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Integrated management of green manures and nitrogen fertilizer on the growth of transplant aman rice

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Abstract

A field experiment was conducted at the Agronomy Field laboratory, Bangladesh Agricultural University, Mymensingh to study the effect of integrated management of green manures and nitrogen fertilizer on the growth of transplant aman rice (cv.BRRIdhan32).The experiment comprised of three green manures viz., *Sesbania rostrata, Sesbania aculeata* and *Crotalaria juncea* and 5 nitrogen (N) levels viz., 0, 20, 40, 60 and 80 kg ha^{-1}. Absolute control and recommended dose of nitrogen (i.e., 80 kg N ha^{-1}) and @ 20 t ha^{-1} of well-decomposed cow dung were also included. Growth attributes of transplant aman rice such as plant height, leaf area index (LAI), leaf area duration (LAD), dry matter production and grain yield due to green manures in combination with 40 kg N ha^{-1} were statistically identical to 80 kg N ha^{-1}. On the other hand, cow dung at 20 t ha^{-1} was comparable with sole green manures in these parameters . Growth attributes showed higher values with the incorporation of green manures in combination with higher levels of nitrogen. The growth performance of rice due to using of cow dung at 20 t ha^{-1} varied and it recorded lower values than that of 80 kg N ha^{-1}. Growth attributes of transplant aman rice with green manures *S. rostrata* and *S. aculeata* in combination with nitrogen were at par and *C. juncea* recorded lower values. All green manuring crops in combination with 40 kg N ha^{-1} produced the highest grain yield in transplant aman rice.

Keywords: Green manure, Nitrogen, Cow dung, Transplant aman rice, Growth

Introduction

In Bangladesh intensive cropping and monoculture of modern varieties of rice are responsible for the decrease of soil fertility which causes nutrient deficiency in plants. This undesirable consequence may be overcome by addition of huge amount of organic manure to the soil. The maintenance of soil organic matter around 2.5 to 3.0 per cent is desirable for satisfactory crop production. But the average percentage of soil organic matter in Bangladesh ranges from 0.31-3.56 per cent the highest value (3.56) is only found in a very few soils (Sattar, 1988). Use of cow dung, organic waste, leaves and crop residues as fuel has been depriving the agricultural soils from their replenishment (Hossain *et al.,* 1995). Green manuring which is environmentally friendly may offer a great opportunity since the chemical fertilizers are getting costly day by day. Green manuring represents an alternate source of nutrients to mineral fertilizers as it readily decomposes under tropical condition (Tiessen *et al.,* 1994). Green manuring species such as *Sesbania* and other legumes can fix sufficient amounts of N for optimum rice yield without any inorganic N input (Becker *et al.,* 1990 and Meelu *et al.,* 1992). Green manuring along with nitrogenous fertilizer helps to release nutrient elements slowly during the period of crop growth (Singh *et al.,* 1990). In double cropped irrigated area rice-rice pattern is the predominant cropping pattern. This cropping pattern covers about 60% of the boro rice based areas (BRRI, 1998). After harvest of boro rice, land remains vacant for about 2-3 months. This period could be used for raising green manures without sacrificing main crops. Therefore, the experiment was conducted to study the effect of green manuring in combination with nitrogen fertilizer on the growth attributes and yield of transplant aman rice.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from May to November 1999. The experimental site was a medium high land which belonged to the Old Brahmaputra Flood Plain (AEZ-9). The soil was silty clay having pH 6.26, 1.21% organic matter, 0.059% N, 20 ppm P, 26 ppm K, and 18 ppm S. Experimental treatments consisted of 3 green manure crops viz., *Sesbania rostrata*, *Sesbania aculeata* and *Crotalaria juncea,* 5 levels of N viz., 0, 20, 40, 60 and 80 kg ha^{-1}(recommended dose of N i.e., RDN) ; cow dung at 20 t ha^{-1}, fallow + 0 kg N (absolute control) and fallow + 80 kg N ha^{-1}. There were in total 18 treatments in the experiment as shown in Table 1.The experiment was laid out in a randomized block design with 3 replications. Green manuring crops were sown on 15 May with 50 kg seed ha^{-1}. Green manures were fertilized with 15 kg N, 30 kg P_2O_5 and 15 kg K_2O ha^{-1} at final land preparation. *Sesbania rostrata* seeds were treated with hot water at 75-80^{0}C for 2 minutes and were dried in the air before sowing. Sixty day old green manuring crops were incorporated in the soil. The mean fresh biomass and dry biomass production of 60 day-old *S. rostrata, S. aculeata, C. juncea* were 18.24, 16.06 and 13.57 t ha^{-1} and 4.38, 4.02 and 3.66 t ha^{-1}, respectively. The corresponding N addition through these green manures were 43.79, 24.92, 27.45 kg ha^{-1}, respectively. Thirty five-day-old seedlings of transplant aman rice were transplanted at a spacing of 20 cm x 15 cm after 10 days of incorporation of green manuring crops. The plots were fertilized with 60 kg P_2O_5, 40 kg K_2O and 60 kg gypsum ha^{-1} at final land preparation. Well decomposed cow dung @ 20 t ha^{-1} was mixed in the specific plots at final land preparation. Nitrogen was applied in the form of urea in three equal splits at 20, 35 and 50 days after transplanting (DAT). All the management practices were done in proper time starting from land preparation to crop harvest. Data were recorded on growth attributes and yield of transplant aman rice. Recorded data were analyzed statistically using "Analysis of Variance" technique and mean differences were adjudged with Duncan's Multiple Range Test (Gomez and Gomez, 1984)

