Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences 3 (2): 219-222, 2004
ISSN 1682-3974

Effect of Green Manures and Different Levels of Nitrogen on Plant Height, Tillering Behaviour, Dry Matter Production and Yield of Transplant Aman Rice

M.Y.A. Pramanik, [1]M.A.R. Sarkar, [2]M.H. Kabir and G.M. Faruk
Department of Agricultural Extension, Dhaka, Bangladesh
[1]Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[2]Bangla Academy, Dhaka, Bangladesh

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 tillering behaviour, dry matter production and yield of transplant aman rice (cv. BRRI dhan32). The experiment was laid out in a randomized complete block design with three replications. 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}. Dry matter production was increased with the age of the plant and also increasing trend was observed irrespective of green manuring crops in combination with higher levels of nitrogen, but number of tillers hill^{-1} increased up to 67 days after transplantation. The highest dry matter production and the highest number of tillers hill^{-1} were obtained with the incorporation of *S. rostrata* in combination with 80 kg N ha^{-1}. *S. aculeata* also exhibited similar behaviour in these regards. The highest number of effective tillers hill^{-1} and the highest grain yield were obtained with *Sesbania* spp. in combination with 40 kg N ha^{-1} but *C. juncea* showed comparatively poor performance in respect of the aforesaid parameters due to less amount of biomass added during incorporation.

Key words: Green manure, nitrogen, tillering, dry matter, yield, transplant aman rice

INTRODUCTION

Naturally, all soils contain all nutrients but their reserves are not unlimited. These can be depleted due to continuous and intensive cropping, erosion, leaching loss, etc. Rice-rice cropping system emerges as important cropping system in double cropped area of Bangladesh. No doubt this system is highly productive but very exhaustive, hence may not be sustainable in the years to come. Deterioration of soil physical properties and decline in fertility status of soil are often associated with this system. Moreover, use of cow dung, organic waste, leaves and crop residues as fuel has been depriving the agricultural soils from their replenishment[1]. This crucial problem may be solved by addition of huge amount of organic matter from different sources of origin. Green manures can play a vital role for increasing organic matter and nutrient status of Bangladesh soil. It has been shown that organic matter cycling is related to the agricultural potential of soils[2] and green manure production and incorporation represent an alternative source of nutrients to mineral fertilizers as it readily decomposes under tropical conditions. Inclusion of Leguminous green manures in cropping system is known to improve the soil conditions for enhanced and sustained plant growth and production during wet season[3]. Incorporation of green manuring crop to the soil can reduce 50% of recommended N levels of rice[4]. Similar opinion was also given by Halepyati and Sheelavantor[5]. Green manuring crops in combination with nitrogen fertilizer can influence growth parameters of plants to a great extent[6]. Application of green manure plus chemical fertilizers was found to produce significantly higher growth and yield than that of sole application of chemical fertilizer[7]. A large area of land is kept fallow after harvesting boro rice in Bangladesh. Thus introduction of green manuring crop is feasible in the existing cropping pattern (Boro-Fallow-T. aman) without sacrificing main crops. Therefore, the present experiment was conducted to study the effect of green manuring on plant height, tillering, dry matter production and yield 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

Corresponding Author: M.A.R. Sarkar, Professor Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. E-mail: masudbd10@hotmail.com

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.0, 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} and the corresponding addition of N 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 20×15 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, 60 kg gypsum and 10 kg $ZnSo_4$ ha^{-1} during final 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 plant height, tillering, dry matter production 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[8].

RESULTS AND DISCUSSION

Effect of green manuring crops on plant height and tiller production: Soil incorporation of green manuring crops had significant influence on plant height and number of tillers $hill^{-1}$ of transplant aman rice (Table 1). The tallest plant and the highest number of tillers $hill^{-1}$ were obtained with the incorporation of *S. rostrata* followed by *S. aculeata* and that of the lowest was observed with *C. juncea.* It was observed that number of tillers increased and attained the peak at 67 DAT and declined slowly up to harvest.

