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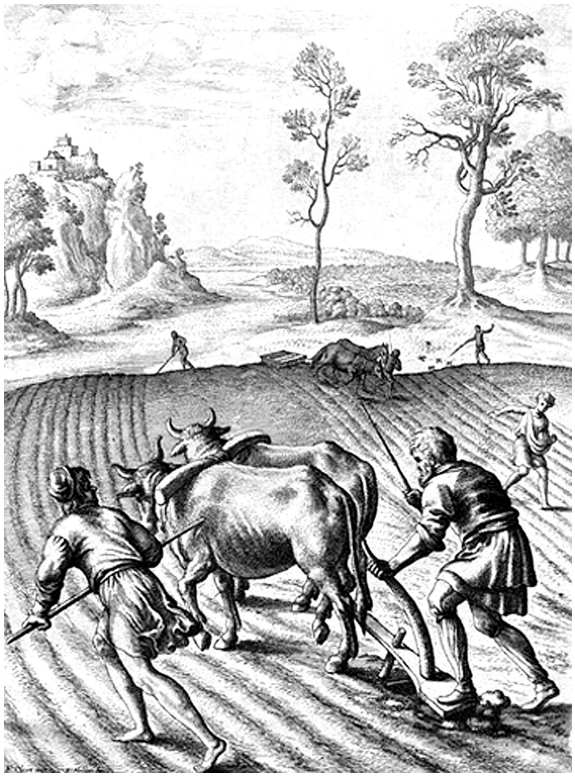

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Effect of Green Manures and Different Levels of Nitrogen on the Yield and Yield Components of Transplant Aman Rice

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Abstract: An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during the period from May to November 1998 to investigate the effect of green manures and different levels of nitrogen on the yield and yield components of transplant aman rice (cv. BRRI Dhan32). The experiment comprised of 3 green manuring crops viz., *Sesbania rostrata, Sesbania aculeata* and *Crotalaria juncea* and 5 levels of N viz., 0, 20, 40, 60 and 80 kg ha^{-1}. Among the green manuring crops *Sesbania rostrata* produced the highest grain yield of transplant aman rice compared to other green manuring crops. The highest grain yield was obtained when the crop was fertilized with 40 kg N ha^{-1} in combination with *Sesbania rostrata. Sesbania aculeata* exhibited similar behaviour as that of *Sesbania rostrata* but *Crotalaria juncea* showed lower performance in respect of yield and yield components of transplant aman rice. *Sesbania rostrata* also showed the best performance in respect of plant height, total number of tillers hill^{-1}, number of effective tillers hill^{-1}, number of grains panicle^{-1}, weight of 1000 grains and straw yield compared to other green manures.

Key words: Green manure, nitrogen, yield, yield components, transplant aman rice

INTRODUCTION

Crop productivity is intimately related with soil fertility. Fertile soil is the fundamental resource for higher crop production, which supplies all of the essential nutrients to the crop. Therefore, maintenance of soil fertility is a pre-requisite for long term sustainable crop productivity. The intensive cultivation as well as monoculture of rice has brought a positive impact on food production in Bangladesh but has resulted in a serious depletion of soil fertility. Organic matter determines the fertility and nutrient status of soil. The maintenance of organic matter around 2.5-3% is desirable for satisfactory crop production. But the average percentage of soil organic matter in Bangladesh ranges from 0.31-3.56%[1,2].The top limit of this range is identified only in few areas. On the other hand, according to Fertilizer Recommendation Guide[3] a good soil should have organic matter content of more than 3%. But in Bangladesh, most soils have less than 1.5 and some soils have less than 1% organic matter. Organic matter can play an important role in improving the fertility and productivity of soil. Green manure helps soil to be fertile but the combined application of green manure and nitrogenous fertilizer increases the yield of rice and the availability of NPK in the soil with increasing the nutrient uptake capacity of rice[4]. Green manuring along with application of nitrogenous fertilizer helps to release nutrient elements slowly during the period of crop growth[5]. Application of green manure plus chemical fertilizers is found to produce significantly higher yield than that of sole application of chemical fertilizer[6]. Inclusion of leguminous green manures in the cropping system was reported to improve the soil conditions for enhanced and sustained rice production during wet season[7]. It has also been reported that green manuring besides its role of supplying plant nutrition, renders the crop more tolerant to diseases and insects, prevents soil erosion[8]. Boro rice-Fallow-Transplant aman rice is the predominant cropping pattern in Bangladesh which covered 60% of the boro rice based cropping pattern[9]. After harvesting 4 of boro rice a large area remains fallow