Results and Discussion

Soil incorporation of green manuring crops and application of different levels of nitrogen had significant effects on growth attributes of transplant aman rice (Table 1) . The table shows an increasing trend of plant height with higher levels of nitrogen in combination with all green manuring crops. The highest plant height was observed in the treatment combination of *S. rostrata* + 80 kg N ha^{-1} and that of the lowest was observed in fallow plots with no nitrogen . *S. aculeata* and *C. juncea* exhibited similar behaviour in terms of plant height as was found in *S. rostrata*. It was observed that plant height in cow dung alone was comparable to green manures alone . Plant height obtained in 80 kg N ha^{-1} was comparable to green manures + 20 kg N ha^{-1}. This indicates that all the green manures along with 20 kg N ha^{-1} met the entire N recommended to transplant aman rice. Leaf area index increased with the age of the plant upto 67 days after transplanting (DAT) and then declined slowly. This situation might be due to the death of older leaves, mutual shading and leaf abscission. However, an increasing trend of LAI was observed with higher levels of N at all dates of sampling. LAI with cow dung (20 t ha^{-1}) was comparable to green manures alone but 80 kg N ha^{-1} alone was comparable to green manures in combination with 20 kg N ha^{-1}. The highest leaf area duration (LAD) was observed in treatment combination of *S. rostrata* + 80 kg N ha^{-1}. Leaf area durations obtained in 60, 40 and 20 kg N ha^{-1} in combination with *S. rostrata* were at par. *S. aculeata* and *C. juncea* in combination with 80,60 and 40 kg N ha^{-1} behaved in the similar manner as that of *S. rostrata* combined with different doses of nitrogen regarding LAD. Cow dung alone was comparable to green manuring crops alone in LAD.

Table 1. Plant growth attributes of transplant aman rice as influenced by green manuring in combination with different levels of nitrogen and cowdung

Treatments*	Plant height (cm)	Leaf area index (LAI)				Leaf area duration (days)
		37DAT	52DAT	67DAT	82DAT	
1.SR+0 N	106.40abc**	1.82b-f	3.22cde	4.18bcd	2.48def	95.00cde
2.SR+20 N	110.20ab	2.01a-e	3.55a-e	4.52abcd	2.82a-f	104.00abcd
3.SR+40 N	115.00ab	2.16abcd	3.82abcd	4.80abcd	3.08abcd	112.00abc
4.SR+60 N	118.60ab	2.24ab	4.03ab	4.96abc	3.26ab	117.00a
5.SR+80 N	121.00a	2.30a	4.18a	5.08a	3.40a	120.00a
6.SA+0 N	104.60abc	1.77cdef	3.14de	4.06bcde	2.34efg	88.00def
7.SA+20 N	108.00ab	1.96a-e	3.43bcde	4.38abcd	2.27b-f	98.00bcde
8.SA+40 N	114.20ab	2.10a-e	3.68a-e	4.66abcd	2.98abcd	107.00abc
9.SA+60 N	117.40ab	2.19abc	3.86abc	4.86abcd	3.16abc	114.00ab
10.SA+80N	119.20ab	2.26ab	4.06ab	5.00ab	3.30ab	118.00a
11.CJ+0 N	103.40bc	1.68ef	3.04ef	3.88de	2.22fg	84.00ef
12.CJ+20 N	107.40ab	1.86a-e	3.36bcde	4.20bcd	2.58cdef	94.00cde
13.CJ+40 N	112.20ab	2.02a-e	3.62a-e	4.48abcd	2.86a-e	102.00a-e
14.CJ+60 N	116.00ab	2.14abcd	3.80abcd	4.68abcd	3.02abcd	109.00abc
15.CJ+80 N	118.60ab	2.22ab	3.96ab	4.86abcd	3.18abc	115.00ab
16.FW+0 N	91.40c	1.41f	2.47f	3.24e	1.88g	74.00f
17.CD+0 N	105.60abc	1.74def	3.08ef	3.98cde	2.24fg	86.00def
18.FW+80N	113.60a-d	2.04a-e	3.58a-e	4.42abcd	2.90a-e	110.00abc
CV (%)	7.62	8.68	7.92	8.70	8.77	7.30
Levels of significance	0.01	0.01	0.01	0.01	0.01	0.01

