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Effects of different nitrogen sources on yield, chemical composition and nutritive value of *Dal* grass (*Hymenachne amplexicaulis*)

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Abstract

The effects of different sources of nitrogen on yield, chemical composition and nutritive value of *Dal* grass (*Hymenachne amplexicaulis*) were measured. Control (T_0) had no fertilizer; T_1 was treated with urea - 240 kg N/ha; T_2 with cow manure–25.8 tonnes (t)/ha; T_3 with goat manure-13.2 t/ha; T_4 with rabbit manure-7.6 t/ha and T_5 with poultry manure–5.9 t/ha. All treatments provided the same amount of nitrogen. Experiment was conducted following completely randomized design (CRD) with four replications in each treatment. In the first cutting maximum green forage (33.3 & 31.1), dry matter (7.7 & 7.1) and organic matter (7.1 & 6.5) MT/ha were obtained ($p<0.01$) for the treatments of urea and poultry droppings. In second cutting, poultry manure showed higher value ($p<0.01$) than other treatments for green forage (27.8), dry matter (DM; 5.3), organic matter (OM; 4.9) and crude protein (CP; 0.6). In first cutting, urea showed higher DM (23.0) and EE (2.1) than other nitrogen sources. On the other hand, rabbit manure showed higher nitrogen free extract (NFE) (46.8) than other treatments. For crude fibre (CF) and ash, no significant difference was observed between treatments. In second cutting, poultry manure showed higher DM (19.1) and EE (3.7). In both cuttings, urea gave higher CP (11.2 and 12.1) than other nitrogen sources. CF was not significantly different ($p>0.05$) for second cutting. Control group showed higher (9.9) and NFE (48.2) than other treatments. There was no significant ($p>0.05$) difference in organic matter digestibility and metabolizable energy content of *Dal* grass between treatments. It is suggested that poultry manure may be recommended as a source of nitrogen fertilizer for *Dal* grass production in Bangladesh. (*Bangl. vet*. 2008. Vol. 25, No. 2, 75-81)

Introduction

Most smallholders of Bangladesh produce livestock, which are well integrated into the farming system. Tareque (1992) reported that over 90% of the feed consumed by ruminants are poor quality roughage, particularly rice straw, and the amount available is far below the requirements. Feeding of green forage is important for optimum growth and production. Therefore, cultivation of green fodder is essential to mitigate the chronic shortage of forage.

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Excessive use of chemical fertilizers adversely affects the soil, causing depletion of organic carbon, reducing micro-flora and earthworms, increasing acidity and alkalinity and making the soil harder. Excess fertilizers contaminate water, which harms fish and other fauna. Production of chemical fertilizers also damages the environment. In this situation, the best option lies in the complementary use of bio-fertilizers and/or organic manures in a suitable proportion with fertilizers. This integrated nutrient management ensures higher productivity, and good health of soil and environment. To make organic farming successful, it is essential to use technologies that maintain or increase productivity (RBDC, 2000). The growth, yield and chemical composition of forages are related to soil quality, plant density, fertilizer dose, growing season and stage of maturity (Islam and Kaul, 1986). There is a growing demand to explore the possibility of using organic manures for fodder production. No systematic work has been undertaken on fodder production using manure as fertilizer. The study was undertaken to evaluate the biomass yield, nutrient contents and *in-vitro* organic matter digestibility and metabolizable energy content of *Dal* grass produced under different organic nitrogen fertilizer application.

