STUDIES OF NITROGEN AND POULTRY MANURE ON THE GROWTH AND YIELD OF BORO RICE (BRRI DHAN28).

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ABSTRACT

An experiment was conducted at the research field in Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, during the boro season of 2017 to evaluate the combine effect of poultry manure (PM) and urea-N on the growth and yield of BRRI dhan28 (Oryza sativa L.). The experiment was laid out in a Randomized Complete Block Design (RCBD) with six treatments and four replications. Total amount of P, K and S fertilizers were applied as basal dose @ 90, 120 and 45 kg/ha, respectively during final land preparation but N from urea (300 kg/ha) was applied as per treatments in there equal splits. Application of PM and urea-N significantly influenced the growth and yield contributing characters of BRRI dhan28 with the savings of urea. The results of the study also indicated that most of the yield and yield contributing characters such as number of effectives tillers per hill (16.73), panicle length (23.98 cm), 1000 grains weight (26.04 gm), grain yield (5.40 t/ha) and straw yield (6.44 t/ha) were the maximum in treatment T_3 (urea-N @ 75 kg/ha + PM @ 6 t/ha). The overall results indicate that application of N fertilizer in T_3 as urea @ 75 kg/ha in combination with 6 t/ha PM can reduce the use of N fertilizer at a substantial level which ultimately reduces the cost of production and in terms of yield and nutrient content in soil in this region. The findings of the study suggest that integrated use of PM and N fertilizer is an important for sustainable production of rice.

Keyword: *Growth, Nitrogen, Poultry manure, Yield*.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is a vital food material for more than half of the world's population. Among cereals rice is more nutritious and about 40% of world population consumes it as a major source of calorie (Banik, 1999). About 77.07% of cropped area of Bangladesh is used for rice production, with annual production of 33.83 million ton from 11.41 million ha of land, which contribute about 19.60% of the country's GDP (BBS, 2013). But rice production area is decreasing day by day due to high population pressure. Therefore, attempts should be taken to increase the yield per unit area. For vertical expansion, the use of modern production technologies should be included, among which high yielding varieties and fertilizer management are remarkable ones. Achieving self-sufficiency in food production and sustaining this in the face of the increasing population pressure continues to be a major goal of agriculturists in Bangladesh. Cropping area of Bangladesh is not possible to increase due to limitation of land source therefore increase in production per unit area is the only way to increase food production. Although about 6.03 m ha of land are used for rice cultivation but the total production was 19.41 million metric tons during 1998-1999 (BBS, 2000).

Nitrogen is one of the most yield-limiting nutrients in rice production around the world, especially in tropical Asian soils and almost every farmer has to apply N fertilizer to get a desirable yield of rice (Saleque *et al.*, 2004). Nitrogen plays a key role in supporting plant activity and increasing the rice yield (Behera, 1998). Nitrogen is the most deficient nutrient element in Bangladesh soils. The efficient N management can increase crop yield and reduce production cost. The farmers mainly use urea as N fertilizer which accounts for about 75% of the total fertilizers used in Bangladesh (Bhuiya, 1991). Continuous uses of inorganic fertilizer deteriorates soil properties, accelerates the depletion of soil organic matter, causes a nutrient imbalance of soil including micronutrient deficiency and reduce the fertility and residual effects remain for long days. Application of inorganic fertilizer has always been expensive inputs for crop production, especially for developing country like Bangladesh. On the other hand if considering organic fertilizers, they have no harmful effect. So, use of poultry is beneficial. Because, poultry manure contains appreciable amounts of nitrogen, calcium, magnesium, chlorine, sodium, manganese, iron, copper, molybdenum and arsenic (Kelleher *et al., 2002).* Poultry manure (PM) may play a vital role in soil fertility and productivity improvement thereby reducing the use of chemical fertilizers and environmental pollution. It is considered a relatively inexpensive source of macro- and micronutrients and its application rates are usually determined in terms of the N, P, and/ or K provided (Sistani *et al.,*

2004). It is used as a soil amendment to add nutrients and organic matter, thereby increasing soil fertility. Poultry manure is also used as organic source of soil nutrient. Meelu and Singh (1991) showed that 4 t/ha PM along with 60 kg N/ha as urea produce grain yield of crop similar to that with 120 kg N/ha as urea alone. So, to obtain the higher yield without affecting soil fertility it is necessary to use chemical fertilizer and manure in an integrated way. Thus, it is necessary to carry out studies by using fertilizers and manures in an integrated way in order to determine the effect of nitrogen and poultry manure on the growth and yield of boro rice and to find the best integrate dose of nitrogen and poultry manure on boro rice production.

