Effect of Different Organic and Inorganic Fertilizers on the Growth and Yield of Boro Rice (BRRI dhan29)

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Abstract: **During the period from December 2016 to May 2017 the study was carried out at the Research Field of Hajee Mohammad Danesh Science and Technology University, Dinajpur in Rabi season to evaluate the efficacy of different organic and inorganic fertilizers on the growth and yield of boro rice (BRRI dhan29). The experiment had eight treatments with three replications and as follows; T_0: Control, T_1: 100% $N_{75}P_{12}K_{45}S_9$ (Recommended dose), T_2: 50% NPKS + 6 t cowdung ha^{-1}, T_3: 75% NPKS + 3 t cowdung ha^{-1}, T_4: 50% NPKS + 6 t poultry manure ha^{-1}, T_5: 75% NPKS + 3 t poultry manure ha^{-1}, T_6: 50% NPKS + 6 t vermicompost ha^{-1} and T_7: 75% NPKS + 3 t vermicompost ha^{-1}. Application of organic and inorganic fertilizers resulted in a considerable influence on the growth and yield contributing characteristics of boro rice (BRRI dhan29). At harvest stage, the tallest plant (94.37 cm) and the greatest number of total tiller per hill (22.10) was recorded from T_4. The longest panicle (26.48 cm), maximum number of total grain per plant (178.3), the highest weight of 1000 seeds (21.96 g), the maximum grain yield (10.33 t ha^{-1}) and straw yield (15.67 t ha^{-1}) was also recorded in T_4 treatment. Although the highest biological yield was recorded from T_4 treatment but statistically similar result was found from T_5 treatment. The findings of the study showed that the performance of the treatment T_4 was the best among all treatments in terms of growth and yields. So, the recommendation of this study is amendment of soil with 50% NPKS + 6 t poultry manure ha^{-1} might be an efficient practice for achieving sustainable higher boro rice (BRRI dhan29) production.**

Key words: **Boro rice, Organic fertilizers, Inorganic fertilizers, Growth, Yield**

I. INTRODUCTION

Rice (*Oryza sativa L.*) is the staple food of Bangladesh. Rice plays absolutely dominant role in Bangladesh agriculture as it covers 77.96 percent of total cropped area (AIS, 2007). Among the three types of rice, boro rice covers about 54.56% of total rice area, which contributes 41.94% of the total rice production in the country (BBS, 2016). Rice is intensively cultivated in Bangladesh covering about 80% of arable land. Continuous use of inorganic fertilizers leads to deterioration in soil physical, chemical and biological properties. It is true that sustainable production of crops cannot be maintained by using only chemical fertilizers and similarly it is not possible to obtain higher crop yield by using organic manure alone (Bair, 1990). A judicious combination of organic and inorganic sources of nutrients is necessary for sustainable agriculture that can ensure food production with high quality (Nambiar, 1991). In intensive cropping, continuous use of high levels of chemical fertilizers declines crop productivity as well as soil fertility status. Use of organic matter to meet the nutrient requirements of crops would be an invertible practice in years to come, particularly for resource poor farmers. Furthermore, ecological and environment concerns over the increased and indiscriminate uses of inorganic fertilizers have made research on uses of organic materials as sources of nutrients very necessary (Giller, 1995) (Ayoub, 1999). More recently, attention is given on the utilization of organic wastes, farm yard manure (FYM), compost, vermicompost and poultry manures as the most effective measure for the improving soil fertility and thereby crop productivity. Applications of both chemical and organic fertilizers need to be applied for the improvement of soil physical properties and supply of essential plant nutrients for higher yield. Therefore this study was conducted to observe the integrated effect of inorganic fertilizers and organic manures on the growth and yield contributing characters of boro rice and to develop a suitable integrated dose of inorganic fertilizers and organic manures (cowdung, poultry manure and vermicompost) for Boro rice.

II. MATERIALS AND METHODS

This research work was conducted at the Research Field of Hajee Mohammad Danesh Science and Technology University, Dinajpur. During the period from December 2016 to May 2017 in Rabi season. The land belongs to the Old Himalayan Piedmont Plain, Agro-ecological Zone-1 (AEZ-1) (UNDP and FAO, 1988) and the field is situated at the north site of the Central Mosque of Hajee Mohammad Danesh Science and Technology University, Dinajpur. The soil of the experimental plot was sandy loam with p^H 5.97. The initial soil (0-15 cm depth) test revealed that the soil contained 0.05 % total Nitrogen, 11.21 ppm phosphorus, 0.10 m.e./100g available potassium, 11.01 ppm sulphur. General soil type was

Non-calcareous flood plain and the parent material of this soil was alluvial deposit (See Table 1).