*DAT = days after transplanting; SR = *Sesbania rostrata*; SA = *Sesbania aculeata*; CJ = *Crotalaria juncea*; FW = Fallow; CD = Cow dung; N = kg N ha^{-1}

** In a column, figures having similar letter(s) or without letter do not differ significantly whereas figures bearing dissimilar letter(s) differ significantly .

On the other hand, green manuring crops + 20 kg N ha^{-1} were comparable to 80 kg N ha^{-1}. The lowest LAD was found in fallow plots. However, an increasing trend of LAD was observed with higher levels of N irrespective of green manuring crops. This result indicates that higher levels of nitrogen in combination with green manuring crops enhanced vigorous plant growth that lengthened vegetative stage and delayed maturity of grains. Dry matter production of transplant aman rice was significantly influenced by incorporation of green manures, different levels of nitrogen and cow dung (Table 2). Dry matter production showed an increasing trend with the age of the plants and also with the higher levels of nitrogen at all dates of sampling. The highest dry matter was produced with the incorporation of *S. rostrata* + 80 kg N ha^{-1} followed in order by the same species plus 60 kg, 40 kg and 20 kg N ha^{-1}. *S. aculeata* showed almost similar results in terms of dry matter production in combination with different levels of nitrogen. *C. juncea* showed poor performance compared to *Sesbania spp.* The lowest dry matter was produced in absolute control (fallow + 0 kg N ha^{-1}) plots. The amount of dry

matter produced by addition of cowdung alone was comparable to that of sole incorporation of green manuring crops. On the other hand, dry matter produced in 80 kg N ha^{-1} was comparable to that of the green of manuring crops in combination with 20 kg N ha^{-1}. Similar results were reported by Hiremath and Patel(1998).From the results of dry matter production it may be concluded that higher levels of nitrogen stimulated plant growth which was reflected in increased dry matter production. Grain yield of transplant aman rice was significantly influenced by the incorporation of green manure crops in combination with different levels of nitrogen and cowdung. The highest grain yield was obtained in the treatment combination of *S. rostrata* + 40 kg N ha^{-1}. *S. rostrata* in combination with 60 and 80 kg N ha^{-1} behaved in the similar manner as that of *S. rostrata* combined with 40 kg N ha^{-1} regarding grain yield. *S. aculeata* and *C. juncea* exhibited almost similar performance in combination with different levels of nitrogen. The lowest grain yield was obtained in fallow plots.

Table 2. Dry matter production and grain yield of transplant aman rice as influenced by green manuring in combination with different levels of nitrogen and cowdung