Effect of levels of nitrogen on plant height and tiller production: Application of different levels of nitrogen had significant influence on plant height and number of tillers $hill^{-1}$ (Table 2). The tallest plant and the highest number of tillers $hill^{-1}$ were obtained when the crop was fertilized with 80 kg N ha^{-1} but the highest number of effective tillers $hill^{-1}$ was obtained when the crop was fertilized with 40 kg N ha^{-1}. However, almost similar plant height and number of tillers $hill^{-1}$ were observed when the crop was fertilized with 40, 60 and 80 kg N ha^{-1}, respectively. Plant height and number of tillers $hill^{-1}$ were the lowest in no nitrogen control treatment.

Interaction between green manuring crops and levels of nitrogen: Interaction between green manuring crops and different levels of nitrogen had no significant influence on plant height and number of tillers $hill^{-1}$ (Table 3). Numerically the highest plant height and the highest number of tillers $hill^{-1}$ were obtained irrespective of green manuring crops in combination with 80 kg N ha^{-1} and that of the lowest were obtained under without nitrogen application. Increasing trend of plant height and number of tillers $hill^{-1}$ were observed in green manuring crops in combination with higher levels of nitrogen. The highest number of effective tillers $hill^{-1}$ was obtained with the treatment combination *S. rostrata*×40 kg N ha^{-1}. Similar performance was found in *S. aculeata* in this regard.

Table 1: Plant height and tiller production of transplant aman as influenced by green manures

		Number of tillers $hill^{-1}$					
Green manuring crops	Plant height (cm)	37 DAT	52 DAT	67 DAT	82 DAT	No. of total tillers $hill^{-1}$ at harvest	No. of effective tillers $hill^{-1}$
Sesbania rostrata	116.07a	7.41a	10.37a	12.48a	11.43a	10.33a	8.36a
Sesbania aculeata	114.23ab	7.06ab	10.15ab	12.02ab	11.07ab	9.95ab	8.30b
Crotalaria juncea	110.46b	6.74b	9.76b	11.71b	10.82b	9.62b	8.10b
CV (%)	4.82	5.40	5.02	5.10	4.82	8.90	5.52
Level of significance	0.01	0.01	0.01	0.01	0.01	0.05	0.01

Table 2: Plant height and tiller production of transplant aman rice as influenced by different levels of nitrogen

		Number of tillers $hill^{-1}$					
Levels of N (kg ha^{-1})	Plant height (cm)	37 DAT	52 DAT	67 DAT	82 DAT	No. of total tillers $hill^{-1}$ at harvest	No. of effective tillers $hill^{-1}$
0	108.6d	6.17c	8.87c	10.70c	9.89c	8.83b	7.69c
20	111.6cd	6.74b	9.88b	11.62b	10.71b	9.59ab	8.20bc
40	113.7bc	7.29a	10.45ab	12.37ab	11.37ab	10.23a	8.70a
60	115.7ab	7.50a	10.58a	12.73a	11.67a	10.49a	8.46ab
80	118.35a	7.66a	10.72a	12.93a	11.90a	10.70a	8.65ab
CV (%)	4.82	5.40	5.02	5.10	4.82	8.90	5.52
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table 3: Plant height and tiller production of transplant aman rice as influenced by the interaction between green manures and different levels of nitrogen

Green manuring crops	Levels of N (kg ha^{-1})	Plant height (cm)	Number of tillers				No. of total tillers hill^{-1} at harvest	No. of effective tillers hill^{-1}
			37 DAT	52 DAT	67 DAT	82 DAT		
Sesbania rostrata	0	111.83	6.60	6.40	11.17	10.37	9.23	8.04
	20	114.43	7.12	10.23	12.07	11.13	9.93	8.56
	40	115.93	7.63	10.67	12.84	11.60	10.60	9.03
	60	117.70	7.78	10.75	13.10	11.88	10.82	8.64
	80	120.30	7.94	10.82	13.23	12.11	11.05	8.86
Sesbania aculeata	0	108.53	6.07	8.93	10.70	9.83	8.72	7.64
	20	112.20	6.70	9.87	11.63	10.68	9.60	8.18
	40	114.52	7.38	10.52	12.33	11.33	10.30	8.76
	60	116.70	7.50	10.65	12.60	11.67	10.48	8.33
	80	119.20	7.65	10.78	12.83	11.87	10.63	8.57
Crotalaria juncea	0	105.40	5.85	8.33	10.23	9.47	8.53	7.39
	20	108.27	6.40	9.55	11.17	10.33	9.23	7.87
	40	110.50	6.85	10.05	11.93	11.13	9.78	8.16
	60	112.60	7.22	10.33	12.48	11.45	10.16	8.40
	80	115.56	7.38	10.57	12.72	11.72	10.43	8.68
CV (%)		4.82	5.40	5.02	5.10	4.82	8.90	5.52
Level of significance		NS	NS	NS	NS	NS	NS	NS