Table 1: Physical, chemical and morphological characteristics of the initial soil of experimental field

Characteristics	Value
%Sand	56.00
%Silt	34.00
%Clay	10.00
Textural class	Sandy loam
pH	5.97
Organic Matter (%)	0.98
Total Nitrogen (%)	0.05
Phosphorus (ppm)	11.21
Potassium (m. e./100g soil)	0.10
Sulphur (ppm)	11.01
Parent material	Alluvial deposit
General soil type	Non-Calcareous Brown Floodplain
Drainage	Moderately well drained
Flood level	Above flood level
Topography	High land

The experiment consists of eight (8) treatments with three (3) replications. Those are as follows; T_0: Control, T_1: 100% $N_{75}P_{12}K_{45}S_9$ (Recommended dose), T_2: 50% NPKS + 6 t cowdung ha^{-1}, T_3: 75% NPKS + 3 t cowdung ha^{-1}, T_4: 50% NPKS + 6 t poultry manure ha^{-1}, T_5: 75% NPKS + 3 t poultry manure ha^{-1}, T_6: 50% NPKS + 6 t vermicompost ha^{-1} and T_7: 75% NPKS + 3 t vermicompost ha^{-1}. The recommended dose was $N_{75}P_{12}K_{45}S_9$ (Fertilizer Recommendation Guide, 2012). As organic manure cowdung, PM and vermicompost were applied before four days of final land preparation. Chemical compositions of the manures have been given (See Table 2).

Table 2: Chemical compositions of organic manure (oven dry basis)

Name of organic manure	Nutrient content (%)				
	C	N	P	K	S
Cowdung	36	1.92	0.29	0.75	0.21
Poultry manure	29	2.19	1.98	0.81	0.34
Vermicompost	30	1.48	0.28	1.27	0.32

The experiment was laid out in Randomized Complete Block Design (RCBD) with 3 replications. Therefore, the total number of plots was 24. The unit plot size was 2.5 m x 2 m (5 m^2) and the distance maintained between two blocks and two plots were 1.0 m and 0.5 m respectively. Different intercultural operations such as irrigation, weeding, pesticide and insecticide application etc. are done timely. Ten hills were randomly selected from each plot at maturity to record the yield contributing characters such as, plant height, number of tillers $hill^{-1}$, panicle Length, number of grains $panicle^{-1}$, number of filled grains $panicle^{-1}$, number of unfilled grains $panicle^{-1}$, weight of 1000 grains, grain yield, straw yield and biological Yield. All the collected data were analyzed for ANOVA using the randomized complete block design (RCBD) with the help of the computer package program MSTAT- C. The differences among the treatment means were evaluated by the Duncan's New Multiple Range Test (DMRT) as outlined by Gomez and Gomez, 1984.

III. RESULTS AND DISCUSSION

The present experiment was conducted to determine the effect of different organic & inorganic fertilizers on soil fertility and the yield of Boro rice (*BRRI Dhan 29*). The result has been presented in various tables, figures and possible explanations have been given under the following headings.

Yield contributing characters of rice

Yield contributing characters such as plant height, number of tillers $hill^{-1}$, panicle length, number of grains $panicle^{-1}$, number of filled grains $panicle^{-1}$, number of unfilled grains $panicle^{-1}$ and weight of 1000 grains.

Plant height

Plant height of rice (BRRI Dhan29) responded significantly due to application of organic and inorganic fertilizers (See Table 3). All the treatments gave significantly higher plant height over the T_0 (control). Plant height ranged from 73.25 to 94.37 cm. The tallest plant height (94.37 cm) was recorded in the treatment T_4 (50% NPKS + 6 t poultry manure/ha) which was closely followed by the treatment T_5 (75% NPKS + 3 t poultry manure/ha). The shortest plant height (73.25 cm) was recorded from the control treatment T_0. The dose of both organic and inorganic fertilizers had positive effects on plant height. A similar effect of FYM with N, P and K was reported by Kobayahi *et al.* (1989).