2. RELATED WORKS

Yoseftabar (2013) reported that N fertilizer is a major essential plant nutrient and key input for in increasing crop yield. The results showed that panicle number, panicle length, panicle dry matter, number of primary branches, total grain and grain yield increased significantly with nitrogen fertilizer. Application 300 kg N/ha observed high rate of this parameter. Mahavishnan *et al.* (2004) conducted a field experiment during the Kharif season of 2000 in Andhra Pradesh, India to investigate the effects of organic fertilizer sources on the growth and yield of rice cv. BPT-5204. The experiment included N: P: K at 75, 100 and 125% of the recommended rate (RDF, 120: 60: 40 kg/ha), combine with farmyard manure (FYM) at 10 t/ha; poultry manure at 5 t/ha and glyricidia (*Gliricidia* sp.) at 10 t/ha, alone with control and fertilizer application based on test crop response (N: P: K at 104: 52: 74 kg/ha). The crop growth and yield were higher with 125% RDF + poultry manure and 100% RDF + poultry manure compared to other treatments. Rajni Rani *et al.* (2001) conducted a pot experiment in a glasshouse of Varanasi, Uttar Pradesh, India during kharif season to assess the response of rice to different combinations of vermicompost (VC), poultry manure (PM) and nitrogen (N) fertilizers. Results showed that all integrated treatments significantly increased plant height, number of effective panicles per pot and dry weight per panicle over the treatment having full N dose through urea. Nahar *et al.* (1996) conducted a field experiment to compare organic and inorganic fertilizers. They reported that grain yield of rice increased markedly due to application of organic fertilizer. They showed that the highest yield (4.37 t ha^{-1}) was obtained in organic fertilized plots.

3. METHODOLOGY

The experiment was conducted at the Hajee Mohammad Danesh Science and Technology University Farm, Dinajpur, Bangladesh during February to May of 2017. The treatments included T_1 (Control), T_2 (Urea-N @ 0 kg/ha + PM @ 8 t/ha), T_3 (Urea-N @ 75 kg/ha + PM @ 6 t/ha), T_4 (Urea-N @ 150 kg/ha + PM @ 4 t/ha), T_5 (Urea-N @ 225 kg/ha + PM @ 2 t/ha), T_6 (Urea-N @ 300 kg/ha + PM @ 0 t/ha). The experiment was laid out in a Randomized Complete Block Design (RCBD) with six treatments and four replications. The size of unit plot was 5.0 m^2 (2.5 m × 2.0 m) while block to block and plot to plot distances were 2.0 m and 1.0 m, respectively. The total numbers of plots were 24 (6 × 4). The row to row and plant to plant distances were also 25 and 20 cm, respectively. Total amount of P, K and S fertilizers were applied as basal dose @ 90, 120 and 45 kg/ha, respectively during final land preparation but nitrogen from urea (300 kg/ha) was applied as per treatments in three equal splits. Poultry manure was applied 7 days before transplanting. Seedlings were transplanted in the experimental plots maintaining three seedlings per hill and plant spacing of 20cm × 20 cm. Intercultural operations were done as and when necessary. At maturity, the crop was harvested.
The pH of initial soil was 5.58 i.e., the soil was slightly acidic having 1.39% organic matter, 0.082% total N, 15.12 ppm soil P, 0.08 meq/100 g of soil K, 11.23 ppm soil S,0.25 ppm B and 0.85 ppm Zn (See Table 1).