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for about 2-3 months. This period could be used to raise green manures without sacrificing main crops. Therefore, the present investigation was conducted to study the effect of green manuring on the performance of transplant aman rice.

MATERIALS AND METHODS

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from May to November 1998. The experimental land was medium high in topography under the agro-ecological zone of Old Brahmaputra Floodplain (AEZ-9). The soil was silt loam in texture having pH 5.38 and 1.19% organic matter. The experiment consisted of 3 green manuring crops viz., *Sesbania rostrata, Sesbania aculeata* and *Crotalaria juncea* and 5 levels of N viz., 10, 20, 40, 60 and 80 kg ha^{-1}. The experiment was laid out in randomized complete block design with 3 replications.

Seeds of green manuring crops were sown on 19 May 1998 using seed rates of 50, 40 and 50 kg ha^{-1} for *S. rostrata, S. aculeata* and *C. juncea,* respectively. During land preparation green manures were fertilized with 10 kg N, 20 kg P_2O_5 and 15 kg K_2O ha^{-1} before sowing. Sixty day old green manuring crops were chopped into pieces and incorporated in the soil. The mean fresh biomass and dry biomass production of shoots of 60 day old *S. rostrata, S. aculeata* and *C. juncea* were 18.41, 22.56 and 15.83 t ha^{-1} and 4.57, 5.68 and 4.21 t ha^{-1}, respectively. The corresponding N addition through this green manures were 51.18, 35.22 and 31.57 kg ha^{-1}, respectively. Forty day old seedlings of transplant aman rice were transplanted at a spacing of 20x15 cm after 10 days of soil incorporation of green manuring crops. The plots were fertilized with 60 kg P_2O_5, 40 kg K_2O and 10 kg $ZnSO_4$ ha^{-1} during land preparation. Nitrogen as specified in the treatment was applied in the form of urea in three equal installments at 20, 35 and 50 days after transplanting. All management practices were done in proper time starting from land preparation to crop harvest. Data were recorded on yield and yield components 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[10].

RESULTS AND DISCUSSION

Effect of green manures: Green manuring significantly influenced the yield and yield contributing characters of transplant aman rice except number of grains $panicle^{-1}$ and weight of 1000 grains (Table 1). The highest grain yield was obtained with the incorporation of *Sesbania rostrata* followed by *Sesbania aculeata*. The lowest grain yield was obtained with the incorporation of *Crotalaria juncea* probably due to less amount of biomass added during incorporation. Similar results were reported by Setty and Channabasavanna[11]. The highest plant height, total number of tillers $hill^{-1}$, number of effective tillers $hill^{-1}$ and straw yield were obtained with the incorporation of *S. rostrata. S. aculeata* exhibited similar behaviour as that of *S. rostrata* in terms of aforesaid parameters. The lowest values for these parameters were obtained with the incorporation of *C. juncea.* Numerically the highest number of grains $panicle^{-1}$ and weight of 1000 grains were obtained with the incorporation of *S. rostrata* followed in order by *S. aculeata* and *C. juncea.*

