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# Integrated use of organic manure with chemical fertilizers on the growth and yield of T. Aman rice

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**ABSTRACT**

*A Field experiment was conducted in combination with chemical fertilizers and manure. The treatments were $T_0$(control), $T_1$($N_{100}P_{15}K_{45}S_{20}$ (Recommended dose), $T_2$ (50% NPKS+5 t $ha^{-1}$ CD), $T_3$ (70% NPKS+3 t $ha^{-1}$ CD), $T_4$(50% NPKS+4t $ha^{-1}$ PM ), $T_5$ (70% NPKS+2.4 t $ha^{-1}$ PM ), $T_6$ (50% NPKS+10 t $ha^{-1}$ DH) and $T_7$ (70% NPKS+6 t $ha^{-1}$ DH). The result demonstrated that the grain and straw yields were significantly influenced by the added fertilizers and manure. Application of 50% of NPKS fertilizers plus 10 t $ha^{-1}$ dhaincha produced maximum grain yield (5085 kg $ha^{-1}$) which was identical to that obtained with 70% of NPKS with 6 t $ha^{-1}$ dhaincha. In case of straw yield, the treatment $T_7$ (70% NPKS+6 t $ha^{-1}$ DH) produced the highest yield (5470 kg $ha^{1}$) and then (5250 kg $ha^{-1}$) yield obtained from $T_6$ (50% NPKS+10 t $ha^{-1}$ DH) treatment. The grain yield increases over control ranges between 115 to 176%. Grain yield of T. Aman rice was positively correlated with plant height, number of effective tiller, panicle length, filled grains $panicle^{-1}$ and straw yield. The overall findings of this study indicate that the integrated use of fertilizer and manure should be encouraged to address the deteriorating soil fertility and increased crop yield of T. Aman rice.*

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## I. Introduction

Major constrain of higher crop production in Bangladesh is depletion of soil fertility. Farmers of this country use on an average 102 kg nutrients $ha^{-1}$ annually (70 kg N + 24 kg P + 6 kg K + 2 kg S and Zn) and the crop removal rate is about 200 kg $ha^{-1}$ (Islam *et al.* 1994). Fertile soil is fundamental for higher crop production and the maintenance of fertility is essential for sustainable crop production. Organic matter is a key factor for maintaining soil fertility and sustainable crop productivity. An ideal soil should contain 2% organic matter but most of the cultivated soil in Bangladesh has only less than 1.5%. This important component of soil is declining day by day for intensive cropping and excessive use of chemical fertilizers. In addition, rapid mineralization of soil organic matter occurs due to humid tropic climatic conditions of Bangladesh. Cycling of organic matter in soil is a prerequisite for efficient cycling of nutrients. Unless due attention is paid to the improvement and maintenance of soil organic matter it may not be possible the goal to increase and sustained productivity of crop. In Bangladesh rice is intensively cultivated crop which cover about 80% of arable land. For ensuring quality food production and sustainable agriculture, the use of suitable combination of organic and inorganic sources of nutrients is essential. The use of cowdung @ 5 t $ha^{-1}$ $year^{-1}$ had increased rice productivity and prevented soil from degradation (Bhuiyan, 1994). Poultry manure is also used as organic source of soil nutrient. Meelu and Singh (1991) showed that 4 t $ha^{-1}$ poultry manure along with 60 kg N $ha^{-1}$ as urea produce grain yield of crop similar to that with 120 kg N $ha^{-1}$ 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. Combined 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 high yield. Thus, it is necessary to carry out studies by using fertilizers and manures in an integrated way in order to obtain sustainable crop yield without affecting soil fertility. Based on the soil fertility problem as discussed above, the objectives of the study is to develop a suitable combination of chemical fertilizers and organic manures for T. Aman rice production.

## II. Materials and Methods

The experiment was conducted in typical rice growing silt loam soil at the Sher-e-Bangla Agricultural University (SAU) farm, Sher-e-Bangla Nagar, Dhaka during the T. Aman season of 2014. BRRI dhan 33, T. Aman rice variety was used in this experiment. Bangladesh Rice Research Institute (BRRI) developed this variety in 1997. Genetic serial no. is BG 850-2, and life cycle ranges from 105-115 days. Heights of mature plants are 100 cm and do not lodge. The experiment was laid out in a randomized complete block design (RCBD). Each block was divided into eight unit plots as treatments with raised bunds around. The plot size was 2 m x 2 m. The fertilizer treatments used in the experiment was based on BARC Fertilizer Recommendation Guide, 2005. Three different types of organic manure (dhaincha, cowdung and poultry manure) were used in this study. The experiment had 8 treatments, viz. control. 100% recommended dose of NPKS and 50% or 30% reduction of NPKS dose plus dhaincha (DH), cowdung (CD) and poultry manure (PM). The treatments were $T_0$: Control, $T_1$: $N_{100}P_{15}K_{45}S_{20}$ (Recommended dose), $T_2$: 50% NPKS + 5 t $ha^{-1}$ CD, $T_3$: 70% NPKS + 3 t $ha^{-1}$ CD, $T_4$: 50% NPKS + 4 t $ha^{-1}$ PM, $T_5$: 70% NPKS + 2.4 t $ha^{-1}$ PM, $T_6$: 50% NPKS + 10 t $ha^{-1}$ DH, $T_7$: 70% NPKS + 6 t $ha^{-1}$ DH

