Bang. J. Anim. Sci. 2010, 39(1&2) : 83 – 88 ISSN 0003-3588

EFFECT OF NITROGEN FERTILIZER ON YIELD CONTRIBUTING CHARACTER, BIOMASS YIELD AND NUTRITIVE VALUE OF COWPEA FORAGE

M. R. Hasan, M. A. Akbar, Z. H. Khandaker and M. M. Rahman[1]

Abstract

The study was conducted to investigate the effect of nitrogen application on the yield contributing characteristics, biomass yield and nutritive values of cowpea forage. Five nitrogen levels viz: 0 (T_0), 15 (T_1), 20 (T_2), 25 (T_3) and 30 (T_0) kg N/ha were applied in 20 plots in a Completely Randomized Design (CRD). The result showed that the application of nitrogen fertilizer had significant ($P<0.01$) effect on plant height and highest plant height (96.25 cm) was observed at 25 kgN/ha. However, application of nitrogen fertilizer from urea did not show any significant effect on branching of plant. The application of nitrogen fertilizer significantly ($P<0.01$) increased the green, dry and organic matter, and crude protein yield of cowpea forage. No significant difference ($P>0.01$) among the groups for chemical composition of cowpea forage was observed due to increasing rate of N fertilizer. Similarly, N fertilization had no affect on OM digestibility and ME content of cowpea forage. From the results of the present study, it may be concluded that the application of N at the rate of 25 Kg N/ha could be used for cowpea forage production.

Key words: Cowpea, Nitrogen fertilizer, Yield, Chemical composition, Nutritive value

Introduction

Livestock is an important component in our agricultural production system, playing a vital role in the national economy of the country. But livestock production can not satisfying the present domestic demands due to huge feed shortage that is considering an acute problem in livestock production in Bangladesh. This huge feed shortage can be overcome by cultivating some potential forage. Among the forages, legumes are important in supplying the most demanding and quality nutrients like protein, minerals and vitamins to the animals. Leguminous forage can be used as supplement with straw-based diets for ruminants in order to improve digestibility of feed and overall performance of ruminants (Khan *et al.*, 1992 and Akbar *et al.*, 2003). Cowpea (*Vigna unguiculata*), a versatile short duration leguminous plant commonly grown as grain pulse, vegetables and fodder in semiarid and humid tropics (Okigbo and Greenland,1976). It is quick growing and excellent in forage quality. Although leguminous forages e.g. cowpea, can fix nitrogen in plants, at the initial stage of growth it

[1] **Corresponding author:** Md. Mostafizur Rahman, E-mail: md_rahman60@yahoo.com
Department of Animal Nutrition, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

(Received: July 14, 2010)

needs nitrogen fertilizer before formation of nodules in the root system. Therefore, nitrogen fertilizer is also sometimes used as starter dose. Cowpea responds to added nitrogen despite of its capacity to fix nitrogen with *Rhizobium* (Sultana, 2003). Although there are divergent views of nitrogen application to legumes, especially cowpea, results of investigations in the tropics have indicated either no response or significant response to nitrogen fertilizer application (Akinola, 1978). It is also established that crude protein content of forage is increased by increased level of N-fertilizer. Considering the above facts, the present investigation was carried out to study the effect of nitrogen fertilizer on yield contributing characteristics, biomass yield and chemical composition as well as *in vitro* organic matter digestibility (IVOMD) and metabolizable energy contents of cowpea forage (*Vigna unguiculata*).

Materials and Methods

The experiment was conducted in the Department of Animal Nutrition, Bangladesh Agricultural University, Mymensingh. The soil of the experimental site was silt loam texture and contained 0.073% nitrogen (N). The land was flat, moderate drained and above flood levels. The whole land was divided into 20 plots having the size of 16 m^2 (4 × 4 meter). Five nitrogen levels viz: 0 (T_0), 15 (T_1), 20 (T_2), 25 (T_3) and 30 (T_0) kgN/ha were applied randomly in 20 plots in a Completely Randomized Design (CRD) at a seed rate of 80 Kg/ha in line sowing method.