Effect of nitrogen levels: Different levels of nitrogen had significant influence on yield and yield components of transplant aman rice except weight of 1000 grains (Table 2). The highest grain yield was obtained with the application of 40 kg N ha^{-1} followed in order by 80, 20 and 60 kg N ha^{-1}, respectively. The lowest grain yield was obtained when the crop was not fertilized with nitrogen (0 kg N ha^{-1}). However, almost similar grain yields were obtained when the crop was fertilized with 20, 40, 60 and 80 kg N ha^{-1}. Number of grains $panicle^{-1}$ showed increasing trend with the increasing levels of nitrogen. The highest number of grains $panicle^{-1}$ was obtained when the crop was fertilized with 60 kg N ha^{-1}. However, 20, 40 and 80 kg N ha^{-1} exhibited similar behaviour as that of 60 kg N ha^{-1} in this respect. The lowest number of grains $panicle^{-1}$ was produced in the no nitrogen control treatment. Number of effective tillers $hill^{-1}$ behaved in the similar manner as that of number of grains $panicle^{-1}$ (Table 2). Improvement of these yield components ultimately resulted in the improvement of grain yield of transplant aman rice. On the other hand the highest plant height, total number of tillers $hill^{-1}$ and straw yield were obtained when the crop was fertilized with 80 kg N ha^{-1} followed in order by 60, 40 and 20 kg N ha^{-1}. The lowest values for these parameters were obtained when the crop was not fertilized with nitrogen (0 kg N ha^{-1}).It was observed that plant height, total number of tillers $hill^{-1}$ and straw yield showed an increasing trend with higher levels of nitrogen.

Interaction effect of green manures and different levels of nitrogen: Grain yield was significantly affected by the interaction between green manures and different levels of nitrogen (Table 3). The highest grain yield was obtained in the interaction of *S. rostrata*×40 kg N ha^{-1} followed in order by *S. rostrata*×60 kg N ha^{-1}, *S. rostrata*× 80 kg N ha^{-1} and *S. rostrata*×20 kg N ha^{-1}. *S. rostrata* without any addition of nitrogen produced the lowest

Table 1: Yield and yield components of transplant aman rice as influenced by green manures

Green manuring crops	Plant height (cm)	Total number tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of grains panicle^{-1}	Weight of 1000 grains (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Sesbania rostrata	116.07a	10.33a	8.63a	101.34	21.51	5.01a	6.71a
Sesbania aculeata	114.23ab	9.95ab	8.30ab	98.44	21.46	4.82ab	6.28ab
Crotalaria juncea	110.46b	9.62b	8.10b	95.78	21.41	4.59b	6.08b
CV (%)	4.82	8.90	5.52	8.80	1.80	8.82	8.22
Level of significance	0.01	0.05	0.01	NS	NS	0.05	0.01

Table 2: Yield and yield components of transplant aman rice as influenced by different levels of nitrogen

Levels of N (kg ha^{-1})	Plant height (cm)	Total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of grains panicle^{-1}	Weight of 1000 grains (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
0	108.6d	8.83b	7.69c	90.84b	21.25	4.13c	5.53c
20	111.6cd	9.59ab	8.20bc	96.20ab	21.44	4.64abc	6.13bc
40	113.7bc	10.23a	8.65ab	103.33a	21.66	5.18a	6.48ab
60	115.7ab	10.49a	8.46ab	108.80a	21.57	4.07ab	6.70ab
80	118.35a	10.70a	8.70a	100.50a	21.53	4.99ab	6.96a
CV (%)	4.82	8.90	5.52	8.80	1.80	8.82	8.22
Level of significance	0.01	0.01	0.01	0.05	NS	0.01	0.01

Table 3: Yield and yield components of transplant aman rice as influenced by interaction between green manures and different levels of nitrogen

