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Effect of integrated nutrient management on the growth and yield of BRRIdhan29

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Abstract: A field experiment was conducted to assess the effect of integrated nutrient management on the growth and yield of BRRIdhan29 at the research farm of Sher-e-Bangla Agricultural University, Dhaka-1207. The maximum dry grain yield (7.72t/ha.) of BRRIdhan29 was found through the application of 100 kg N from urea along with 40 kg N/ha from cowdung. But the effect of cowdung along with nitrogenous fertilizer was the most pronounced than that of vermicompost or only nitrogenous fertilizer. The effect of 100 kg N from urea along with 40 kg N/ha from cowdung was statistically at par to treatments 140 kg N/ha as the source of urea, 100 kg N/ha from urea along with 20 kg N/ha from cowdung and 20 kg N/ha as the source of vermicompost, 80 kg N/ha as the source of urea with the combiantion of 60 kg N/ha from cow dung, 80 kg N/ha from urea with the combination of 60 kg N/ha as the source of vermicompost and 80 kg N from urea with the association of 30 kg N/ha from cowdung along with 30 kg N/ha from vermicompost. The overall results indicate that 100 kg N/ha from urea along with 40 kg N/ha as the source of cow dung was the best treatment in producing higher rice yield with sustenance of soil fertility.

Key words: Integrated, nutrient management, BRRIdhan29, growth, yield.

Introduction

Rice is the staple food belongs to Gramineae family cultivated throughout the Bangladesh covering about 80% of the total cropped area and it constitutes about 97% of the total cereal production of the country (Bari *et al.,* 1997). About 6.03 million hectares of land are used for rice cultivation. The total production was 26.53 million metric tons during 2005-2006 (BBS, 2006). Out of total rice production in this county about 45% comes from Aman and the rest 8% and 47% come from Aus and Boro crops, respectively (BBS, 2006). The total production of rice in Bangladesh is not sufficient to feed for the peoples of the country.

Integrated nutrient management is essential for carbohydrate use within plants and stimulates root growth and development as well as the uptake of other nutrients (Brady, 1990). Consistent and indiscriminate use of chemical fertilizers has caused serious damage to the soil health and ecology. There has been a gradual declining or stagnation trend in the yield almost all over the country which might be due to imbalance use of inorganic fertilizer, less use of organic manure such as cowdung, poultry manure, mustard oilcake and vermicompost. To get maximum yield through the application of organic and inorganic fertilizer is best option.

The organic manures viz. cowdung and vermicompost may be used as an alternative source of N which increases efficiency of applied N (Saravana *et al*., 1987). Integrated use of organic manures with the combination of inorganic fertilizers can contribute to increase N content of rice soil as well as to increase long term productivity and enhancement of ecological sustainability.Combined application of cowdung and vermicompost along with chemical nitrogen fertilizer improves soil health and soil productivity but only use of nitrogenous fertilizer for a long period causes deterioration of soil health, organic matter decrease and reduce crop yield. When cowdung and vermicompost are applied along with chemical fertilizers for efficient growth of crop, decline in organic carbon is arrested and the gap between potential yield and actual yield is minimized. (Rabindra *et al.*, 1985). Now a days, it is the demand of time to develop an integrated nutrient management program for higher crop yield and improved soil health ultimately increase the crop sustainability. Keeping these facts in mind, the present research has been undertaken to asses the effects of cowdung and vermicompost along with nitrogen as the source of urea on growth and yield of BRRIdhan29, and to evaluate the combined effect of cowdung and vemicompost with the combination of chemical nitrogen fertilizer on the nutrient uptake by BRRIdhan29.

Materials and Methods

The experiment was carried out at research farm of Sher-e-Bangla Agricultural University, Dhaka-1207 during Boro season of 2011-2012. BRRIdhan29 a high yielding variety was used as the test crop in the Boro season. The variety was released by Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur for Boro season. Life cycle of these variety ranges from 150-160 days in Boro season (BRRI, 1995). A well puddled land was selected for seedling raising. The sprouted seeds were sown uniformly as possible and covered with thin layer of fine earth. Proper care of the seedlings in the nursery was taken. The initial soil sample was collected from the experimental field before manuring and fertilization. Five samples of 0-15 cm depth were collected, mixed, air-dried, ground and sieved through a 2 mm (10 mesh) sieve. The composite samples of initial soils were stored in clean polyethylene bag for physical and chemical analyses. The texture, prosity, bulk density, partical density, soil pH, organic carbon, total nitrogen, available phosphorus, exchangeable potassium and available sulfer were silty loam, 44.5 %,1.30g/cc, 2.52g/cc, 5.70, 0.89, 0.073, 16.90, 0.12 and 12.00mg/kg respectively.

