO_3) which is absorbed by the plant through cation exchanges of their roots and stored in the cell for protein synthesis.

The NDF content of grasses was highest in control treatment ($p<0.05$) and decreased with the application of cowdung and urea fertilizer (T_3 and T_4). Differences in NDF content among the treatments were highest in dry followed by monsoon and summer seasons. This indicates that grasses grown in dry season mature at an early stage and may have higher fibre components which can be slightly controled by the application of cowdung and urea fertilizer (Frame, 1991). It is evident that contents of DM, OM and NDF in grasses grown in dry and monsoon are higher than that in summer season, which can be explained by the higher water content in soil as well as in plant bodies during the summer season. Application of nitrogen fertilizer to native grasses has been shown to increase protein and decrease fibre content.

Degradability of the native grasses

Effect of season and fertilizer treatment on degradability and rate of degradation of DM and CP in the rumen are shown in table 4. It appears that average the degradable portion (b) of DM in summer (58.0%) was similar to dry but higher than that of monsoon season (55.8%). The degradable portion of CP in summer (71.5%) was also higher followed by dry and monsoon seasons (67.7%). Irrespective of fertilizer treatments the potential degradability (a+b) of DM (DMD) and CP (CPD) in summer were 4.1 and

Table 3. Nutrient contents (% on DM basis) of native grasses grown in different seasons and with fertilizer treatments

Parameter	Season	Treatment					Mean	SEM
		T_1	T2	T3	T4	T5		
Dry Matter*	Summer	17.51	16.77	15.84	15.15	16.67	16.39^{c}	0.251
	Monsoon	33.27	30.78	28.19	27.47	30.22	30.05^{b}	0.470
	Dry	38.83	35.61	33.57	29.52	34.19	34.34$_{a}$	0.428
	Mean	29.87^{a}	27.72^{b}	25.96^{c}	24.05^{d}	27.03^{bc}		
	SEM	0.508	0.329	0.339	0.508	0.227		
Organic matter	Summer	85.25	85.34	86.56	86.95	86.09	86.04^{b}	0.316
	Monsoon	88.66	90.34	90.85	90.60	90.71	90.23^{a}	0.326
	Dry	92.58	91.39	90.05	89.34	89.60	90.59^{a}	0.266
	Mean	88.83	89.03	89.15	88.96	88.80		
	SEM	0.165	0.300	0.465	0.320	0.265		
Crude protein	Summer	7.35	8.71	8.80	9.90	9.53	8.86^{a}	0.303
	Monsoon	8.22	9.25	9.21	9.96	10.32	9.39^{a}	0.224
	Dry	5.71	6.08	6.45	7.42	7.04	6.54^{b}	0.146
	Mean	7.09^{d}	8.01^{c}	8.15^{bc}	9.09^{a}	8.96^{ab}		
	SEM	0.194	0.092	0.314	0.385	0.317		
Neutral detergent fiber	Summer	73.03	71.94	73.11	69.15	69.30	71.31^{b}	0.606
	Monsoon	76.29	75.90	69.07	70.88	74.39	73.31^{a}	0.909
	Dry	84.01	76.57	68.57	70.39	75.22	74.95^{a}	0.731
	Mean	77.78^{a}	74.80^{b}	70.25^{c}	70.14^{c}	72.97^{b}		
	SEM	1.120	0.530	0.676	0.676	0.714		

Values with different superscripts within row and column are significantly different ($p<0.05$).

* On fresh basis. T_1 = control; T_2 = cowdung @ 3000 kg/ha was applied during land preparation; T_3 = T_2 + urea @ 21kg/ha, top dressed after first harvest; T_4 = T_2 + urea @ 21 kg/ha, top dressed after first and second harvest; T_5 = urea @ 42 kg/ha as basal dose during land preparation. Description of seasons as in table 2.

8.4%, and 3.9 and 5.8% higher than those of monsoon and dry seasons, respectively. Similarly, content of soluble materials and rate of degradation of the grasses exhibited the same trend in these seasons. Islam and Alam (1996) observed 11% higher potential degradability of native grasses grown in pre-monsoon than in pre-dry season, but Walsh and Birrell (1987) have reported a lower degradability of DM in summer than in monsoon and dry seasons. A negative correlation between day temperature and dry matter digestibility of grasses was found by Minson and McLeod (1970). Variations in temperature, rainfall and solar radiation in these studies are likely to be different from the seasonal variations in the present experiment. The trend for higher degradability of DM and CP observed in summer in this study may be explained by the presence of more young vegetation and a higher proportion of leaves in the forage in monsoon than in dry season. Low degradability in dry season may be due to early maturation of plants which led to higher fibre and lignin contents in these periods (Wilman and Altimimi, 1984; Buxton et al., 1985). The DMD and CPD values found in this study are similar to the *in sacco* degradability values of DM and CP observed by Islam and Alam (1996) in native grasses, Rajput et al. (1991) in Cowpea, Maize, Jower and Napier grass, and Tamminga et al. (1991) in conserved forages. Similar values for *in vivo* digestibility of DM and CP of different grasses were reported by Reid et al. (1987) and Akbar et al. (1976). Thus it appears that our values may indiccate potential digestibility. On average, values of DMD and CPD are 59 and 76%, respectively, at 96 h of incubation. Therefore, grasses grown in these seasons are qualitatively comparable to many other high quality forages (Huq and Saadullah, 1987; Rajput et al., 1991; Singh et al., 1991).