Materials and Methods

The experiment was carried out in the field of Bangladesh Agricultural University (BAU), Mymensingh. The soil was silt loam, neutral (pH 7.0) and contained 0.1% nitrogen (N), 0.1% phosphorus (P) and 1.8% organic matter (OM). The land was flat, moderately drained and above flood levels. Four different types of manure (cow, goat, rabbit and poultry) were collected from different farms of BAU and were made them free from any bedding material. The manure was dried in the air and crushed. Nitrogen (N) content of each sample is presented in Table 1. *Dal* grass was cultivated under six treatments: T_0 (control), T_1 (urea - 240 kg N/ha), T_2 (cow manure - 25.76 tonnes (t)/ha), T_3 (goat - 13.2 t/ha), T_4 (rabbit - 7.62 t/ha) and T_5 (poultry - 5.90 t/ha) in a randomized design having four replications in each treatment. The dose of nitrogen was 240 kg N/ha for treatments T_1 to T_5. Two-third of total amounts was applied initially, and the remaining one-third at 5 weeks after sowing. A basal dose of triple super phosphate (TSP) 60 kg/ha was applied to all plots. The treatments with replications were assigned randomly. The size of each plot was 3m × 3m. Cuttings (12to 14 cm) of the grass were planted on the same day to each plot maintaining a row and plant spacing of 15 cm. Weeding was done three times during the experiment. Grass was cut at 3-5 cm 60 days after sowing and 46 days later. Fresh biomass yield from each plot and each cutting was recorded. Representative samples of the plants were collected from each plot during harvesting. The samples were chopped and dried in the sun and ground to pass through 40 mm mesh sieve and kept in polythene bags for analysis. At the same time freshly collected samples from each plot were cut into small pieces for determining DM content. The chemical components (DM, CP, EE, ash and NFE) were determined according to the method of AOAC (2000). *In-vitro* organic matter digestibility (IVOMD) and metabolizable energy (ME) contents of forage samples were estimated according to Menke *et al*. (1979 and 1988).

The statistical analysis was done using 'MSTAT' program in a completely Randomized Design (CRD), and differences among the treatment means were determined by the least significant difference method (Gomez and Gomez, 1984).

Table 1. Nitrogen (N) % of different manures

Sources	% Dry matter	% Nitrogen	% Crude protein (DM basis)
Urea	-	44.0	275.0
Cow manure	25.0	0.4	10.3
Goat manure	30.5	0.8	16.4
Rabbit manure	43.3	1.4	20.0
Poultry manure	47.0	1.8	23.8

Results and Discussion

Yields

The yield of grass cultivated with different fertilizers in respect of green forage, DM, OM and CP are shown in Table 2. The source of nitrogen had a significant effect ($p<0.01$) on yield characteristics. The highest green forage yield (33.3 t/ha) was recorded in the first cutting after urea treatment, followed by poultry manure (31.1), rabbit (27.8), goat (26.7), cow (24.4) and control group (22.2), respectively. In second cutting highest yield (27.8 t/ha) was obtained with poultry manure followed by rabbit (23.1), goat (23.1), cow (22.2), urea (21.1) and control group (15.6), respectively. The results are similar to the findings with sorghum (Patel and Patel, 1992) and Chinese cabbage (Sanmaneechai *et al.*, 1992). Poultry manure produced significantly ($p<0.01$) higher green forage yield than cow, goat and rabbit, possibly because of the higher availability of nitrogen. The highest biomass and DM yield were obtained with urea, significantly ($p<0.01$) more than manures except poultry in the first cutting. In the second cutting, poultry manure gave significantly ($p<0.01$) higher biomass, DM and OM yield than other manures and urea. Highest average DM yields in first and second cuttings was 7.7 t/ha in urea and 5.3 in poultry manure, respectively. The lowest yield was 4.4 and 2.4 t/ha in first and second cuttings, respectively, in control group. DM yield was significantly higher ($p<0.01$) with all sources of nitrogen than in control group. Among the organic manures, poultry manure gave significantly ($p<0.01$) higher DM and OM yield, followed by rabbit, goat and cow. Significantly higher DM yield was seen with fermented slurry than chemical fertilizer in successive cuttings of Napier grass (Mikled *et al.*, 1994). Similar results were observed by Halim (1993), who found higher DM yield of Napier grass with organic manure than chemical fertilizer. In the present study the highest CP yield was obtained with urea in the first cutting and with poultry manure in the second. This is an agreement with Patel and Patel (1992) on sorghum forage. Poultry manure was superior in DM, OM, CP and biomass yield than cow, goat and rabbit manure in both cuttings.

