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Effect of Manures and Fertilizers on the Growth and Yield of BRRI Dhan 30

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Abstract: An experiment was conducted at the Soil Science Field Laboratory of Bangladesh Agricultural University Farm, Mymensingh during the Aman season of 1999 to evaluate the effect of manures and fertilizers on the growth and yield of BRRI Dhan 30. The experiment was laid out in Randomized Complete Block Design with three replications. There were seven treatments such as T_0 (control), T_1 (N_{100}), T_2 ($N_{100}S_{10}Zn_5$), T_3 (PM_5), T_4 ($PM_{7.5}$), T_5 (PM_{10}) and T_6 (CD_{10}). The results demonstrated that all the treatments had positive effect on the yield components and yields of BRRI Dhan 30. Grain and straw yields of BRRI Dhan 30 were significantly increased due to different treatment and the highest value was recorded with the application of poultry manure at 10 t ha^{-1}. The NPKS content in BRRI Dhan 30 and their uptake were increased due to the application of manures and fertilizers. Analysis of post-harvest soils revealed that organic manure application had a positive influence on organic matter, total N, available P, exchangeable K, available S and CEC of the post-harvest soils.

Key words: Manures, fertilizers, growth, yield, BRRI Dhan 30

Introduction

Bangladesh is an agro-based country where rice (*Oryza sativa* L.) is the staple food covering 68% of the total calorie intake of her people (MOA, 1996). Although the cropping patterns of Bangladesh are mainly rice based but still a chronic problem of food deficiency is existing for a long time mainly because of low yields of rice due to poor fertility status of our soils. The intensive rice cultivation with HYV to meet up the food demands resulting in a marked depletion of nutrients status of soils. Annual depletion of plant nutrients in. the intensively cropped area ranges from 180 to 260 kg ha^{-1} (BARC, 1997). As a result, nutrient supply either from manures or fertilizers is a must but continuous use of chemical fertilizers deteriorates some soil properties and causes nutrient imbalance in soil. Soil organic matter plays an important role in maintaining soil fertility and productivity. Organic matter acts as a reservoir of plant nutrients especially N, P, S and micro-nutrients and prevent leaching of the nutrients. Organic matter content of Bangladesh soils is low and declining day by day. The ever decreasing organic matter content in our soils is causing nutritional imbalance including micro-nutrient deficiency. Cowdung and poultry manure are, good sources of organic matter and may play a vital role in soil fertility improvement as well as in supplying nutrients especially N. S and Zn for crop production. The problem of nutrient deficiencies as well as nutrient mining caused by intensive cropping with high yielding varieties of rice and nutrient imbalance can be minimized by judicious application of nutrients through organic manures or chemical fertilizers. Thus the present study was undertaken to see the effect of manures and fertilizers on the yield and yield contributing characters, nutrient uptake by grain and straw and on post-harvest soil properties under BRRI Dhan 30 rice cultivation.