Cow dung and vermicompost contained 1.20% nitrogen, 1.00% phosphorus, 0.70% potassium and 2.00% nitrogen, 2.00% phosphorus, 0.80% potassium respectively.

Land was prepared for the cultivation of BRRIdhan29. First it was ploughed with a power tiller. The soil was saturated with adequate supply of irrigation water and finally prepared by successive ploughing and cross ploughing followed by laddering. The unexpected residues were removed from the experimental plot. The experiment was carried out in the Randomized Complete Block Design (RCBD). The entire experimental area was divided into 3 blocks representing the replications to reduce soil heterogeneity and each block was subdivided into 12 unit plots with raised band as per treatments. Thus, the total number of unit plots was 36, treatments were twelve. The

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unit plot size was 3.5 m × 2.0 m and the plots were separated through raising soil band upto 25 cm from the soil level. The blocks were separated by 1.0 m drains. The treatments were randomly distributed within each block. BARC manual (BARC, 2007) was followed by the application of fertilizers and for selecting the manurial doses. Well decomposed cowdung, vermicompost Phosphorous as the source of triple super phosphate (TSP), potassium from muriate of potash (MP), sulphur from gypsum and zinc from zinc oxide were applied during final land preparation. Urea was top dressed in three equal installments (splits) at 15, 35 and 60 days after transplanting.

Thirty five days old seedlings were transplanted in the experimental plots on 10 January, 2011 in Boro season. Distances of 20 cm from row to row and 15 cm from plant to plant were maintained. The crops were infested by pests which were controlled through the application of ripcord. Necessary intercultural operations like weeding and irrigations were done as and when necessary. The crops were harvested plot wise at maturity after 155 days in Boro season on 11 may 2011.

Five hills were randomly selected to keep records on yield and yield contributing characters from each plot. The selected hills were collected before the crop was harvested and necessary information was recorded. The grain and straw samples were also kept for chemical analyses.

The analysis of variance for the crop characters and also the nutrient content of the plant samples were done following the ANOVA technique and the mean values were anlyzed by Least Significant Difference Test (LSD).

Results and Discussion

Plant height: Plant height was significantly influenced by cowdung and vermicompost with the combination of inorganic nitrogenous fertilizer (Table 1). Plant height ranged from 95.73 to 78.60 cm. The highest plant height (95.73 cm) was recorded in the treatment T_1 receiving 140 kg N/ha as the source of urea, which was statistically identical to T_4 and T_5 treatments. Plant height recorded either with single or combined application of nitrogen and manure or vermicompost was higher than that of control treatment. The lowest plant height (78.60 cm) was observed by control treatment having no cowdung or vermicompost even any chemical fertilizer. Treatment T_1 receiving 140 kg N/ha from urea fertilizer produced 21.79% higher plant height compared to control treatment (Fig. 1). Plant height of BRRIdhan29 was increased by the application of farm wastes (Budhar *et al.* 1991). Hoque (1999) found that plant height significantly increased with the application of cowdung along with chemical fertilizer. The increased plant height through the application of FYM along with N, P and K was also reported by many other scientists (Kobayashi *et al.* 1989, Maskina *et al.* 1987). Maximum plant height was noted in BRRIdhan29 due to the application of poultry manure at the rate of 3t/ha along with 50% soil test basis fertilizer in boro season (Anonymous ,2008).