Plant height and branching per plant were measured. Samples of cowpea forage at different fertilizer treatment were collected, dried and ground for further analysis. Collected samples from different treatments were analyzed for chemical composition according to AOAC (1990) method. *In vitro* organic matter digestibility (IVOMD) and ME content of cowpea forage was determined following the method as described by Menke *et al.* (1979). The data generated from the experiment were analyzed using MSTAT statistical program to compute analysis of variance for a Completely Randomized Design (CRD) and differences among the treatment means were determined by the least significant difference test (Steel and Torrie, 1980).

Results and Discussion

Yield contributing characteristics

Plant height and number of branches per plant

Application of nitrogen fertilizer showed significantly ($P<0.01$) higher plant height than that obtained in control group having no fertilizer (Table 1). Among the fertilizer doses, the application of 25 kgN_2/ha (T_3) gave the highest plant height (96.25 cm). No significant effect on branching of plant due to increasing level of N fertilizer. Jatasra and Dahia (1988) stated that fodder yield was positively correlated with leaf weight, stem weight, plant height and number of branching per plant. Sultana *et al.* (2005) also reported the similar results on plant height due to increasing N fertilizer.

Biomass yield

Green matter yield of forage increased with increasing level of nitrogen fertilizer (Table 1) and highest value was observed when urea fertilizer applied at 25 kgN/ha. The increasing yield of green forage of the present experiment is similar to that reported by Kumar *et al.*, (2001) who indicated that the green forage yield increased significantly (P<0.05) with increase level of nitrogen fertilizer. The increasing trend of green forage yield in response to increasing level of N fertilization was also observed by many other workers (Sultana *et al.*, 2005; Khan *et al.*, 1996 and Rajput and Singh, 1996).

It can be seen from the Table 1 that the increasing doses of nitrogen fertilizer resulted in progressive (P<0.01) increase in dry matter (DM) and OM yield of cowpea forage. The present findings were in agreement with the findings of Sultana *et al.* (2005) and Khan *et al.* (1992) who found higher DM and OM yield when extra N fertilizer was applied to the land.

The CP yield increased significantly (P<0.01) with the increasing doses of N fertilizer (Table 1). The increased crude protein yield of cowpea forage was due to application of N fertilizer might be due to increased availability of nitrogen from the soil for synthesis of tissue protein of the plants which have been reflected in the increased growth of plants in the form of plant height and also increased yield of forage. The increased crude protein yield of forage was also reported by Sultana *et al.* (2005) in cowpea forage.

Table 1. Effect of N-fertilizer on yield characteristics and biomass yield of cow pea forage

Parameters	Treatments[#]					SEM	Level of Sig.
	T_0	T_1	T_2	T_3	T_4		
Plant height (cm)	78.38^{c}	79.68^{c}	85.63^{bc}	96.25^{a}	91.15^{ab}	2.57	**
No. of branches per plant	3.98	4.25	4.40	4.58	4.73	0.16	NS
Biomass yield (MT/ha)							
Green forage	33.88^{c}	39.13^{b}	40.63^{b}	42.75^{a}	42.88^{a}	1.64	**
Dry mater	4.71^{c}	5.43^{b}	5.75^{ab}	6.08^{a}	6.09^{a}	0.48	**
Organic mater	4.24^{c}	4.88^{b}	5.18^{ab}	5.47^{a}	5.49^{a}	0.36	**
Crude protein	0.89^{c}	1.07^{b}	1.14^{ab}	1.22^{a}	1.23^{a}	0.06	**

[#] T_0 = No fertilizer, T_1 = 15 kgN_2/ha, T_2 = 20 kgN_2/ha, T_3 = 25 kgN_2/ha, T_4 = 30kgN_2/ha
SEM = Standard error of means; NS = Not-significant; ** = P<0.01
[a,b,c] Mean values with different superscripts differ significantly

Chemical composition

Dry matter content of cowpea forage varied between 13.93 to 14.21% (Table 2) and no significant (P>0.05) differences found among the treatments although there was slightly increase in this parameter due to fertilizer treatment. In case of organic matter content of cowpea forage, the highest value (90.21%) observed in treatment T_4. On the other hand, the

lowest (89.87%) OM content was observed in treatment T_0 and no significant differences among the treatments were noticed.