Green manuring crops	Levels of N (kg ha^{-1})	Plant height (cm)	Total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of grains panicle^{-1}	Weight of 1000 grains (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
S. rostrata	0	111.83	9.23	8.04	95.40	21.34	4.45b-e	6.15bc
	20	114.43	9.93	8.56	99.40	21.55	4.88a-d	6.66ab
	40	115.93	10.60	9.03	107.70	21.98	5.51a	6.74ab
	60	117.90	10.82	8.64	103.10	21.70	5.18ab	6.91a
	80	120.30	11.05	8.86	101.10	21.53	5.02abc	7.07a
S. aculeata	0	108.53	8.72	7.64	91.00	21.28	4.15de	5.54c
	20	112.20	9.60	8.18	96.60	21.44	4.74a-d	5.94bcd
	40	114.52	10.32	8.76	104.90	21.60	5.26a	6.35bc
	60	116.70	10.84	8.33	101.70	21.51	5.09ab	6.62ab
	80	119.20	10.63	8.57	190.00	21.47	4.85a-d	6.94a
C. juncea	0	105.40	8.53	7.39	85.79	21.24	3.80e	4.91d
	20	108.27	9.23	7.87	92.80	21.34	4.32cde	5.79cd
	40	110.50	9.78	8.16	97.40	21.41	4.76a-d	6.30bc
	60	112.60	10.16	8.40	100.60	21.49	4.94abc	6.55ab
	80	115.56	10.43	8.68	102.30	21.58	5.12ab	5.86a
CV (%)		4.82	8.90	5.52	8.80	1.80	8.82	8.22
Level of significance		0.01	NS	NS	NS	NS	0.05	0.05

Mean values in a column having the same letter do not differ significantly as per DMRT NS = Not significant

grain yield. *S. aculeata* in combination with different levels of nitrogen gave similar results as that of *S. rostrata*. Similar results were found by Hiremath and Patel[12]. They also reported that nitrogen fertilizer application could be reduced to 50% of the recommended dose due to green manuring. In case of *C. juncea* an increasing trend of grain yield was observed in combination with higher levels of nitrogen. The lowest grain yield was obtained when the crop was green manured with *C. juncea* and not fertilized with nitrogen (Table 3). In general, similar grain yields were observed with the incorporation of all green manuring crops in combination with 40, 60 and 80 kg N ha^{-1}, respectively. The heighest straw yield was obtained in the interaction of S. rostrata×80 kg N ha^{-1}. Similar straw yields were observed in the interaction of *S. aculeata*×80 kg N ha^{-1}, *S. rostrata*×60 kg N ha^{-1} and *C. juncea*×80 kg N ha^{-1}, respectively. The lowest straw yield was obtained in the interaction of *C. juncea*×0 kg N ha^{-1}. Irrespective of all green manuring crops an increasing trend of straw yield was observed with higher levels of nitrogen.

Numerically the highest number of effective tillers hill^{-1} and number of grains panicle^{-1} were obtained in the interaction of *S. rostrata*×40 kg N ha^{-1} and these were at par with the interaction of *S. aculeata*×40 kg N ha^{-1}. The lowest values for the aforesaid parameters were obtained with the interaction of *C. juncea*×0 kg N ha^{-1}. Irrespective of green manuring crops an increasing trend of plant height and total number of tillers hill^{-1} were observed with higher levels of nitrogen. Numerically the highest plant height and total number of tillers hill^{-1} were obtained in the interaction of *S. rostrata*×80 N ha^{-1} and the lowest values for these parameters were obtained in the interaction of *C. juncea*×0 kg N ha^{-1}. It is, therefore, evident that *Sesbania* species supplied relatively more nutrients than *Crotalaria juncea* due to soil incorporation of biomass produced. Grain yield of rice increased with the additional application of N along with soil incorporation of *Crotalaria juncea* but the extent of response was much less than those of *Sesbania rostrata* and *Sesbania aculeata*. It may be concluded that *Sesbania rostrata* appeared as the promising green

manuring crop compared to *Sesbania aculeata* and *Crotalaria juncea* and green manuring with *Sesbania rostrata* in combination with 40 kg N ha^{-1} emerged out as a promising practice for the cultivation of transplant aman rice.

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