Materials and Methods

The experiment was conducted at the Soil Science Field Laboratory of Bangladesh Agricultural University, Mymensingh during the amen season of 1999 using BRRI Dhan 30 as the test crop. The land belonged to the Old Brahmaputra Floodplain Agro-ecological zone. The soil was silt loam in texture having pH 6.40, organic matter 2.52%, total N 0.129%, available P 11.60 ppm, exchangeable K 0.10 me/100 g soil, available S 17.60 ppm and CEC 14.20 me/100 g soil. There were seven treatments consisting of T_0-control, T_1-N_{100} (nitrogen at 100 kg ha^{-1}), T_2-($N_{100}S_{10}Zn_5$) (nitrogen at 100 kg ha^{-1} + sulphur at 10 kg ha^{-1} + zinc at 5 kg ha^{-1}). T3 (poultry manure at 5 ton ha^{-1} dry basis), T_4-$PM_{7.5}$ (poultry manure at 7.5 ton ha^{-1}), T^5-PM^{10} (poultry manure at 10 ton ha^{-1}) and T_6-CD (cowdung at 10 ton ha^{-1} dry basis). Phosphorus at 25 kg ha^{-1} from TSP and potassium at 20 kg ha^{-1} from MP were applied as basal dose to all the experimental plots. The experiment was laid out in a randomized complete block design with 3 replications. The unit plot size was 4.0 m × 2.5 m and the total number of plots was 21. The land was adequately prepared by ploughing and laddering. The full dose of cowdung and poultry manure was applied to the plots 7 days before transplanting. Sulphur at 10 kg ha^{-1} from gypsum, zinc at 5 kg ha^{-1} from zinc oxide, phosphorus from TSP at 25 kg ha^{-1} and potassium from MP at 20 kg ha^{-1} were applied one day before transplanting. Nitrogen at 100 kg ha^{-1} was applied in three equal splits. The seedlings of 35 days old were transplanted in the experimental plots on August 7, 1999. The intercultural operations were done as and when necessary. The crop was harvested at maturity on December 3, 1999. Ten hills were randomly selected from each plot at maturity to record the yield contributing characters. The grain and straw yields were recorded plot-wise and were expressed on 14% moisture basis. The N, P, K and S content of grain and straw were determined following Micro-kjeldhal method (Jackson, 1962), Olsen method (Olsen *et al*., 1954), Flame photometer method (Black, 1965) and furbidimetric method, respectively. Nutrient uptake was calculated by multiplying the nutrient content with crop yield. The post-harvest soil sample were analyzed for soil pH (Jackson, 1962). Organic matter content (Page *et al*., 1989), total N (Page *et al*. 1989), available P (Olsen *et al*. 1954), Exchangeable K (Black, 1965), available S ($CaCl_2$ extraction method) and CEC (Black, 1965). The collected data were analyzed following F-test and mean comparison was made by DMRT at $p \leq 5\%$.

Results and Discussion

Yield components: The application of manures and fertilizers showed a positive effect on the yield components studied (Table 1). Plant height, effective tillers $hill^{-1}$, panicle length, grains $panicle^{-1}$ and filled grains $panicle^{-1}$ responded significantly to the treatment. However, their effect was not significant, on 1000-grain weight. The tallest plant (104.70 cm) was found in T_5 which was significantly higher than all other treatments. The effect of other treatments on plant height was identical although the shortest plant (93.00 cm) was found in

Table 1: Effect of manures and fertilizers on the yield cornpon ants of BRRI Dhan 30

Treatment	Plant height (cm)	Effective tillers hill^{-1} (No.)	Panicle length (cm)	Grain panicle^{-1} (No.)	Filled grain panicle^{-1} (No.)	1000-grain weight (g)
T_0	93.0b	7.30c	20.33c	112.00c	100.00c	21.17
T_1	99.33a	8.14bc	23.67b	117.70bc	111.30b	21.53
T_2	101.30a	8.79ab	24.33ab	127.70ab	112.30b	21.97
T_3	103.00a	9.31ab	25.00a	129.70a	115.30ab	22.37
T_4	103.30a	9.50ab	25.33a	130.30a	117.00ab	22.63
T_5	104.70a	9.96a	25.67a	133.70a	120.00a	22.96
T_6	100.00a	9.21ab	24.67ab	129.30a	115.00ab	22.28
LSD (5%)	5.53	1.40	1.34	10.45	6.20	NS

Figure(s) in a column having common letter(s), do not differ significantly at 5% level of significance

Table 2: Effect of manures and fertilizers on the yield of BRRI Dhan 30

Treatment	Grain yield (t ha^{-1})	% increase over control	Straw yield (t ha^{-1})	% increase over control
T_0	3.13d	-	4.87c	-
T_1	3.83c	22.38	5.50b	12.94
T_2	4.00bc	27.80	5.70ab	17.04
T_3	4.27abc	36.42	5.80ab	19.10
T_4	4.40ab	40.58	6.00a	23.20
T_5	4.50a	43.77	6.1 Oa	25.26
T_6	4.20abc	34.19	5.8Oab	19.10
LSD (5%)	0.45	-	0.39	-