Number of tillers $hill^{-1}$

Application of organic and inorganic fertilizers responded significantly on the number of effective tillers $hill^{-1}$ of rice (See Table 3). The maximum tillers $hill^{-1}$ (22.10) was found in the treatment T_4 which was statistically superior to the other treatments. The minimum tillers $hill^{-1}$ (8.89) was observed from the control treatment (T_0). Ahmad and Rahman (1991) found that increased number of effective tillers $hill^{-1}$ of rice with the integrated use of organic and inorganic fertilizers.

Panicle length (cm)

Panicle length of BRRI Dhan 29 significantly influenced due to application of organic and inorganic fertilizers (See Table 3). The Panicle length varied from 18.21 to 26.48 cm. The highest Panicle length (26.48 cm) was recorded in the treatment T_4 which was statistically identical with T_1, T_3, T_5 and T_7. On the other hand the lowest panicle length (18.21 cm) was found in the T_0 (control). Ahmad and Rahman (1991) also

observed that combined application of organic and inorganic fertilizers increased the Panicle length of rice.

Number Filled Grains panicle^{-1}

The number of filled grains panicle^{-1} was significantly affected due to application of cowdung, poultry manure, vermicompost and chemical fertilizers. The number of filled grains panicle^{-1} ranged from 90.20 to 170.20 (See Table 3). The highest number of filled grains panicle^{-1} (170.20) was recorded in the treatment T_4 which statistically similar to T_5 treatment. . On the other hand the number of filled grains panicle^{-1} was lowest (90.20) obtained in the T_0 treatment. Umanah *et al.* (2003) stated that poultry manure increased the grains panicle^{-1}.

Number Unfilled Grains panicle^{-1}

The effect of different levels of organic and inorganic fertilizers was significant as observed on number of unfilled grains panicle^{-1}. The number of unfilled grains panicle^{-1} ranged between 6.10 and 12.20 (See Table 3). The highest number of unfilled grains panicle^{-1} (12.20) was recorded in the treatment T_0 (control). On the other hand the number of unfilled grains panicle^{-1} was lowest (6.10) obtained in the T_5 treatment which was statistically identical with T_1, T_2, T_3, T_4 and T_7 treatments.

Number of Total Grains panicle^{-1}

Combined applications of organic and inorganic fertilizers ensured favorable growth of rice and ultimate result was the maximum number of grains panicle^{-1}. Results in Table 3 indicated that number of Grains panicle^{-1} of rice varied significantly due to application of organic and inorganic fertilizers. The highest Grains panicle^{-1} (178.3) was recorded in the treatment T_4 which was statistically same as T_5 treatment. On the other hand the Grains panicle^{-1} was lowest (102.4) obtained in the T_0 treatment.

1000-grains weight

Variation in 1000-grains weight was observed with the application of organic and inorganic fertilizers (See Table 3). The highest 1000-grains weight (21.96g) was recorded from the treatment T_4 which was superior to other treatments. The lowest weight (17.10g) was recorded under T_0 (control). Apostol (1989) viewed that organic fertilizers along with inorganic fertilizers improved 1000-grains weight in rice.

Table 3: Effects of organic and inorganic fertilizers on the Plant Height, Number of Tillers hill^{-1}, Panicle Length, Number of Grains panicle^{-1}, Number of Filled Grains panicle^{-1}, Number of Unfilled Grains panicle^{-1}, Weight of 1000 grains in BRRI Dhan 29.

Treatments	Plant height at harvest (cm)	Number of tillers/ hill	Length of panicle (cm)	Number of filled grains/ panicle	Number of unfilled grains/ panicle	Number of total grains/ panicle	Weight of 1000 seed (g)
T_0	73.25 e	8.89 f	18.21 d	90.20 f	12.20 a	102.4 f	17.10 e
T_1	89.04 b	15.78 c	24.69 abc	158.1 bc	8.63 bc	166.8 bc	21.20 b
T_2	81.85 d	10.89 e	23.68 bc	130.8 e	7.81 bc	138.6 e	20.50 c
T_3	86.30 c	13.78 d	24.71 abc	151.8 cd	6.21 c	158.0 cd	20.98 b
T_4	94.37 a	22.10 a	26.48 a	170.2 a	8.12 bc	178.3 a	21.96 a
T_5	93.42 a	19.78 b	25.24 ab	164.2 ab	6.10 c	170.3 ab	21.10 b
T_6	87.20 c	11.67 e	22.92 c	147.8 d	9.51 b	157.3 d	19.76 d
T_7	90.54 b	13.45 d	24.61 abc	157.2 bcd	8.10 bc	165.3 bcd	20.98 b
LSD value	1.65	1.67	2.04	9.34	2.38	8.56	0.30
CV %	1.08	6.54	4.89	3.65	16.28	3.16	0.85
Level of significance	*	*	*	*	*	*	*

In a column having common letters do not differ significantly at 5% level of significance.