Table 1. General characteristics of initial soil of the experimental site

Items	pH	OM (%)	Total N (%)	P (µg/g)	K (meq/100 g soil)	S (µg/g)	B (µg/g)	Zn (µg/g)
Initial soil	5.58	1.39	0.082	15.12	0.08	11.23	0.25	0.85
Critical level	-	-	0.12	10.00	0.12	10.00	0.20	0.60
Interpretation	-	-	L	M	VL	L	L	M

L= Low, M: Medium, VL: Very Low

Data were analyzed by SPSS statistical program. The first split of urea was applied 15 day before transplanting. The second split of urea was applied as top dressing after 30 days of transplanting and the third split of urea was applied after 45 days of transplanting (panicle initiation stage). The data on the following growth and yield contributing characters of the crop were recorded on plant height, number of leaf per hill, number of tiller per hill, number of effective tillers per hill, panicle length, number of filled grains per panicle, 1000 grains weight, grain yield, straw yield and biological yield.

4. RESULTS AND DISCUSSIONS

The results revealed that growth and yield characters such as plant height, number of leaf per hill, number of tillers per hill, number of effective tillers per hill, panicle length, filled grain per panicle, 1000 grains weight, grain yield, straw yield and biological yield responded significantly to integrated application of urea-N and PM. Application of urea-N and PM significantly influenced the plant height of BRRI dhan28. The tallest plant of 89.68 cm was found in T_4 was

followed by T_5, T_6, T_3 and T_2 with the value of 89.68, 89.19, 87.83, 86.18 and 81.82 cm, respectively (See table 2). The shortest plant height of 69.52 cm was found in T_1 (control). The treatment T_5 produced the highest number of leaves (78.03 per hill), which was statistically alike to the treatments T_2 (80.71 per hill), T_3 (66.41 per hill) and T_4 (72.70 per hill) (See table 2). They all produced the higher amounts number of leaf over control. The highest number of tiller of 12.50 was found in T_2 which was followed by T_5, T_3 T_4 and T_6 with the value of 12.46, 12.37, 12.03 and 10.70, respectively. The shortest number of tiller (8.04 per hill) was found in T_1 (control) (See table 2). The treatment T_3 produced the highest number of effective tillers (16.73 per hill), which was statistically identical to the treatments T_5 (15.80 per hill) and T_6 (16.27 per hill). The treatment T_5 (15.80 per hill) was statistically comparable to the treatments T_2 (14.20 per hill) and T_4 (13.93 per hill). The treatments T_2 (14.20 per hill) and T_4 (13.93 per hill) were found statistically similar to each other. The control treatment recorded the lowest (10.13 per hill) effective tillers (See table 2). The highest panicle length (23.98 cm) was found in the treatment T_3 which was statistically identical to T_5, T_2, T_4 and T_6 with the value of 22.96, 22.90, 22.69, and 22.32 cm, respectively. The lowest panicle length (20.02 cm) was observed in T_6 (See table 2). All the treatments showed higher production of filled grains compared to that of the control. Treatment T_2 (125.2 per panicle), produced higher production of filled grains (121.7 per panicle) which was similar to all the treatments except the control (See table 2). The 1000 grains weight ranged from 24.30 to 26.04g (See table 2). The highest values (26.04gm) was noted in T_3 was followed by T_2, T_4,T_5 and T_6 with the values of 25.82, 25.83, 25.63 and 25.78 gm, respectively and the lowest value of 1000 grains weight (24.30gm) was noted in T_1 .

Table 2: Effect of urea-N and PM on the yield contributing characters of BRRI dhan28

Treatments	Plant height (cm)		Number of leaf /hill		Number of tillers /hill		Number of effective tillers/hill		Panicle length (cm)	Filled grains/ panicle		1000 grains wt. (gm)	
T_1	69.52	b	41.56	b	8.04	b	10.13	b	20.02	75.93	b	24.30	b
T_2	81.82	a	80.71	a	12.50	a	14.20	ab	22.90	125.2	a	25.82	ab
T_3	86.18	a	66.41	a	12.37	a	16.73	a	23.98	96.87	ab	26.04	a
T_4	89.68	a	72.70	a	12.03	a	13.93	ab	22.69	121.7	a	25.83	ab
T_5	89.19	a	78.03	a	12.46	a	15.80	a	22.96	110.3	a	25.63	ab
T_6	87.83	a	61.15	ab	10.70	a	16.27	a	22.32	101.1	ab	25.78	ab
LSD	8.88		23.34		2.60		4.59		6.40	28.85		1.53	
CV %	5.81		19.22		12.59		17.38		15.66	15.07		3.29	

Figures in column having common letters do not differ significantly at 5% levels of significance
LSD = Least Significance Difference
CV (%) = Coefficient of variation