Figure(s) in a column having common letter(s) do not differ significantly at 5% level of significance

Table 3: Effect of manures and fertilizers on N,P,K,S, uptake by BRRI Dhan 30

Treatment	N uptake kg (ha^{-1})			P uptake (kg ha^{-1})			K uptake (kg ha^{-1})			S uptake (kg ha^{-1})		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_0	32.81c	24.54c	57.34d	5.71d	3.05d	8.79d	5.79d	47.11d	52.90d	36.4a	3.21c	6.85a
T_1	44.19b	31.12b	75.31c	7.08c	4.21c	11.29c	8.14c	57.60c	65.74c	4.48d	3.87d	8.35d
T_2	47.17ab	33.11ab	80.28bc	7.71 be	4.66b	12.37b	8.34bc	57.68c	66.02c	4.79cd	4.11d	8.90d
T_3	47.31ab	31.90b	79.21 be	7.97abc	4.70b	12.66b	8.94abc	63.80b	72.74b	5.33abc	4.54bc	10.08eb
T_4	49.56ab	33.26ab	82.82ab	8.32ab	4.88ab	13.20ab	9.22ab	66.00ab	75.22ab	5.5Oab	4.75ab	10.25ab
T_5	52.55a	34.89a	87.44a	8.59a	4.99a	13.61a	9.74a	69.78a	79.52a	5.70a	4.99a	10.69a
T_6	46.57b	31.29b	77.86bc	8.13ab	4.80ab	12.93ab	9.24ab	67.37ab	76.61 ab	5.10bc	4.44c	9.54c
LSD (5%)	5.13	2.05	5.87	0.67	0.23	0.68	0.970	4.22	4.23	0.55	0.28	0.63

Table 4: Effect of different treatments on the properties of the post harvest soils

Treatment	pH	Organic matter (%)	Total N (%)	Available P (ppm)	Exchangeable K (me1100 gsoil)	Available S (ppm)	CEC (me/100gsoll)
T_0	6.35	2.50	0.128	10.23	0.113	16.10	14.00
T_1	6.35	2.47	0.126	11.98	0.120	15.60	14.30
T_2	6.32	2.45	0.125	11.69	0.122	18.20	14.50
T_3	6.30	2.55	0.130	14.92	0.124	19.70	15.10
T_4	6.30	2.58	0.132	15.33	0.127	19.80	15.10
T_5	6.27	2.60	0.133	15.39	0.128	20.03	15.80
T_6	6.28	2.58	0.131	12.20	0.125	19.80	15.40
Initial soil status	6.40	2.52	0.129	11.80	0.100	17.60	14.20

T_0 All the treatments produced higher number of effective tillers hill^{-1} over control. The highest number of effective tillers hill^{-1} was recorded in T_5 treatments which was statistically identical with rest of the treatments except T_0 and T_1.

The panicle length (25 cm) as obtained in T_5 which was statistically similar with T_4 (25 cm), T_3 (25 cm) and T_6 (29 cm) and significantly higher than T_1 (23 cm) and T_0 (20 cm). All the treatments produced higher number of grains and filled grains panicle^{-1} in comparison to control. The grains and filled grains panicle^{-1} ranged from 112 and 100 (control) to 133 and 120 (T_5). This indicated that organic manures showed superior beneficial effect in producing grains and filled grains panicle. Similar results were obtained by Azim (1999) and Hoque (1999). The treatment T5 produced the maximum 1000-grain weight of 22.96 g which was at par with all other treatments and the minimum value of 21.17 g was found in control (Table 2).