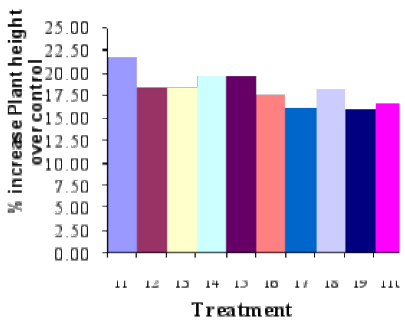
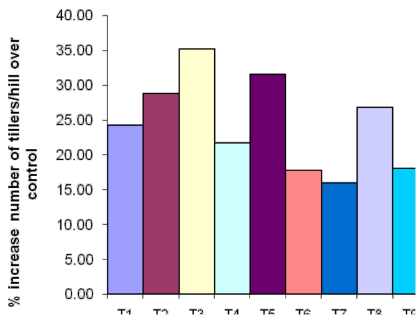
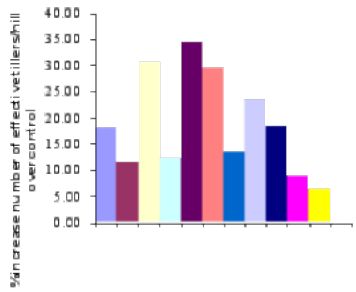


Fig. 1. Effect of integrated nutrient





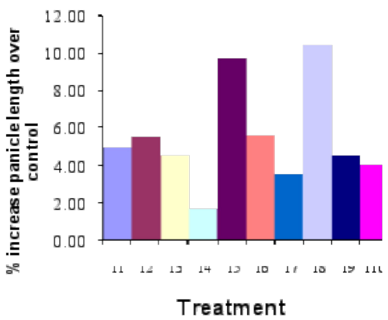


Fig.4 Effect of integrated nutrient management on percent increase panic length of BRRIdhan29 over control

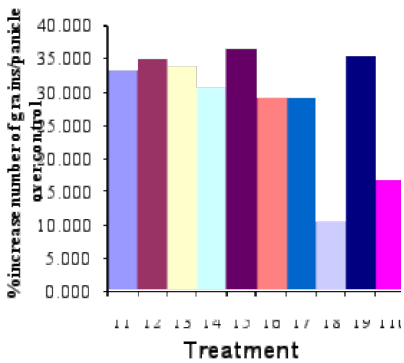


Fig.5.Effect of integrated nutrie management on percent increase n of grains per panicle over control BRRIdhan29

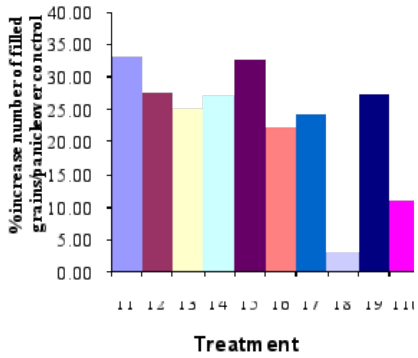


Fig.6.Effect of integrated nutrient management on percent increase number filled grains per panicle over control of

Number of tillers per hill: Number of tillers per hill was significantly influenced by cowdung and vermicompost along with chemical nitrogenous fertilizer (Table 1). The highest number of tillers per hill (24.87/hill) was recorded in T_3 treatment receiving 20 kg N from vermicompost along with 120 kg N/ha as the source of urea. Vermicompost along with chemical nitrogenous fertilizer exerted positive effect on the number of tillers per hill. Cowdung and vermicompost in combination with nitrogenous fertilizers showed better performance than only nitrogenous fertilizers. The lowest number of tillers per hill (18.40/hill) was noted by control (T_{12}) treatment. Treatment T_3 produced 35.16% higher number of tiller per hill than control treatment (Fig. 2). Ahmed and Rahman (1991) recorded significantly increased tiller number of rice due to the application of cowdung or vermicompost along with chemical nitrogenous fertilizers. Aptosol (1989) also found that combined application of organic and inorganic fertilizers increased the number of tillers per hill.

Number of effective tillers per hill: There was a significant effect of the treatments on number of effective tiller per hill (Table 1). All the treatments significantly produced higher number of effective tillers per hill over control treatment. Application of 20kg N /ha from cowdung along 120 kg N/ha as the source of urea produced the highest number of effective tillers (24.00/hill). Treatment T_2 produced 34.30% higher number of effective tiller per hill than control treatment (Fig.3),which was statistically identical with T_5. Cowdung with the association of chemical nitrogenous fertilizer was found to be more or less similar to vermicompost along with chemical nitrogen in producing number of effective tiller.

