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Organic and inorganic fertilizers influence the nutrient use efficiency and yield of a rice variety BINA dhan7

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Integration of chemical fertilizers with manures improves crop yield and minimizes the detrimental effects of fertilizers. Here, an effort was made to evaluate the combined effect of organic and inorganic fertilizers on the growth and yield of rice (BINA dhan7). Application of organic and inorganic fertilizers significantly increased the yield attributes as well as grain and straw yields of rice. The treatment T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) produced the highest grain yield (5670 kg ha^{-1}) and straw yield (6768 kg ha^{-1}) of rice. The lowest grain yield (3692 kg ha^{-1}) and straw yield (3751 kgha^{-1}) were found in T_0. Further, it was observed that application of same doses of fertilizers with poultry manure performed better than that of cowdung and compost. The NPKS uptake and use efficiency of BINA dhan7 were markedly influenced by combined application of organic and inorganic fertilizers. Overall, the treatment T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) was found to be the best combination of organic and inorganic fertilizers for obtaining the maximum yield as well as the economic yield of BINA dhan7.

Key words: Cowdung, Poultry manure, Compost, Fertilizers, Rice yield, Nutrient uptake.

INTRODUCTION

In Bangladesh, continuous use of chemical fertilizers has significant deleterious effects on soil fertility and crop productivity. Chemical fertilizers pollute soil and water making environment even more harmful for both terrestrial as well as aquatic life. As a result, in recent years there has been considerable scholarly interest in managing soil fertility and crop productivity through an integrated approach.

Organic matter contributes to soil fertility and productivity through its positive effect on the chemical, physical and biological properties of the soil. It has a nutritional function in that it serves as a reservoir of N, P and S for plant growth. But the organic matter content in many of our soils has been seriously depleted due to intensive cropping with modern varieties, very little use of crop residues, little or no use of organic fertilizers, etc. As a result, soil productivity, in general, has been degraded and stagnation in yield has occurred even with high dose of inorganic fertilizers in most of our soils under rice and wheat based cropping patterns. So efforts need to be concentrated to build up and maintain a satisfactory level of soil organic matter for getting increased and sustainable crop productivity.

Now a day, cropping intensity of Bangladesh is 180%

(BBS, 2010). The increasing cropping intensity without adequate and balanced use of chemical fertilizers and with little or no use of organic manures have caused severe fertility deterioration of our soils resulting in stagnating or even declining crop productivity. The organic matter content of most of our soils is below 1.5% and in many cases it is less than 1% (BARC, 2005). Depletion of soil organic matter in many of Bangladesh soils has reached such an alarming stage that it is caused serious concern among the crop production specialists. It is now feared that unless drastic measures are taken to improve and maintain organic matter reserves, many soils would soon become unproductive. Moreover, tropical monsoon climate with high temperature and abundant rainfall provide favorable condition for enhanced microbial decomposition of soil organic matter. So, it is very difficult rather impossible to conserve and maintain high level of organic matter in the soils. Hence, management of soil organic matter has now become a major issue in dealing with the problem of soil fertility and productivity in Bangladesh.

Akter *et al.* (2011) demonstrated the beneficial effects of inorganic and organic N fertilizers on rice yield. Long term application of fertilizers containing P, especially organic fertilizers, usually increase the water soluble and available P of soil and at the same time it may result in P accumulation in soil (Mohammadi *et al.* 2009). Residual effects of organic fertilizer or compost application on crop production and soil properties can last for several years (Eghball *et al.* 2005).

A great deal of work has been conducted with cowdung, poultry manure and compost and fertilizers in many countries of the world but the information on the relative contribution of organic fertilizers with chemical fertilizers in rice production is scarce in Bangladesh. Rahman *et al*. (2007), Parvez *et al.* (2008) and Rahman *et al*. (2009) previously reported the contribution of organic and inorganic fertilizers in rice production. However, to date there is insufficient understanding of the use of organic fertilizers integrating with inorganic fertilizers. Consequently, the goal of the present study was to evaluate the combined effect of organic and inorganic fertilizers on the yield of a rice variety BINA dhan7, the suitability of different sources of organic materials for using as manures for rice cultivation and to see any possible improvement in soil fertility due to use of organic fertilizers along with inorganic fertilizers.