The plant height was measured from the ground level to the top of the panicle. From each plot, plants of 10 hills were measured and averaged. The measurement of panicle length was taken from basal node of the rachis to the apex of panicle. Each observation was an average of 10 hills. Ten hills were taken randomly from each plot and total numbers of effective tillers $hill^{-1}$ were recorded. Filled and unfilled grains per panicle were counted and averaged from the panicles of ten hills. 1000 grains were taken from the samples and after sun drying the weight was recorded by using electrical balance. The harvested crops was threshed, cleaned, dried and weighed. Straw and grain yields were adjusted to 14% moisture content.

Data for every crop parameters and also for the nutrient concentration and nutrient uptake by the plant (grain and straw) were analyzed by using F-test to examine whether the treatments were significant or

non-significant (Gomez and Gomez, 1984). The mean comparisons of the treatment were evaluated by DMRT (Duncan's Multiple Range Test).

## III. Results and Discussion

### Plant height

The plant height varied significantly for different treatments (Table 01). It was revealed that all the treatments produced significantly taller plants compared to the control. The plant height ranged from 98.50 to 104.88 cm and the highest value (104.88 cm) was $T_4$ (50% NPKS + 4 t ha$^{-1}$ poultry manure), which was statistically similar to those found in treatments $T_2$, $T_3$, $T_6$ and $T_7$ respectively. The lowest plant height (98.50 cm) was obtained in the treatment $T_0$ where no fertilizers were used. The combined application of fertilizers with manure increased the plant height compared to single application of recommended dose of fertilizers. Babu *et al.* (2001) observed that the application of organic manure and chemical fertilizers has significant influence on plant height. Rajani Rani *et al*. (2001); Singh *et al.* (1999); Hossain *et al.* (1997) and Sharma and Mitra (1991) also observed similar results.

### Panicle length

The panicle length of BRRI dhan 33 varied significantly by different treatments (Table 01). The panicle length ranged from 23.19 to 24.41 cm. The highest panicle length of 24.41 cm was observed in $T_4$ (50% NPKS+4 t ha$^{-1}$ poultry manure). The lowest panicle length (23.19 cm) was recorded in $T_0$. The treatments of $T_1$, $T_5$, $T_6$ and $T_7$ produced statistically similar panicle length. The more increase of panicle length was observed in the single application of NPK fertilizers compared to combined application of chemical fertilizers with cowdung or dhonicha. BRRI dhan 33 responded significantly better-combined application of 50% chemical fertilizers with organic manure. Haque (1999) and Azim (1999) noted a significant increase in panicle length which was obtained by using organic manure and chemical fertilizers. Babu *et al*. (2001); Ahmed and Rahman (1991) and Apostol (1989) also observed similar results.

### Number of grains panicle$^{-1}$

The number of grains panicle$^{-1}$ varied significantly by different treatments (Table 01). The number of grains panicle$^{-1}$ ranged from 84.2 to 106.1 and the highest value (106.1) was observed in the treatment $T_7$ (70% NPKS+ 6 t ha$^{-1}$ dhaincha). It was observed that the number of grains panicle$^{-1}$ did not vary significantly among the treatments $T_0$, $T_1$, $T_3$ and $T_4$. The lowest value (84.17) was obtained in the treatment $T_2$ where 5 t ha$^{-1}$ cowdung was applied along with 50% NPKS fertilizers. Dhaincha manure applied in combination with NPKS fertilizer increased the number of grains panicle$^{-1}$ of BRRI dhan 33 considerably compared to poultry manure and cowdung. The effect of manure on increasing the number of grains panicle$^{-1}$ was more pronounced as compared to fertilizers. Grains panicle$^{-1}$ significantly increased due to the application of organic manures and chemical fertilizers (Razzaque, 1996). These results are also similar with Hoque (1999) and Azim (1999).