Crude protein content of the cowpea whole plant ranged from 18.78 to 20.22% and no significant ($P>0.05$) difference among the treatments was observed. However, there was a progressive increase in the protein content of cowpea forage being influenced by the increasing level of nitrogen fertilizer.

There was no significant difference of CF content of cowpea among the treatment means. Similarly, no remarkable changes of CF content of cowpea forage was reported by Khan *et al.* (1992) by using increased levels of N fertilizer. No significant differences were observed among treatment groups for NFE, EE and Ash contents of cowpea forage as using different levels of N-fertilizer. Sultana (2003) observed that crude fibre, ether extract, ash and nitrogen free extract contents were not influenced by the increasing levels of N fertilizer.

In vitro OM digestibility and nutritive value

In vitro organic matter digestibility

In vitro organic matter digestibility of cowpea forage at different levels of N fertilizer application is presented in Table 2. The highest (59.16%) organic matter digestibility was obtained where 30 kgN/ha (T_4) was applied and the lowest value (55.81%) was obtained at 0 kgN/ha (T_0). However, there was no significant ($P<0.05$) effect of nitrogen fertilizer on the *in vitro* OM digestibility of cowpea forage. Sultana (2003) conducted an experiment by applying different doses N fertilizer on cowpea forage production and obtained a non-significant effect on *in vitro* OM digestibility by increasing N-fertilizer from 0 to 45 kg N/ ha. Similarly, Khan *et al.* (1992) did not find any significant increase in the *in vitro* OM digestibility (70.80 and 71.60%) at N-fertilizer application rate of 20, 40, 60 kg/ha on cowpea forage.

Metabolizable energy

Metabolizable energy (ME) content of cowpea forage is presented in Table 2. The values for ME in the present study ranged from 7.34 to 7.86 MJ/kg DM

No significant difference was observed in terms of ME content of cowpea forage due to fertilizer treatment. However, the treatment T_4 (30 kgN/ha) showed the highest value (7.86 MJ/Kg DM) and the lowest value (7.34 MJ/Kg DM) was obtained in treatment T_0 where no fertilizer was applied. The level of N-fertilizer appeared to have no significant effect on ME content of cowpea forage. Sultana (2003) also found no significant effect on nitrogen fertilizer application on ME contents of cowpea. Similar results were also reported by Khan *et al.* (1992) in cowpea forage.

From the present findings it is seen that the plant characteristics (such as: plant height, no. of branches/Plant) were increased with the increasing levels of N fertilizer. The biomass yield of forages was also significantly increased up to fertilizer dose 25 kgN/ha. It may be

concluded that the application of N at the rate of 25 Kg N/ha could be used for cowpea forage production.

Table 2. Effect of N-fertilizer on chemical composition and nutritive value of cowpea forage

Parameters	Treatments[#]					SEM	Level of Sig.
	T_0	T_1	T_2	T_3	T_4		
DM (%) (Fresh)	13.93	13.90	14.15	14.21	14.19	0.42	NS
Chemical composition (on DM basis)							
OM	89.87	89.93	90.15	90.04	90.21	0.16	NS
CP	18.78	19.61	19.74	20.03	20.22	0.44	NS
CF	30.20	30.05	29.88	29.95	29.76	0.50	NS
EE	2.00	2.22	2.01	2.28	2.33	0.15	NS
Ash	10.13	10.07	9.85	9.96	9.79	0.15	NS
NFE	38.89	38.05	38.52	37.78	37.90	0.61	NS
***In vitro* organic matter digestibility (dOM) and metabolizable energy (ME)**							
dOM (%)	56.64	55.81	57.42	56.14	59.16	0.72	NS
ME (MJ/kg DM)	7.34	7.48	7.60	7.40	7.86	0.15	NS