MATERIALS AND METHODS

The experiment was carried out at the Soil Science Field Laboratory, Bangladesh Agricultural University, Mymensingh during July to December, 2010 to evaluate the effects of organic and inorganic fertilizers on the growth and yield of a rice variety BINA dhan7.

Soil: The soil belongs to Sonatala series under the AEZ-9 (Old Brahmaputra Floodplain). The soil was silt loam in texture having pH 6.18, organic matter content 2.15%, total N 0.124%, available P 6.51 ppm, exchangeable K 0.074 me%, available S 14.85 ppm and CEC 12.5 me%.

Treatments: There were altogether seven treatment combinations consisting of NPKS fertilizers applied as urea, triple superphosphate (TSP), muriate of potash (MoP) and gypsum, respectively in association with three sources of manure such as cowdung, poultry manure and compost. The rate of cowdung (CD), poultry manure (PM) and compost (Com) used was 5, 3, and 5 t ha^{-1}, respectively. The inorganic fertilizers were applied following the Fertilizer Recommendation Guide (BARC, 2005). The treatments include T_0 (control), T_1 (100%RFD), T_2 (75%RFD + CD 5 tha^{-1}), T_3 (75%RFD + PM 3 t ha^{-1}), T_4 (75%RFD + Com 5 t ha^{-1}), T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) . The RFD indicates recommended fertilizer dose.

Experimental design: The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The total number of unit plots was 21 and the size of unit plot was 5 m × 4 m.

Application of manures and fertilizers: Total amount of P, K and S fertilizers was applied as basal during final land preparation and urea was applied in 3 equal splits. Rotten cowdung, decomposed poultry manure and compost were applied 7 days before transplanting.

Transplanting: Twenty-five days old seedlings were transplanted in the experimental plots maintaining three seedlings per hill and 20 cm × 20 cm plant spacing.

Intercultural operations: Usual intercultural operations like weeding, watering, etc. were done as and when required.

Data collection: At maturity, the crop was harvested and the data on plant height, panicle length, effective tillers hill^{-1}, field grains panicle^{-1} and 1000-grain weight were recorded. Grain yield was recorded at 14% moisture basis and straw yield at sun dry basis.

Analysis of grain and straw samples: The grain and straw samples were analyzed for N, P, K and S contents following standard methods. Then the nutrient uptake as well as nutrient use efficiency was calculated with the following equations:

Nutrient uptakes were also calculated by the following formula:

Table 1. Nutrient contents in cowdung, poultry manure and compost

Manure	Nutrient contents			
	%N	%P	%K	%S
Cowdung	0.57	0.47	0.69	0.23
Poultry manure	1.18	1.13	0.81	0.35
Compost	0.89	0.30	0.45	0.46

$$\text{Nutrient uptake} = \frac{\text{Nutrient content (\%) x Yield (kg/ha)}}{100}$$

Nutrient use efficiency (NUE): $= (Gy_{+N} - Gy_{0N}) / FN$
Where, Gy_{+N} = grain yield in treatment with particular nutrient application
Gy_{0N} = grain yield in treatment without that particular nutrient application
FN = amount of fertilizer nutrient applied (kg/ha)

Analysis of soil samples: Initial and post-harvest soil samples were analyzed for physical and chemical properties following standard methods. Organic matter was determined by Walkley and Black method (Walkley and Black, 1934), soil pH (1:2.5 soil-water) by glass electrode pH meter method (Michael, 1965), total N by Semi-micro Kjeldahl method (Bremner and Mulvaney, 1982), available P by Olsen method (Olsen *et al.*, 1954), exchangeable K by Flame Photometer after extraction with 1N NH_4OA_c at pH 7.0 (Knudsen *et al.*, 1982), available S by extracting soil samples with $CaCl_2$, solution (0.15%) and by measuring turbidity by Spectrophotometer (Williams and Steinbergs,1959) method and CEC by Sodium saturation method (Chapman, 1965). The nutrient content of manures used in this study has been depicted in Table 1.