CV% = Coefficient of variation

LSD = Level of Significance

Grain and straw yield of Rice

Grain yield

The grain yield of Boro rice (*BRRI dhan29*) was significantly influenced by the different treatments. Application of different levels of organic and inorganic fertilizers showed variation in between the treatments due to the variation for grain yield (See Figure 1 and Table 4). The grain yield varied from 4.63 to 10.33 t ha^{-1}. The highest grain yield was recorded in the treatment T_4 (50% NPKS + 6 t poultry manure/ha) which was closely followed by T_5 treatment (75% NPKS + 3 t poultry manure/ha) and the lowest grain yield was recorded in the T_0 (control) treatment. The result clearly indicated that organic source of nutrients gave significantly higher grain yield over

inorganic fertilizers. The study revealed that integrated use of poultry manure with inorganic fertilizers reductase fertilizer without any remarkable yield decline. Bodruzzaman *et al.* (2010) and Asit *et al.* (2007) also found almost the similar results.

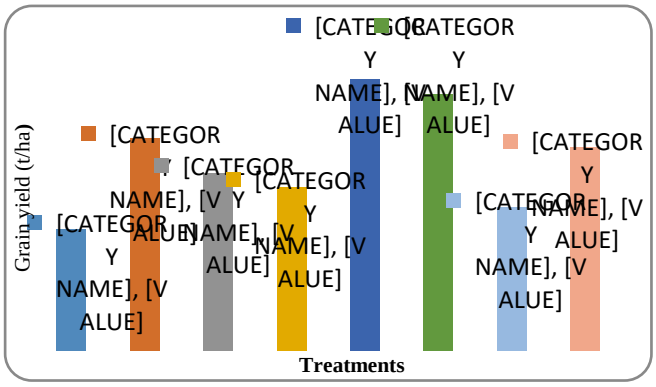

Figure 1: Effect of organic and inorganic fertilizers on grain yield of Boro rice (*BRRI Dhan29*)

Straw yield

Application of organic and inorganic fertilizers at different levels showed the variation for straw yield per hectare (See Figure 2 and Table 4). The increased straw yield might be accounted for the superior growth of plant as well as increased number of tillers hill^{-1}. The highest straw yield (15.67 t ha^{-1}) was recorded in the treatment T_4 which was statistically identical with T_5 treatment. On the other hand the lowest straw yield (6.73 t ha^{-1}) obtained from the control treatment T_0. The results showed that the application of organic and inorganic fertilizers induced higher straw yield of rice. Rajput and Warsi (1992) observed that combined application of organic and inorganic fertilizers significantly increased the straw yield of rice.

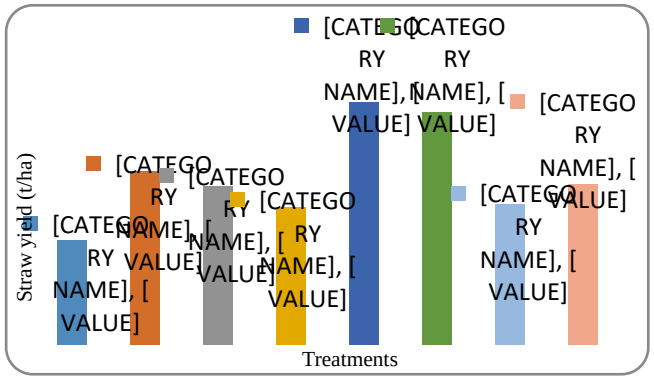

Figure 2: Effect of organic and inorganic fertilizers on Straw yield of Boro rice (*BRRI Dhan 29*)

Biological yield

Biological yield is the total yield of grain and straw. It was significantly affected due to application of different organic and inorganic fertilizers (See Table 4). The biological yield varied from 11.37 to 26.00 t ha^{-1}. The highest biological yield (26.00 t ha^{-1}) was recorded in the treatment T_4 (50% NPKS + 6 t poultry manure/ha) which was statistically similar to T_5 treatment (75% NPKS + 3 t poultry manure/ha) and the lowest biological yield (11.37 t ha^{-1}) was recorded in the T_0 (control) treatment. Among organic fertilizers poultry manure was superior to cowdung and vermicompost and increased rate also had positive effect in it.