Grain yield was the most important parameter of this study. It was found that the grain yield due to application of urea-N fertilizer and PM varied from 2.11 to 5.40 t/ha (See table 3). The highest grain yield (5.40 t/ha) was recorded in T_3 which was identical with T_2, T_4, T_5 and T_6 with the value of 5.12, 4.98, 4.35 and 4.21 t/ha, respectively. The lowest value (2.11 t/ha) was recorded in T_1. The straw yield obtained from different treatments ranged from 3.31 to 6.44 t/ha (See table 3). The maximum (6.44 t/ha) straw yield was noted in T_3 and it was statistically similar to that of the treatments T_2 (5.70 t/ha) and T_5 (5.34 t/ha). Treatment T_5 (5.34 t/ha) was statistically comparable to the treatments T_4 (5.11 t/ha) and T_6 (5.00 t/ha). The control treatment recorded the lowest straw yield.

Table 3: Effect of urea-N and poultry manure on the yield of BRRI dhan28

Treatments	Grain yield (t/ha)	Straw yield (t/ha)	Biological yield(t/ha)
T_1	2.11 b	3.31 c	5.42 c
T_2	5.12 a	5.70 ab	10.82 ab
T_3	5.40 a	6.44 a	11.84 a
T_4	4.98 a	5.11 b	10.09 ab
T_5	4.35 a	5.34 ab	9.69 ab
T_6	4.21 a	5.00 b	9.21 b
LSD	1.52	1.06	2.13
CV %	19.19	11.31	12.29

Chemical properties of the soil collected after harvesting the crops Soil pH

The initial soil pH was 6.57 and the pH values of post-harvest soil between 6.51 and 6.80 (See table 4). The treatment T_2 showed slightly increasing in soil pH than the initial soil pH 6.57. Treatments T_1, T_3, T_4, T_5, T_6 and T_7 i.e. all the treatments were statistically identical with treatment T_2. Due to application of urea-N and PM, organic matter content of the post-harvest soil was slightly varied. The organic matter in initial soil was 1.49%. The maximum soil organic matter

was found in the treatment T_3 (1.72%). The lowest soil organic matter content was noted in control treatment T_1 (1.36%) (See table 4). The soil nitrogen content in the post-harvest soil varied from 0.068% to 0.086% (See table 4) which proved that the application of nitrogen and PM has positive effect on total nitrogen content in post-harvest soil. The available P content in the post-harvest soil was affected by the different treatments to some extent. The values of exchangeable K content in post-harvest soil varied between 0.067 and 0.08 m.e./100 g soil (See table 4). The highest value of 0.08 m.e./100 g soil was noted in T_2, T_3 and T_4 treatments, respectively which expressed that exchangeable K content in the post-harvest soil was influenced by the applied treatments. Available S content in soil was also slightly affected by the applied treatments which ranged between 11.29 ppm to 12.31 ppm (See table 4).

Table 4: Effect of urea-N and PM on nutrient content of post-harvest soil

Treatments	pH	Organic matter (%)	Total N (%)	Available P (ppm)	Exchangeable K (m.e./100 g soil)	Available S (ppm)
T_1	6.57	1.36	0.068	15.05	0.067	11.29
T_2	6.58	1.68	0.084	15.92	0.08	12.15
T_3	6.56	1.72	0.086	15.99	0.08	12.31
T_4	6.55	1.58	0.079	15.28	0.08	12.30
T_5	6.53	1.48	0.074	15.24	0.07	12.27
T_6	6.51	1.42	0.071	15.12	0.07	12.24
LSD	1.91	0.73	0.057	3.04	0.058	3.08
CV %	15.98	24.48	17.26	10.84	16.93	14.00

Figures in column having common letters do not differ significantly at 5% levels of significance.
LSD=Least Significant Difference
CV (%) = Coefficient of variation

Grain yield of a crop is a complex character, which results from interactions of many characters. Grain yield was positively correlated with plant height, number of leaf per hill, number of effective tillers, and filled grains per panicle. The correlation matrix and regression lines of these parameters are shown in figure 1, 2, 3 and 4.