Economic analysis: A partial budget was estimated. Marginal benefit cost ratio (MBCR) was used as a tool of partial budget analysis. Added cost and added benefit were calculated. Besides, the gross return was calculated on the basis of farm prices of rice grain and straw prevailed during the harvesting period. Marginal benefit cost ratio (MBCR) is the ratio of marginal or added benefit and cost. To compare different fertilizer treatments with control the following equation was used as outlined by Rahah *et al*. (2007).

$$MBCR = \frac{Gross\ income\ of\ treatment - Gross\ income\ of\ control}{Gross\ cost\ of\ production\ (treatment) - Gross\ cost\ of\ production\ (control)}$$

Statistical analysis: All the data were statistically analyzed by F-test and the mean differences were adjudged by Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez; 1984).

RESULTS AND DISCUSSION

Yield attributes

The yield attributes of BINA dhan7 was significantly influenced due to combined application of organic and inorganic fertilizers (Table 2). The tallest plant of 90.76 cm was found in T_3 (75% RFD + PM 3 t ha^{-1}) and the shortest one (81.00 cm) was observed in control. The highest panicle length (23.96 cm) was found in T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and the lowest value (21.92) was noted in T_0. The maximum number of effective tillers $hill^{-1}$ of 13.46 was found in T_1 (100% RFD) and the minimum value of 9.73 was observed in T_0. The treatment T_4 (75%RFD + Com 5 t ha^{-1}) and T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) demonstrated statistically similar effective tillers $hill^{-1}$. The number of filled grains $panicle^{-1}$ varied from 61.15 to 117.86 with the highest value in T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and the lowest value in T_0. The 1000-grain weight ranged from 21.34g in T_0 (control) to 22.05g in T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}).

Grain yield

The application of organic and inorganic fertilizers had a remarkable effect on the grain yield of BINA dhan7. The grain yield ranged from 3692 to 5670 kg ha^{-1}. The highest grain yield (5670 kg ha^{-1}) was observed in T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and the lowest value (3692 kg ha^{-1}) was recorded in T_0 (control) as shown in Table 2. The increase in grain yield over control ranged from 39.72 to 53.56% where the highest increase was obtained in T_5 and the lowest one was obtained with T_2 (75%RFD + CD 5 t ha^{-1}). Khan *et al.* (2007) reported that grain yield was significantly increased due to application of organic manure and chemical fertilizers.

Table 2. Effects of manures and fertilizers on the yield components and yield of BINA dhan7

Treatment	Plant height (cm)	Panicle length (cm)	Effective tillers hill^{-1} (No.)	Filled grains panicle^{-1} (No.)	1000-grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_0	81.00b	21.92c	9.73c	61.15e	21.34	3692b	3751e
T_1	88.00a	23.82a	13.46a	96.10b	21.37	5458a	5811c
T_2	88.26a	22.43bc	10.26bc	81.60d	22.04	5159a	5220d
T_3	90.76a	23.78a	10.76bc	105.06b	21.70	5641a	5809c
T_4	89.03a	23.50ab	12.06ab	82.90cd	21.34	5330a	5383d
T_5	87.70a	23.96a	12.13ab	117.86a	21.71	5670a	6768a
T_6	87.36a	23.27ab	10.90bc	94.03bc	22.05	5526a	6297b
CV (%)	2.33	2.74	9.54	6.92	3.45	5.39	4.36
SE (±)	1.1759	0.3677	0.6244	3.6429	0.4307	162.3097	138.6036

Figures in a column having common letters do not differ significantly at 5% level of significance. CV (%) = Coefficient of variation; SE (±) = Standard error of means
T_0 (Control), T_1 (100% RFD), T_2 (75%RFD + CD 5 t ha^{-1}), T_3 (75%RFD + PM 3 t ha^{-1}), T_4 (75%RFD + Com 5 t ha^{-1}), T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}).

Straw yield

The straw yield of BINA dhan7 ranged from 3751 to 6768 kg ha^{-1} (Table 2). The highest straw yield of 6768 kg ha^{-1} was obtained in T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and the lowest value of 3751 kg ha^{-1} was noted in T_0 (control). Regarding the percent increase of straw yield, maximum increase (70.44%) was noted in T_5 and the minimum (39.17%) was found in T_2 (75%RFD + CD 5 t ha^{-1}). Rahman *et. al.* (2009) reported that the application of urea-N in combination with cowdung and poultry manure increased the straw yields of rice.