Table 1. Effect of integrated nutrient management on different parameters of BRRIdhan29

Treatment	Plant height (cm)	No. of tillers/hill	No. of effective tillers/hill	No. of non effective tillers/hill	Panicle length (cm)	No. of grain/panicle
T_1	95.73a	22.87abc	21.07bcd	1.133bc	26.53cd	224.00a
T_2	93.13ab	23.7abc	24.00 a	1.900a	26.67bc	227.00a
T_3	93.07ab	24.87a	23.33ab	1.800a	26.43cd	225.20a
T_4	94.07ab	22.4abcd	20.10cde	1.000c	25.70cde	219.50a
T_5	94.07ab	24.20ab	23.13ab	1.300b	27.73ab	229.70a
T_6	92.47ab	21.68bcd	19.95cde	1.700a	26.70bc	216.80a
T_7	91.27 b	21.33cd	20.27cde	1.300b	26.17cde	217.00a
T_8	92.87ab	23.33abc	22.1abc	1.00c	27.90a	185.60b
T_9	91.13b	21.73bcd	21.13bcd	0.700de	26.43cd	227.60a
T_{10}	91.80b	20.07de	19.47 de	0.700de	26.30cde	196.30b
T_{11}	81.60c	18.53e	19.00de	0.800d	25.53de	182.60bc
T_{12}	78.60d	18.40 e	17.87e	0.533e	25.27e	168.10c
CV (%)	2.54	7.46	7.06	9.02	2.41	4.14

Table 2. Effect of integrated nutrient management on yield contributing parameters of BRRIdhan29.

Treatment	No. of filled grain/panicle	No. of unfilled grain/panicle	Wt. of grain (g/panicle)	Wt. of filled grain (g/panicle)	Wt. of unfilled grain (g/panicle)	1000-grain wt. (g)
T_1	216.70a	7.30h	4.88a	4.45ab	0.15g	21.46cd
T_2	207.70abc	19.35bc	4.06cde	4.15bcd	0.38bc	20.54bcd
T_3	203.50abc	21.70a	4.40abc	4.27bc	0.45a	21.01bcd
T_4	206.80abc	12.70f	4.31bcd	4.58ab	0.28e	22.15abc
T_5	215.80ab	13.87ef	4.74ab	4.88a	0.31de	22.64ab
T_6	198.70c	18.13c	4.14cde	3.93cde	0.36cd	20.03d
T_7	202.00bc	15.07de	4.15def	3.84bcd	0.31de	20.52cd
T_8	167.50de	18.07c	3.92cdef	3.50cde	0.42ab	23.50a
T_9	207.00abc	20.60ab	4.57bcd	4.11ab	0.45a	22.10abc
T_{10}	180.20d	16.10d	4.27bcd	3.75de	0.52cd	20.79bcd
T_{11}	172.50de	10.08g	3.59ef	3.38e	0.21f	20.84bcd
T_{12}	162.50e	5.66i	3.36f	3.36e	0.12g	19.42d
CV (%)	4.40	6.13	8.11	7.13	7.98	5.36

Table 3. Effect of integrated nutrient management on raw and dry grain as well as straw yield of BRRIdhan29

Treatment	Raw grain yield (t/ha)	Raw straw yield (t/ha)	Dry grain yield (t/ha)	Dry straw yield (t/ha)
T_1	8.40a	15.12ab	7.67a	4.91bc
T_2	6.77cd	12.13def	6.45bcd	5.75ab
T_3	7.49bc	13.32cde	6.65bcd	5.52ab
T_4	6.26d	14.67ab	5.92cd	4.57cd
T_5	8.46a	15.80a	7.72a	6.25a
T_6	6.26d	14.11bc	5.75de	4.06cd
T_7	7.56b	12.98cde	6.93ab	5.64ab
T_8	7.56b	13.54cd	7.04ab	6.09a
T_9	7.38bc	14.00bc	6.77abc	5.52ab
T_{10}	7.38bc	11.97ef	6.84abc	5.98a
T_{11}	5.30e	11.17f	4.80ef	3.88d
T_{12}	4.85e	9.59g	4.42f	4.40cd
CV (%)	6.34	6.82	9.12	10.67

Means in a column followed by same letter (s) are not significantly different at 5% level of significance by LSD

Number of non effective tiller: The effects of different treatments on non effective tiller per hill are shown in Table 1. The maximum number of non effective tillers (1.90/hill) was recorded in treatment T_2 receiving 20 kg N /ha from cowdung along with 120 kg chemical nitrogen fertilizer. The effect of the T_2 treatment was statistically superior to the rest of the treatments. The minimum number of non effective tillers per hill (0.53/hill) was noted in control (T_{12}) treatment.