Table 4: Dry matter production and yield of transplant aman as influenced by green manures

Green manuring crops	Dry matter production (t ha^{-1})					Grain yield (t ha^{-1})
	37 DAT	52 DAT	67 DAT	82 DAT	at harvest	
Sesbania rostrata	2.64a	5.30a	7.03a	8.39a	1049.00a	5.01a
Sesbania aculeata	2.51a	4.94ab	6.75ab	8.17ab	10.25ab	4.82ab
Crotalaria juncea	2.30b	4.62b	6.33b	7.74b	4.40b	5.59b
CV (%)	5.99	5.56	7.38	7.00	8.35	8.28
Level of significance	0.01	0.05	0.05	0.05	0.05	0.05

Table 5: Dry matter production and yield of transplant aman rice as influenced by different levels of nitrogen

Levels of N (kg ha^{-1})	Dry matter production (t ha^{-1})					Grain yield (t ha^{-1})
	37 DAT	52 DAT	67 DAT	82 DAT	at harvest	
0	2.10c	4.45c	6.16c	7.45c	9.26c	4.13c
20	2.37b	4.73bc	6.48bc	7.80bc	9.88bc	4.64abc
40	2.53ab	4.73abc	6.74abc	8.16abc	10.31abc	5.18a
60	2.64a	5.13ab	6.95ab	8.32ab	1063.00ab	5.07ab
80	2.78a	5.41a	7.18a	8.67a	11.00a	4.99ab
CV (%)	5.99	5.56	7.38	7.00	8.35	8.28
Level of significance	0.01	0.05	0.05	0.05	0.05	0.01

Table 6: Dry matter production and yield of transplant aman rice as influenced by the interaction between green manures and different levels of nitrogen

Green manuring crops	Levels of N (kg ha^{-1})	Dry matter production (t ha^{-1})					Grain yield (t ha^{-1})
		37 DAT	52 DAT	67 DAT	82 DAT	at harvest	
Sesbania rostrata	0	2.36	4.76	6.43	7.75	9.52	4.45bc
	20	2.53	5.08	6.78	8.09	10.17	4.88ab
	40	2.66	5.34	7.12	8.41	10.61	5.51a
	60	2.77	5.57	7.31	8.68	10.84	5.18ab
	80	2.89	5.73	7.53	8.96	11.24	5.02abc
Sesbania aculeata	0	2.10	4.50	6.30	7.60	9.35	4.15de
	20	2.43	4.76	6.59	7.97	9.86	4.74ad
	40	2.56	4.93	6.76	8.26	10.33	5.26a
	60	2.67	5.13	6.94	8.46	10.66	5.09ab
	80	2.80	5.38	7.17	8.64	11.07	4.85ad
Crotalaria juncea	0	1.89	4.08	5.76	7.00	8.93	3.80e
	20	2.16	4.36	6.07	7.35	9.60	4.32cde
	40	2.36	4.65	6.36	7.80	9.98	4.76ad
	60	2.48	4.88	6.60	8.10	10.34	4.94abc
	80	2.65	5.13	6.86	8.43	10.69	5.12ab
CV (%)		5.99	5.56	7.38	7.00	8.35	8.28
Level of significance		NS	NS	NS	NS	NS	0.05

Mean values in a column having the same letter(s) do not differ significantly

Effect of green manuring crops on dry matter production and yield: Incorporation of green manuring crops had significant influence on dry matter production and grain yield of transplant aman rice (Table 4). Dry matter production increased with the age of plants up to harvest. The highest dry matter was produced with the incorporation of *S. rostrata* at all dates of sampling up to harvest. Almost similar results were observed with *S. aculeata*. The lowest performance was observed with the incorporation of *C. juncea*. The highest grain yield was obtained with the incorporation of *S. rostrata* followed in order by *S. aculeata* and *C. juncea*.