Table 2. Mean green forage, DM, CP and OM yields of *Dal* grass after different fertilizers (First and second cutting)

Yields (MT/ha)	Treatments						SED	Significance
	T_0	T_1	T_2	T_3	T_4	T_5		
For first cutting :								
Green forage	22.22^c ±2.03	33.3^a ±1.57	24.4^{bc} ±2.03	26.7^b ±2.4	27.8^b ±3.14	31.1^a ±1.57	1.33	**
DM	4.4^d ±0.41	7.7^a ±0.35	5.1^c ±0.42	5.9^b ±0.53	6.1^b ±0.73	7.1^a ±0.35	0.25	**
OM	3.9^d ±0.37	7.1^a ±0.33	4.6^c ±0.36	5.3^b ±0.49	5.6^b ±0.63	6.5^a 0.33	0.22	**
CP	0.4^d ±0.09	0.9^a ±0.05	0.5^d ±0.05	0.6^c ±0.06	0.6^c ±0.08	0.7^b 0.03	0.03	**
For second cutting :								
Green forage	15.6^c ±2.03	21.1^c ±1.82	22.2^b ±3.27	23.1^b ±2.46	23.3^b ±2.87	27.8^a ±2.03	1.27	**
DM	2.4^d ±0.32	3.5^c ±0.32	3.9^{bc} ±0.54	4.2^b ±0.47	4.3^b ±0.53	5.3^a ±0.39	0.23	**
OM	2.1^d ±0.28	3.2^c ±0.30	3.5^{bc} ±0.50	3.8^{bc} ±0.44	4.0^b ±0.48	0.9^a ±0.38	0.21	**
CP	0.2^c ±0.03	0.4^b ±0.04	0.4^b ±0.06	0.5^b ±0.05	0.5^b ±0.05	0.6^a ±0.04	0.02	**

T_0 = Control (without fertilizer), T_1= Urea (240 kg/ha), T_2 = Cow manure (25.76 MT/ha), T_3 = Goat manure (13.20MT/ha), T_4 = Rabbit manure (7.62MT/ha), T_5 = Poultry manure (5.90MT/ha)
** = Significant p<0.01; NS = Non significant; SED = Standard error differences; abcdef = Mean values with different superscripts differ significantly

DM, CP and OM yields in first cutting were higher than in second cutting for control and treatment groups. Similarly higher yield of German grass in first cutting than in second cutting was reported by Pervin (2004). The increase at second cutting may be due to age of grass, as the first cutting was on 60th day after sowing, while second cutting was 46 days after the first.

Chemical composition

Table 3 shows that DM increased significantly ($p<0.01$) with all fertilizers than control and T_1 was significantly higher than T_2, T_3, T_4 and T_5. Similar results were found for 2nd cutting, but T_5 gave significantly higher DM than T_4, T_3, T_2 and T_1. There was no significant ($p>0.05$) variation between different nitrogen sources in DM, presumably because of soil nitrogen. Urea increases soil nitrogen content very quickly and it is utilized by the plants rapidly. Organic manures gradually increase soil nitrogen. Similar results were found by Gupta and Pradhan (1975). CP was significantly ($p<0.01$) higher with urea than organic manures in both cuttings.

Table 3. Mean chemical composition of *Dal* grass at different sources of nitrogen fertilizer (First and second cutting)