Yield: The application of manures and fertilizers significantly influenced the grain and straw yields of BRRI Dhan 30. The grain and straw yields ranged from 3.13 to 4.50 t ha^{-1} and 4.87 to 6.10 t ha^{-1}, respectively. It was observed that the PM_{10} treatment produced the highest grain and straw yields which might be due to supply of higher amount of slow release of nutrients from poultry manure. The percent increase of grain and straw yields due to different treatment ranges from 22.36 to 43.77 and 12.94 to 25.26. The results indicate that BARI Dhan 30 responded better to the nutrients supplied from organic manures rather than from chemical fertilizers. Poultry manure was found more effective in producing grain and straw yields of BARI Dhan 30 as compared to the cowdung and chemical fertilizers. Sulphur and zinc application in combination with nitrogen also exerted positive effect on grain and straw yields of BARI Dhan 30. Ahmed and Rahman (1991) reported that the application of organic matter and chemical fertilizer increased grain and straw yields of rice. Similar results were obtained by Khan (1998).

NPKS uptake: Nitrogen, phosphorus, potassium and sulphur uptake by BRRI Dhan 30 grain and straw were significantly influenced due to the addition of manures and fertilizers

(Table 3). N uptake by grain and straw as well as total uptake was maximum in the treatment T_5 which was significantly different from T_0 N uptake by grain was higher than that by straw. The total N uptake ranged from 57.34 to 87.44 kg ha^{-1} and the treatment ranked in the order of $T_5 > T_4 > T_2 > T_3 > T_1 > T_0$. The P uptake differed significantly both in grain and straw. The treatment T5 resulted the maximum P uptake both in grain and straw and the minimum value was recorded in the T_0 Total P uptake also varied in similar way. The highest K uptake by grain and straw as well as total uptake by BRRI Dhan 30 was recorded with the treatment T_5 and the lowest value was found in the T_o S uptake by grain and straw was maximum in the treatment T_5 and minimum value was recorded in the treatment T_0 The total S uptake ranged from 6.85 to 10.69 kg ha^{-1}. The results indicated that the influence of poultry manure was pronounced in increasing the NPKS uptake by BRRI Dhan 30. Azim (1999) and Hoque (1999) recorded higher uptake of NPKS with the application of manures and fertilizers either alone or in combination.

Post harvest soil properties: Table 3 reveals that the effect of manures and fertilizer influenced the properties of the post harvest soils. The pH of the post harvest soils tended to decrease slightly which might be due to an increase in organic matter content of post harvest soils that probably released organic acids through decomposition. The organic matter content of the post harvest soils varied from 2.45 to 2.60%. The treatment T_5 caused the maximum increase in organic matter content of the post harvest soils and the lowest value was found in T_0. It was observed that organic matter content tended to increase in the soils treated with organic manures while the soils treated with chemical fertilizer caused a decreasing effect. A slight increase in total N content was noted in all the soils treated with poultry manure and cowdung while the treatment T_o, T_1 and 12 showed a slight decrease in N value as compared to the initial value. it might be due to the presence of N in cowdung and poultry manure and their residual effect. Available P ranged from 10.23 to 15.39 ppm in different treatments. The available P content of initial soil was 11.60 ppm. Organic manuring slightly increased exchangeable K and available S of the post harvest soils whereas a decreasing trend was noted with application of chemical fertilizers. A little increased value of CEC due to all the treatments was observed except for control. From the above study it may be concluded that S and Zn fertilization is essential in addition to NPK for profitable rice cultivation in the BAU Farm soil. BRRI Dhan 30 responded better to S and Zn supplied from organic mamures rather than fertilizers. The performance of poultry manure was better than that of cowdung and fertilizers in providing plants with S and Zn for the growth and yield of rice. Organic manuring also exerted some beneficial effects on soil properties and thus improved soil health. Profitable and successful rice cultivation in Sonatala silt loam soil can be done through the application of poultry manure/cowdung alone or in combination with NPKSZn fertilizers (Table 4).

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