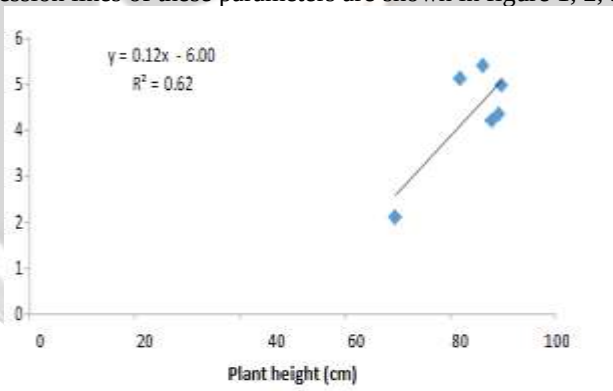

Figure 1

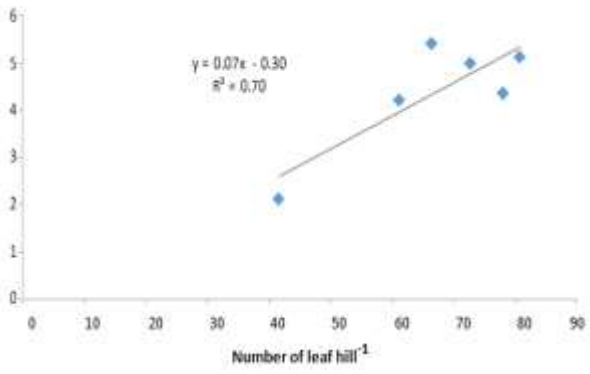

Figure 2

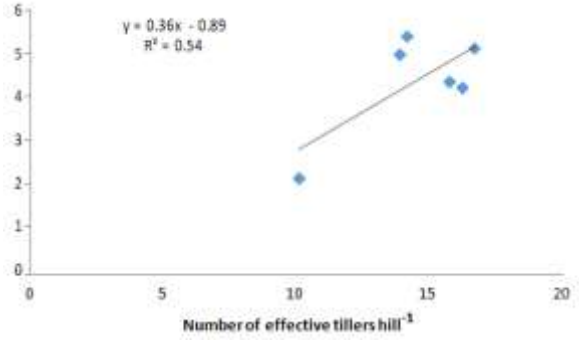

Figure 3

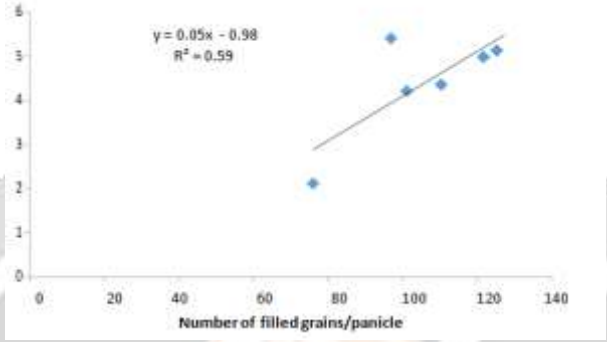

Figure 4

Relationship between grain yield and plant height (Figure 1), grain yield and number of leaf (Figure 2), grain yield and number of effective tillers per hill (Figure 3) and grain yield and number of filled grains per panicle (Figure 4) of BRRI dhan28 due to the effect nitrogen and poultry manure.

5. CONCLUSIONS AND FUTURE SCOPE

The overall results indicated that application of N fertilizer as urea @ 75 kg/ha in combination with 6 t/ha PM can reduce the amount of recommended N fertilizer. Therefore, the urea-N 75 kg/ha along with 6 t/ha PM (T_3 treatment) was the best combination in terms of yield, yield contributing characters and nutrients content. Higher levels of organic and inorganic fertilizer as a source of N may be needed to include for further study to make sure the performance of fertilizer for rice production**.** Such study is also needed in different agro-ecological zones (AEZ) of Bangladesh for regional adaptability.

6. ACKNOWLEDGEMENT

I feel much pleasure to express my gratitude, sincere appreciation and heartfelt indebtedness to my research supervisor Prof. Dr. A. K. M. Mosharof Hossain, Department of Soil Science, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200 for his scholastic guidance, support, encouragement, valuable suggestions and constructive criticism throughout the study period. I would like to express my thanks to the Ministry of Science and Technology for giving the fund through National Science and Technology program in 2017-18 fiscal year.

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