Nutrient Uptake

N uptake by BINA dhan7 varied significantly due to application of organic and inorganic fertilizers. The highest N uptake (112.8 Kg ha^{-1}) was observed in T_1 (100%RFD) and the lowest value (61.32 Kg ha^{-1}) was found in T_0 (Table 3).

The highest P uptake (21.21 kg ha^{-1}) was obtained in T_5

Table 3. Effects of organic and inorganic fertilizers on N, P, K, S uptake by BINA dhan7

Treatment	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})	S uptake (kg ha^{-1})
T_0	61.32d	9.114e	62.35e	5.520e
T_1	112.8a	16.86c	122.7c	9.664b
T_2	89.71c	15.83c	128.5c	6.163d
T_3	95.83bc	18.82b	111.5d	9.285b
T_4	102.1b	12.86d	129.4c	8.161c
T_5	98.30b	21.21a	171.5a	10.74a
T_6	91.17c	20.76a	156.8b	10.73a
CV (%)	4.08	4.12	3.28	3.45
SE (±)	2.1901	0.3924	2.3904	0.1717

Figures in a column having common letters do not differ significantly at 5% level of significance.
CV (%) = Coefficient of variation; SE (±) = Standard error of means
T_0 (Control), T_1 (100% RFD), T_2 (75%RFD + CD 5 t ha^{-1}), T_3 (75%RFD + PM 3 t ha^{-1}), T_4 (75%RFD + Com 5 t ha^{-1}), T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1})

(75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) which was identical with T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and the lowest total P uptake (9.114 kg ha^{-1}) was observed in T_0 (control) as shown in Table 3. Poultry manure exerted better effect in increasing the P uptake by rice grain and straw compared to cowdung and compost. Dongarwar *et al*. (2003) observed that the P uptake by rice grain was increased with the combined application of organic and inorganic fertilizers.

The K uptake by BINA dhan7 was also elevated with the use of manures and fertilizers. The highest K uptake (171.5 Kg ha^{-1}) was obtained in T_5 and the lowest value (62.35 Kgha^{-1}) was observed in T_0 (Table 3). The results are in agreement with Meena *et al*. (2003) who reported that application of organic and inorganic fertilizers significantly increased the K uptake by rice.

The maximum S uptake (10.74 kg ha^{-1}) was found in T_5 (75%RFD + CD 2.5t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) which was at par with T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and the minimum value (5.520 kg ha^{-1}) was observed in T_0 (Table 3). Combination of cowdung, poultry manure and compost with the inorganic fertilizers showed better effects than other treatments in increasing S uptake by BINA dhan7. Sarfaraz *et al.* (2002) observed that application of sulphur enhanced sulphur uptake significantly by rice.

Nutrient use efficiency

Grain yield increase in Kg per Kg nutrient applied is considered as nutrient use efficiency. The NPKS use efficiency for different organic and inorganic fertilizers treatments were calculated to compare the use efficiency of nutrients by crop. The use efficiency of NPK was maximum in T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) except P and minimum in T_2 (75%RFD + CD 5 t ha^{-1}). But the S use efficiency was the highest in T_3 (75%RFD + PM 3 t ha^{-1}) followed by T_1 and T_6 and the minimum value was quantified in T_4 (75%RFD + Com 5 t ha^{-1}) as shown in Figure 1. However, it might be considered that the nutrient use efficiency is better in T_6 than the other organic and inorganic fertilizers combinations.