[#] T_0 = No fertilizer, T_1 = 15 kg N_2/ha, T_2 = 20 kg N_2/ha, T_3 = 25 kg N_2/ha, T_4 = 30kg N_2/ha
SEM = Standard error of means; NS = Not-significant

Literature Cited

Akbar, M. A., Islam, M. S. and Bhuiya, M. S. U. 2003. Effect of fodder production in rice field on soil nutrient status and of supplementing fodder with rice straw- based diets of dairy cows for milk production. *Tropical and Sub-tropical Agro ecosystem (Special volume),* 3(1-3): 33-37

Akinola, A. A.1978. Influence of soil organic matter on cowpea: Response to N fertilizer. *American J. Agron.,* 70(1): 25.

AOAC. 1990. Official methods of analysis. 15th Ed. Association of Official Analytical Chemists, Inc., Arlington, Virginia, USA.

Jatasra, D. S. and Dahiya, B. N. 1988. Relative importance of forage yield components in cowpeas under dry land conditions. Indian J. Agric. Res., 22(1): 1-5.

Khan, M. J., Tareque, A. M. M. and Shajalal, M. 1992. Effect of inoculation and nitrogen fertilizer on yield chemical composition, *in vitro* organic matter digestibility and energy content of cowpea (*Vigna unguiculata*) forage. Indian J. Anim. Nutr., 9(3): 177-180.

Khan, M. J., Shajalal, M. and Sarkar, A. R. 1996. Yield, chemical composition and nutritive value of oat (*Avena sativa*) fodder at different levels of nitrogen fertilizer. Bangladesh J. Anim. Sci., 25(1-2): 109-115.

Kumar, A., Jaiswal, R. S., Verma M. L. and Y. P. Joshi. 2001. Effect of nitrogen level and cutting management on yield and qualities of different varieties of oat fodder. Indian J. Anim. Nutr., 18(3): 262-266.

Menke, K. H., Rab, L., Salewaski, A., Steingass, H. D. Fritz. and W.Schnerider. 1979. The estimation of digestibility and metabolizable energy content of ruminant feedstuffs from the gas production when they are incubated with rumen liquor *in vitro*. J. Agric. Sci., 93: 217-222.

Okigbo, B. N. and Greenland, D. J. 1976. Intercropping system in tropical Africa. In: Multiple Cropping, E.D. Stelly and D.M. Kill. A Soc. of Agro. Sper. Publ. Series, 27. Madison, Wisconsin, USA.

Rajput, A. L. and Singh, T. P. 1996. Response of nitrogen and phosphorus with and without rhizobium inoculation. Indian J. Agron. 36 (2): 285-286.

Steel, R.G.D. and J. H. Torrie. 1980. Principals and Procedures of Statistics. MacGraw-Hill Book Company, Inc. New York.

Sultana, M.N. (2003). Effects of Rhizobium inoculum and nitrogen fertilizer on yield and nutrient quality of cowpea (*Vigna unguiculata*) forage at different stages of maturity. M. Sc. (A.H). Thesis, Dept. of Animal Nutrition, Bangladesh Agricultural University, Mymensingh.

Sultana, M. N, Khan, M. J., Khandaker, Z. H. and Uddin, M. M. 2005. Effects of Rhizobium inoculum and nitrogen fertilizer on biomass production of cowpea (*Vigna unguiculata*) forage at different stages of maturity. Bangladesh J. Agri. Univ., 3(2): 249-255.