Effect of nitrogen levels on dry matter production and yield: Application of different levels of nitrogen had significant influence on dry matter production and grain yield of transplant aman rice (Table 5). The highest dry matter was produced 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 dry matter was produced at without nitrogen application. However, similar results were observed in respect of dry matter production when the crop was fertilized with 80, 60 and 40 kg N ha^{-1}, respectively. The highest grain yield was obtained when the crop was fertilized with 40 kg N ha^{-1} followed in order by 60, 80 and 20 kg N ha^{-1}. The lowest grain yield was obtained under without nitrogen application treatment. Similar trend was reported by Hiremath and Patel[9].

Interaction between green manuring crops and levels of nitrogen: Dry matter production of transplant aman rice was not significantly influenced by the interaction between green manures and levels of nitrogen (Table 6). Numerically the highest dry matter was produced with the treatment combination of *S. rostrata*×80 kg N ha^{-1} and that of the lowest with *C. juncea*×without nitrogen. Irrespective of green manuring crops an increasing trend of dry matter production was observed with higher levels of nitrogen. The highest grain yield was obtained with the treatment combination of *S. rostrata*×40 kg N ha^{-1}. *S. aculeata* behaved in the similar manner in this regard. *C. juncea* showed the lowest performance in grain yield production probably due to less amount of biomass added during incorporation. From the experiment it is clear that *Sesbania spp.* showed better performance compared to *C. juncea* in respect of growth attributes and yield of transplant aman rice. Similar results were also reported by Setty and Channabasavanna[10].

It may be concluded that green manuring with *Sesbania rostrata* in combination with 40 kg N ha^{-1} appeared as the promising practice to improve the growth and yield of transplant aman rice.

REFERENCES

1. Hossain, S.M.A., M.U. Salam, A.B.M.M. Alam and M.A. Kashem, 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.
2. Tiessen, H.D., E. Cuevas and P. Chacon, 1994. The role of organic matter in sustaining soil fertility. Nature, 371: 783-785.
3. IRRI (International Rice Research Institute), 1988. Proc. Symp. on Sustainable Agric. The role of green manure in rice farming systems, 25-29 May, 1987, Intl. Rice Res. Inst., Manila, Philippines.
4. Singh, B., Y. Singh, M.S. Maskina and O.P. Meelu, 1989. Green manure as N source for flood rice. IRRN., 13: 25-26.
5. Halepyati, A.S. and M.N. Sheelavanator, 1990. *Sesbania rostrata* a new green manure for rice. Indian J. Agron., 35: 279-302.
6. Tiwari, K.N., A.N. Pathak and H. Ram, 1980. Green manuring in combination with fertilizer nitrogen in rice under double cropping system in alluvial soil. J. Indian Soc. Soil Sci., 28: 162-169.
7. Aktar, M.S., M.K. Hasan, R. Adhikery and M.K. Chowdhary, 1993. Integrated management of *Sesbania rostrata* and urea nitrogen in rice under a rice-rice cropping system. Ann. Bangladesh Agric., 3: 109-114.
8. Gomez, K.A. and A.A. Gomez, 1984. Statistical procedure for agricultural research. Intl. Rice Res. Inst., Manila, Philippines, pp: 139-207.
9. Hiremath, S.M. and Z.G. Patel, 1998. Effect of winter green manuring and nitrogen application on summer rice (*Oryza sativa*). Indian J. Agron., 43: 71-76.
10. Setty, R.A. and A.S. Channabasavanna, 1991. Optimum combination of nitrogen and *Sesbania* in rice production. Current Res., 20: 207-209.