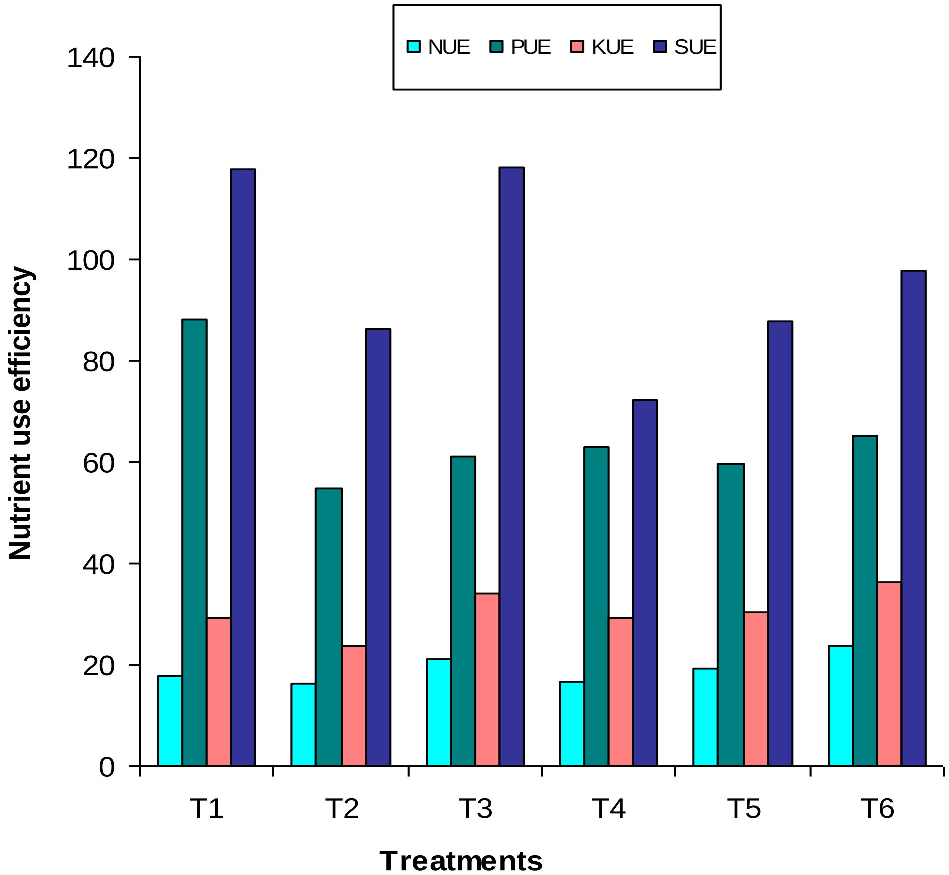

Figure 2. Nutrient use efficiency as influenced by organic and inorganic fertilizers

Soil properties

Soil pH

Application of cowdung, poultry manure, compost and NPKS fertilizers caused in general a declining trend in pH of the post-harvest soils (Table 4). Most of the treatments slightly decreased the soil pH as compared to initial soil except T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}). The pH values of the post-harvest soils ranged from 6.03 to 6.36 where the pH of the initial soil was 6.18. The lowest value of pH 6.030 was observed in T_2 (75%RFD + CD 5 t ha^{-1}) and the highest value of pH 6.367 was found in T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}).

Organic matter content

The organic matter content of the post-harvest soils ranged from 2.01% in T_0 (control) to 2.20% in T_4 (75%RFD + Com 5 t ha^{-1}) (Table 4). The organic matter content of initial soil was 2.15%. The organic matter content of post-harvest soils slightly increased due to application of organic and inorganic fertilizers although the increase was not significant. Increase of organic matter is a long term process. It is not possible to bring a significant change in organic matter content of soil by one year.

Total nitrogen

A little increase in N content of post-harvest soils in the manures and fertilizers treated plots was noted as compared to the initial soil (Table 4). The total N content of the post-harvest soils ranged from 0.116 to 0.128% as compared to the value of 0.124% in initial soil.

Available phosphorus

Available phosphorus content of the post-harvest soils was influenced a bit by the application of organic and

Table 4. Effects of organic and inorganic fertilizers on the properties of the post-harvest soils

Treatment	pH	Organic matter (%)	Total N (%)	Available P (ppm)	Exchangeable K (me %)	Available S (ppm)	CEC (me %)
T_0	6.18	2.01	0.116	6.650	0.064	5.850	11.87
T_1	6.06	2.06	0.119	7.000	0.077	12.90	11.87
T_2	6.03	2.14	0.124	9.750	0.069	14.40	12.50
T_3	6.10	2.18	0.126	7.850	0.067	13.35	11.87
T_4	6.17	2.20	0.127	11.93	0.074	13.05	12.50
T_5	6.36	2.19	0.127	6.957	0.072	14.17	11.25
T_6	6.23	2.19	0.127	7.317	0.072	9.300	12.50
Initial soil status	6.18	2.15	0.124	6.510	0.074	14.85	12.50
SE (±)	NS	NS	NS	NS	NS	NS	NS

NS = Non-significant
T_0 (Control), T_1 (100% RFD), T_2 (75%RFD + CD 5 t ha^{-1}), T_3 (75%RFD + PM 3 t ha^{-1}), T_4 (75%RFD + Com 5 t ha^{-1}), T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}).

inorganic fertilizers (Table 4). Available P content in soil ranged from 6.650 to 11.93 ppm against the P value of 6.510 ppm in the initial soil. The release of available P from the decomposition of organic fertilizers might be the cause of higher values in soils treated with these manures.