Table 4: Effect of different organic & inorganic fertilizers on the Grain yield, Straw yield and Biological yield of Boro rice (BRRI Dhan 29)

Treatments	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological Yield (t ha^{-1})
T_0	4.63 d	6.73 d	11.37 e
T_1	8.07 b	11.20 b	19.27 b
T_2	6.73 bc	10.20 bc	16.93 bcd
T_3	6.20 c	8.87 c	15.07 cd
T_4	10.33 a	15.67 a	26.00 a
T_5	9.73 a	15.00 a	24.73 a
T_6	5.47 cd	9.07 bc	14.53 d
T_7	7.73 b	10.33 bc	18.07 bc
LSD value	1.34	1.98	3.13
CV %	10.42	10.39	9.79
Level of significance	*	*	*

In a column having common letters do not differ significantly at 5% level of significance.

CV% = Coefficient of variation

LSD = Level of Significance

* = Significant

Relationship among different growth characteristics with Grain yield of boro rice:

The relationship between Plant height (at harvest) and Grain yield has been shown in figure 3. The positive slope indicates that the plant height and grain yield are directly correlated i.e., increase in plant height results in an increase in grain yield of rice.

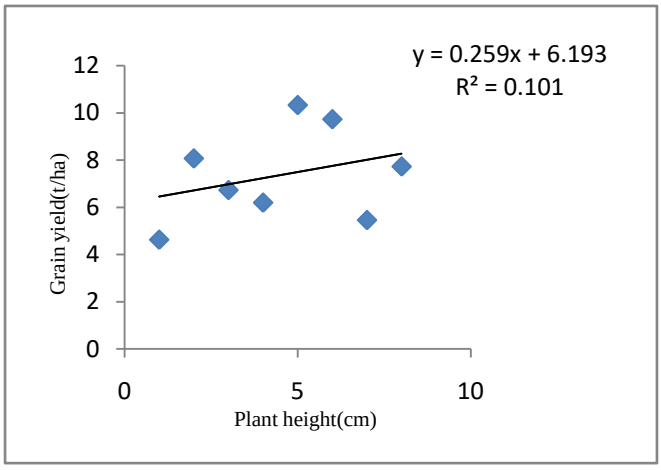

Figure 3: Relationship between Plant height (at harvest) and Grain yield.

The relationship between number of tiller/hill and grain yield has been found out (See Figure 4). There is a positive relation between number of tiller/hill and grain yield.

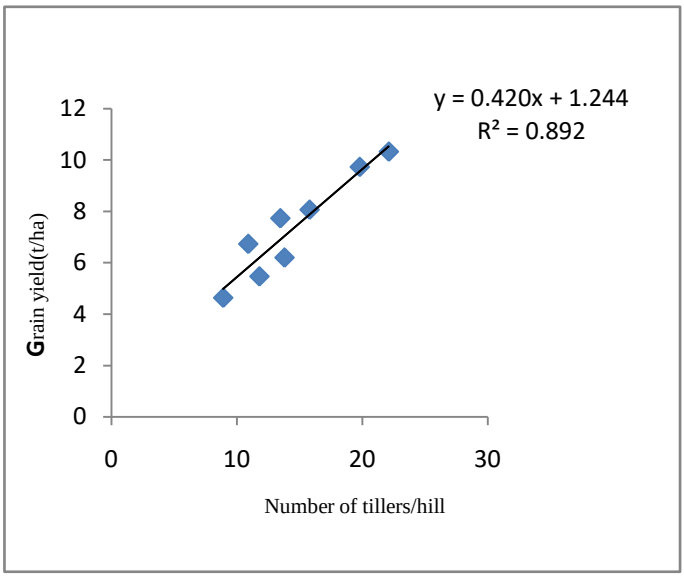

Figure 4: Relationship between number of tiller/hill and Grain yield.

IV. CONCLUSIONS

Finally, it can be concluded from the present study that the application of organic manures along with inorganic fertilizers showed better performance in respect of grain yield, yield contributing characters. Here, 50% NPKS + 6 t poultry manure/ha (T_4) gave better performance than another combinations in most of the aspects. Combined application of organic and inorganic fertilizers can significantly increase the yield and yield contributing characters and 50% NPKS + 6 t poultry manure/ha (T_4) also produced the maximum yield of rice. Further study is needed to verify the adaptability of the recommendation of this study to other regions of Bangladesh.

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