Treatments*	Dry matter production (t ha^{-1})					Grain yield (t ha^{-1})
	37DAT	52DAT	67DAT	82DAT	At harvest	
1.SR+0 N	2.32abc**	4.69abc	6.40abcd	7.64 cd	9.66bc	4.24de
2.SR+20 N	2.50ab	4.94abc	6.73abcd	7.96abcd	10.18bc	4.95abc
3.SR+40 N	2.65ab	5.12ab	6.92abc	8.46abcd	10.67abc	5.46a
4.SR+60 N	2.72ab	5.24ab	7.06ab	8.72ab	11.04abc	5.33a
5.SR+80 N	2.80a	5.33a	7.18a	9.02a	12.04a	5.28a
6.SA+0 N	2.24abc	4.48bc	6.23bcd	7.50bcd	9.48bc	4.16de
7.SA+20 N	2.42ab	4.82abc	6.54abcd	7.80bcd	10.00bc	4.77bcd
8.SA+40 N	2.56ab	5.03abc	6.80abcd	8.28abcd	10.46abc	5.18ab
9.SA+60 N	2.68ab	5.16ab	6.96abc	8.51abcd	10.84abc	5.32a
10.SA+80 N	2.74a	5.26ab	7.10a	8.67abc	11.16ab	5.26a
11.CJ+0 N	2.14bc	4.28cd	6.08d	7.34d	9.28e	3.96e
12.CJ+20 N	2.34abc	4.61abc	6.46abcd	7.76bcd	9.80bc	4.58cde
13.CJ+40 N	2.52ab	4.82abc	6.68abcd	7.94abcd	10.26abc	5.14ab
14.CJ+60 N	2.63ab	4.98abc	6.84abcd	8.47abcd	10.68abc	5.22ab
15.CJ+80 N	2.70ab	5.20ab	6.97abc	8.65abc	11.07abc	5.28a
16.FW+0 N	1.73c	3.63d	4.73e	5.56e	6.24d	2.47f
17.CD+0 N	2.22abc	4.46bc	6.20cd	7.47cd	9.34bc	4.21de
18.FW+80N	2.54ab	5.00abc	6.74abcd	8.18abcd	10.36abc	5.06ab
CV (%)	7.21	6.64	7.77	6.48	6.99	6.81
Levels of significance	0.01	0.01	0.05	0.05	0.01	0.01

*DAT = days after transplanting; SR = *Sesbania rostrata*; SA = *Sesbania aculeata*; CJ = *Crotalaria juncea*; FW = Fallow; CD = Cow dung; N = kg N ha^{-1}.

**In a column, figures having similar letter(s) or without letter do not differ significantly whereas figures bearing dissimilar letter(s) differ significantly.

Grain yield obtained in cowdung alone was comparable to that of sole incorporation of green manuring crops. Grain yield produced in 80 kg N ha^{-1} was comparable to green manuring crops in combination with 20 kg N ha^{-1}.

From the study it may be concluded that green manures in combination with the highest levels of nitrogen gave the highest values in respect of growth attributes .On the other hand, all green manuring crops in combination with 40 kg N ha^{-1} produced the highest grain yield and emerged as a promising practice for higher yield in transplant aman rice.

References

Becker, M., Ladha, J. K. and Ottow, J.C.G.1990. Growth and N_2-fixation of two stem nodulating legumes and their effect as green manure on low land rice. Soil Biol. and Biochem. 28(2):1109-1119.

BRRI (Bangladesh Rice Research Institute). 1998. Proc. Ann. Inter. Rev. for 1997. Rice Farming System, Bangladesh Rice Res. Inst., Gazipur. 60p.

Gomez, K.A. and Gomez, A.A.1984. Statistical Procedure for Agricultural Research. 2nd Ed. Intl. Rice Res. Inst., Manila, Philippines, pp. 139-207.

Hiremath, S. M. and Patel, Z. G. 1998 Effect of winter green-manuring and nitrogen application on summer rice. Indian J. Agron. 43 (1) 71-76.

Hossain, S.M.A., Salam. M.U., Alam, A.B.M.M. and Kashem, M.A. 1995. Soil organic matter management. Farm yard manure and organic waste. Paper presented in the workshop on "Cropping Systems Based Fertilizer Management" held on 22-23 January 1995 at BRRI Joydebpur, Gazipur, organized by OFRD, BRRI, in collaboration with DAE and DANIDA.

Meelu, O.P., Morris, R.A., Furoc, R.E.and Dizon, M.A. 1992. Grain yield responses in rice to eight tropical green manures. Trop. Agric. Trinidad 69: 133-136.

Sattar, M. A. 1988 . Fertilizer status of paddy soil of Bangladesh . Proc. Inter. Symp. on Paddy Soil Fertility, Chaingmai. pp.99-119.

Singh, Y., Singh, B., Meelu, O.P. and Maskina, M.S. 1990. Nitrogen equivalence of green manure for wet land rice on coarse textural soils. Intl. Rice Res. Notes . 15 (2): 25.

Tiessen, H. D., Cuevas, E. and Chacon, P. 1994. The role of organic matter in sustaining soil fertility. Nature (London). 37(1): 783-785.