Exchangeable potassium

The exchangeable K content of the initial soil was 0.074 me% and the values in the post-harvest soils ranged from 0.064 to 0.077 me%. The highest exchangeable K (0.077 me%) was found in the T_1 (100% RFD) due to application of inorganic fertilizers while the treatment T_0 (control) produced the lowest value (0.064 me%).

Available sulphur

The available S content of post-harvest soils varied slightly due to different treatments as shown in Table 4. The available S content of post-harvest soils ranged from 5.850 to 14.40 ppm. The highest available S content (14.40 ppm) was found in T_3 (75%RFD + PM 3 t ha^{-1}) and the lowest value (5.850 ppm) was found in T_0 (control).

Cation exchange capacity

The cation exchange capacity (CEC) of post-harvest soils ranged from 11.25 to12.50 me% (Table 4) where the CEC of the initial soil was 12.50 me%. In some treatments the CEC of soil decreased. It might be due to the loss of basic cations from soil by different ways.

Table 5. Economic analysis of BINA dhan7 as influenced by the application of organic and inorganic fertilizers

Treatment	Yield (kg/ha)		Gross return (Tk.)	Added cost over control (Tk/ha)	Added benefit over control (Tk/ha)	Gross margin over control (Tk/ha)	MBCR (over control)
	Grain	Straw					
T_0	3692.33	3751	66637	-	-	-	-
T_1	5458	5811	99303	8935	32666	23731	3.656
T_2	5159	5220.33	93046	11700	26409	14709	2.257
T_3	5641.67	5329	100612	9700	33975	24275	3.503
T_4	5330.67	5383	96109	11700	29472	17772	2.519
T_5	5670	6768.33	105355	13200	38718	25518	2.933
T_6	5526	6297	101781	10974	35144	24170	3.202

T_0 (Control), T_1 (100% RFD), T_2 (75%RFD + CD 5 t ha^{-1}), T_3 (75%RFD + PM 3 t ha^{-1}), T_4 (75%RFD + Com 5 t ha^{-1}), T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) and T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}).

Economic analysis

The marginal-benefit cost ratio (MBCR) of BINA dhan7 as influenced by fertilizers and manurial treatments has been presented in Table 5. MBCR is the ratio of marginal or added benefit and cost. To compare different organic and inorganic fertilizers treatments with control the following equation outlined by Rahah *et al*. (2007) was used:

$$MBCR = \frac{Gross\ income\ of\ treatment - Gross\ income\ of\ control}{Gross\ cost\ of\ production\ (treatment) - Gross\ cost\ of\ production\ (control)}$$

The cost and return analysis of BINA dhan7 shows that the highest marginal benefit-cost ratio of 3.656 was obtained from T_1 (100% RFD) which was followed by T_3 (75%RFD + PM 3 t ha^{-1}) with the value of 3.503 and T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) with the value of 3.202. But the gross margin was maximum in T_5 (75%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) followed by T_3, T_6 and T_1. Considering the benefit-cost ratio and marginal benefit T_3 might be ranked first followed by T_6. However, the residual effects on the following crops will be higher in T_6 compared to all other treatments. Considering the above facts, the T_6 might be the best suited combination of organic and inorganic fertilizers for BINA dhan7 and it could be considered as economically profitable as well.

CONCLUSIONS

The overall results indicate that application of cowdung, poultry manure and compost in combination with different doses of NPKS fertilizers had a significant effect on the growth and yield of Binadhan-7. It was noted that application of 2.5 t ha^{-1} CD, 1.5 t ha^{-1} PM and 2.5 t ha^{-1} compost may reduce the use of NPKS fertilizers by 25% to 50%. Based on economic analysis, it can be concluded that the treatment T_6 (50%RFD + CD 2.5 t ha^{-1} + PM 1.5 t ha^{-1} + Com 2.5 t ha^{-1}) can be used for profitable cultivation of BINA dhan7.

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