The degradable portion of DM and CP increased after application of cowdung and with increasing urea fertilizer; the DMD and CPD also increased. In the present study, irrespective of seasons DMD in T_4, T_3, T_2 and T_5 were 11.3, 9.2, 5.1 and 3.6% higher than in control (T_1) (58.6%). In the same way CPD in T_4, T_3 and T_2 were 5.9, 4.9 and 1.5% higher than in control (76.1%). The CPD values in T_1 were almost similar to that of T_5. Jung and Fahey (1983) observed an increasing trend of DM and CP degradability with increasing use of N-fertilizer. Higher dry-matter digestibility was also found with nitrogen fertilizer in *Chloris gayana, Digitaria decumbens* and *Pannisetum*

Table 4. Effect of season and fertilizer on percent in DM of soluble materials (a) and degradable portion (b) of the native grasses, rate constant of degradation (c) and potential extend of degradation (a+b) of dry matter (DM) and crude protein (CP)

Parameter	Season	Treatment	a	b	c	a+b	RSD
DM	Summer	T_1	4.62	54.67	0.069	59.48	2.49
		T_2	5.27	55.69	0.062	60.96	2.71
		T_3	5.31	60.86	0.054	66.17	3.15
		T_4	5.17	62.29	0.054	67.46	1.51
		T_5	7.95	56.38	0.047	64.33	1.26
	Monsoon	T_1	5.69	50.32	0.060	55.93	1.85
		T_2	7.27	55.60	0.043	62.87	1.07
		T_3	6.05	57.21	0.055	63.26	0.67
		T_4	3.45	61.55	0.066	65.00	4.38
		T_5	4.40	54.35	0.051	58.75	2.73
	Dry	T_1	3.16	57.17	0.048	60.33	2.82
		T_2	5.05	55.99	0.048	61.04	2.02
		T_3	3.87	58.74	0.048	62.61	2.85
		T_4	5.62	57.52	0.047	63.14	0.97
		T_5	2.88	56.28	0.048	59.16	1.57
CP	Summer	T_1	8.52	65.95	0.037	78.47	2.29
		T_2	8.60	70.40	0.038	79.00	1.99
		T_3	9.34	74.90	0.038	84.24	1.68
		T_4	9.74	75.57	0.040	85.31	1.24
		T_5	9.15	70.70	0.036	79.85	2.01
	Monsoon	T_1	7.62	67.30	0.040	74.95	1.39
		T_2	8.26	67.66	0.039	75.92	1.17
		T_3	7.97	68.47	0.043	76.44	1.65
		T_4	8.22	69.44	0.044	77.66	1.31
		T_5	5.02	65.68	0.051	70.40	3.01
	Dry	T_1	7.57	67.23	0.039	74.80	1.12
		T_2	7.61	68.57	0.041	76.18	1.87
		T_3	8.25	70.44	0.040	78.73	1.88
		T_4	7.62	71.31	0.044	78.93	1.48
		T_5	6.83	69.23	0.044	76.08	0.47

RSD=Residual standard deviation; description of seasons and treatments are as in table 2 and table 3, respectively.

clandestinum (Minson, 1973), and *Cynodon dactylon* (Carver et al., 1975). In some studies with tropical grasses, N-fertilizer increased dry-matter digestibility by 9% (Skerman and Riveros, 1990). In this study, application of up to 35 kg N/ha increased the DMD and CPD of native grasses by 11.3 and 5.9%, respectively.

The rates of degradation of DM and CP have not been tabulated but it was observed that irrespective of season and fertilizer treatment most of the degradability of DM (56%) occured within 48 h of incubation. The degradability of CP was faster and reached 55% within 24 h of incubation. The rate of turn over of these grass species in the rumen may be high.

It is concluded that the naturally grown grass species are of high quality and can be improved by the application of N-fertilizer. The nutritional quality of natural grasses is higher in monsoon and summer and the effect of N fertilizer is greater in the dry season.

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