Yields (MT/ha)	Treatments						SED	Significance
	T_0	T_1	T_2	T_3	T_4	T_5		
For first cutting :								
DM (g/100g)	19.9^{e}	23.02^{a}	21.0^{d}	22.0^{c}	22.0^{c}	22.8^{b}	0.04	**
	±0.05	±0.10	±0.07	±0.08	±0.12	±0.03		
CP	8.5^{e}	11.2^{a}	9.1^{d}	9.6^{c}	9.8^{c}	10.3^{b}	0.14	**
	±0.13	±0.16	±0.20	±0.21	±0.39	±0.40		
CF	32.0	34.3	32.6	33.1	33.2	33.9	1.15	NS
	±3.10	±0.12	±0.11	±0.19	±0.22	±0.14		
EE	1.3^{d}	2.1^{a}	1.5^{cd}	1.6^{bc}	1.7^{b}	1.8^{b}	0.07	**
	±0.15	±0.11	±0.07	±0.12	±0.13	±0.12		
Ash	11.9	7.8	10.4	9.6	8.6	8.0	2.36	NS
	±2.26	±1.70	±1.63	±1.66	±2.39	±1.74		
NFE	46.3^{ab}	44.6^{c}	46.4^{ab}	46.2^{ab}	46.8^{a}	46.0^{b}	0.25	**
	±0.54	±0.43	±0.47	±0.22	±0.75	±0.34		
For second cutting :								
DM (g/100g)	15.3^{f}	16.5^{e}	17.4^{d}	18.0^{c}	18.6^{b}	19.1^{a}	0.13	**
	±0.27	±0.35	±0.33	±0.16	±0.16	±0.19		
CP	9.0^{e}	12.1^{a}	10.1^{d}	10.9^{c}	10.6^{c}	11.5^{b}	0.12	**
	±0.24	±0.28	±0.21	±0.14	±0.21	±0.30		
CF	30.1	32.2	30.63	31.13	31.58	32.02	1.1	NS
	±3.40	±0.19	±0.11	±0.17	±0.16	±0.25		
EE	2.9^{d}	3.7^{a}	3.22^{c}	3.59^{ab}	3.34^{bc}	3.74^{a}	0.09	**
	±0.15	±0.17	±0.21	±0.18	±0.17	±0.15		
Ash	9.9^{a}	7.3^{d}	8.74^{b}	8.72^{b}	8.63^{b}	7.67^{c}	0.07	**
	±0.19	±0.14	±0.99	±0.14	±0.13	±0.14		
NFE	48.2^{a}	44.7^{e}	47.36^{b}	45.69^{cd}	45.85^{c}	45.04^{de}	0.24	**
	±0.60	±0.51	±0.42	±0.44	±0.04	±0.57		

Treatments :
T_0 = Control (without fertilizer), T_1= Urea (240 kg/ha), T_2 = Cow manure (25.76 MT/ha), T_3 = Goat manure (13.20MT/ha), T_4 = Rabbit manure (7.62MT/ha), T_5 = Poultry manure (5.90MT/ha)
** = Significant $p<0.01$; NS = Non significant; SED = Standard error differences; abcdef = Mean values with different superscripts differ significantly

This might be due to rapid synthesis of carbohydrates and their conversion to protein and protoplasm leaving smaller portion for cell wall synthesis (Verma and Singh, 1987). Similar results were found by Gransted and Kjellenberg (1997) who observed highest CP content in potatoes and wheat grain with chemical fertilizer. It appears from Table 3 that the CF content was not influenced significantly ($p<0.01$)

with nitrogen from different sources in first and second cuttings. These results are similar to those reported by Milked *et al*. (1994) on Napier grass. EE content in the first cutting, was significantly ($p<0.01$) higher in T_2 (2.1) than with other treatments, but in second cutting T_5 gave significantly ($p<0.01$) higher EE (3.7) than others. Ash content was significantly ($p<0.01$) lower with manures than control. The possible reason may be the amount of nitrogen taken by the plants from the soil. An increase in nitrogen uptake decreases the total ash content of the plants. Organic manures supplied higher available nitrogen in the soil than urea during the later part of the experiment. From Table 3 it was found that in first cutting T_4 and in second cutting T_0 gave significantly ($p<0.01$) higher NFE than other treatments.

In vitro digestibility and energy contents

In vitro IVOMD and ME content of *Dal* grass for both cuttings did not differ insignificantly ($p>0.05$) with different treatments (Table 3). Similar results were reported by Peyraud *et al.* (1997), who conducted an experiment on perennial rye grass with nitrogen fertilizer and obtained no significant effect on IVOMD. The present findings are in agreement with Shahjalal *et al.* (1996) in oats and maize. They found no significant changes in ME with the application of nitrogen fertilizer.

Based on the above findings it may be concluded that organic manures performed better for optimum production and nutritive value of *Dal* grass than chemical fertilizer. Poultry manure performed better than other manures. Therefore, poultry manure may be recommended as a source of nitrogen fertilizer for *Dal* grass production in Bangladesh.

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