Panicle length: The effects of different treatments on panicle length are shown in Table 1. The highest panicle length (27.90 cm) was noted in T_8 treatment receiving 80 kg N as the source of urea with combination of 60 kg N from cowdung which was statistically identical to T_5 treatment. Treatment T_2 produced second highest panicle length among the treatment were selected. The lowest panicle length (25.27 cm) was produced by T_{12} treatment receiving no inorganic and organic fertilizer. Treatment T_8 produced 10.41% higher panicle length than control treatment (Fig. 4). This might be due to the balanced supply of nutrients from cowdung along with urea fertilizer, which enhanced panicle length.

Number of grains per panicle: Number of grains per panicle of BRRIdhan29 ranged from 168.10 to 229.70 and the highest and the lowest number of grains per panicle was found in the treatment T_5 and T_{12}, respectively (Table 1). All the treatments significantly produced higher number of grains per panicle over control treatment of BRRIdhan29. Application of 100 kg N as the source of urea along with 40 kg N from cowdung/ha produced the maximum number of grains per panicle (229.70) with an increase of 36.64% over control treatment under study (Fig. 5). Inorganic nitrogen with the combination of cowdung was found to be more effective in producing number of grain per panicle compared to other treatments even with only inorganic nitrogenous fertilizer. This is in agreement with the findings of other researchers (Anonymous, 2008).

Number of filled and unfilled grains per panicle: There was a significant effect of the treatments on number of filled and unfilled grains per panicle (Table 2, Fig.6). This might be due to the nitrogenous fertilizer increase vegetative growth resulting decrease the number of filled grains, which enhanced number of unfilled grains per panicle. Mondal *et al*. (1990) stated that increasing NPK rates and FYM gave significant number of filled grains per panicle of rice.

Weight of grain per panicle: Weight of grain (filled and unfilled) per panicle was significantly influenced by different combinations of organic and inorganic fertilizer (Table 2). Weight of grain per panicle ranged from 3.36 to 4.88 g. The maximum weight of grains per panicle (4.887 g) was recorded by the treatment T_1 whose effect was statistically similar to T_3 and T_5 treatments but superior to the rest of the treatments. Treatments T_4, T_9 and T_{10} were statistically similar in respect of weight of grains per panicle. The lowest weight of grains per panicle (3.487 g) was noted in control treatment (T_{12}). The effect of this treatment was statistically identical to T_{11} treatment of BRRIdhan29.

1000-grain weight: A significant difference in 1000-grain weight was observed at different levels of nitrogen along with cowdung and vermicompost (Table 2). The highest weight of 1000- grain (23.50 g) observed in the treatment T_8 receiving 80 kg N as the source of urea and 60 kg N/ha from cowdung. The effect of this treatment was statistically identical to T_4, T_5 and T_9 treatments and ranks in second position. All the treatments including chemical nitrogen with the association of cowdung and vermicompost performed better in recording 1000-grain weight over only nitrogen treatment and control. The lowest 1000-grain weight (2.54 g) was found in control treatment.

Raw grain and straw yield: There was a significant effect of the treatments on grains and straw yield (Table 3). The highest raw grain and straw yield was found when 100 kg N as the source of urea along with 40 kg N from cowdung per hectare was applied. The lowest raw was noted in control (T_{12}) treatment.

Dry grain and straw yield: Dry grain and straw yield was significantly influenced by different fertilizer treatments (Table 3). The maximum dry yield was recorded in T_5 treatment which effect was statistically at par to T_1, T_7, T_8, T_9 and T_{10} treatment of BRRIdhan29 and the lowest dry grain yield was obtained from the control (T_{12}) treatment.

Combined application of 100 kg N as the source of urea along with 40 kg N/ha from cowdung performed the best in recording yield and yield contributing characters of BRRIdhan29. Among the organic sources, cowdung performed the best in recording yield and yield attributing characters as well as NPK content and uptake by BRRIdhan29.

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