### Number of effective tillers hill$^{-1}$

The number of effective tillers hill$^{-1}$ of BRRI dhan 33 significantly varied due to application of organic manure and chemical fertilizers. The number of effective tillers hill$^{-1}$ due to different treatments ranged from 12.70 to 19.50 (Table 1). The treatment $T_1$ ($N_{100}P_{20}K_{45}S_{15}$) gave the highest number of effective tillers hill$^{-1}$ where chemical fertilizers were applied at the recommended doses. The treatment $T_6$ and $T_0$ was statistically similar and $T_7$ was statistically similar with $T_2$. The lowest number of effective tillers hill$^{-1}$ (12.7) was observed in the treatment $T_3$ (70% NPKS+3 t ha$^{-1}$ cowdung). The lower number of effective tillers hill$^{-1}$ also observed in the treatment $T_4$ (50% NPKS + 4 t ha$^{-1}$ poultry manure) and $T_5$ (70% NPKS+2.4 t ha$^{-1}$ PM). The superior effect of dhaincha in increasing the number of effective tillers hill$^{-1}$ of BRRI dhan 33 over cowdung and poultry manure was noted. BRRI dhan 33 responded significantly better to chemical fertilizers when applied at the recommended doses than the manure when applied singly or combined application of 50% of manure and chemical fertilizers. Chander and

Pandey (1996) observed a significant increase in effective tillers hill$^{-1}$ due to application of higher doses of nitrogen.

### 1000-grain weight

The 1000-grain weight varied significantly due to different treatments. The 1000-grain weight ranged from 22.5 to 23.03 gm. The highest thousand grain weight of 23.03 gm was obtain in $T_1$ (Recommended dose) treatment which was statistically similar with all other treatments except $T_0$ and $T_4$. The lowest thousand-grain weight was recorded in $T_0$ (Control) treatment, which was statistically identical with $T_4$ treatment. Abedin *et al*. (1999) reported that the combined application of organic manure and chemical fertilizers increased the 1000-grain weight of rice. Apostol (1989) observed that application of organic manure and chemical fertilizer increased 1000-grain weight of rice. Hoque (1999) also observed that 1000-grain weight was increased by applying organic manure.

**Table 01. Effect of organic manures and chemical fertilizers on different growth parameter of T. Aman rice (cv. BRRI dhan 33)**

| Treatments | Plant height (cm.) | Panicle length (cm.) | Number of grains panical$^{-1}$ | Number of effective tiller hill$^{-1}$ | 1000-grain weight (gm.) |
|---|---|---|---|---|---|
| $T_0$ | 98.50 c | 23.19 b | 89.2 c-e | 18.85 ab | 22.57 b |
| $T_1$ | 101.61 b | 24.00 ab | 92.3 b-d | 19.50 a | 23.04 a |
| $T_2$ | 102.26 ab | 23.13 b | 84.9 e | 17.70 bc | 23.03 a |
| $T_3$ | 103.11 ab | 23.40 b | 93.3 bc | 12.70 e | 23.00 a |
| $T_4$ | 104.88 a | 24.41 a | 93.4 bc | 14.70 d | 22.62 b |
| $T_5$ | 101.79 b | 23.58 ab | 86.1 de | 16.25 c | 23.02 a |
| $T_6$ | 103.48 ab | 23.66 ab | 96.8 b | 18.95 ab | 23.01 a |
| $T_7$ | 104.23 ab | 23.96 ab | 106.1 a | 17.75 bc | 23.00 a |
| *SE (±)* | *0.61* | *0.19* | *1.55* | *0.36* | *0.05* |
| *CV (%)* | *1.68* | *2.24* | *4.73* | *6.00* | *0.59* |

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

### Grain yield

The grain yield of BRRI dhan 33 varied significantly for the application of organic manure and chemical fertilizers (Table 02). All the treatments gave significantly higher grain yield over the control. The grain yield ranged from 2895 to 5085 kg ha$^{-1}$. The highest grain yield (5085 kg ha$^{-1}$) was observed in the treatment $T_6$ (70% NPKS + 6 t ha$^{-1}$ dhaincha) and the lowest value (2895 kg ha$^{-1}$) was recorded in the treatment $T_0$ (control). The next higher grain yield (5080 kg ha$^{-1}$) was observed in the treatment $T_7$ (70% NPKS+ 10 t ha$^{-1}$ dhaincha) which was statistically identical with $T_1$ (Recommended dose). The treatment may be ranked in order of $T_6>T_7>T_1>T_2>T_5>T_4>T_3>T_0$. The percent increase in grain yield over control ranged from 75.65 to 14.85%. Dhaincha manure when applied in combination with fertilizer NPKS exerted marked effect in increasing the grain yield of BRRI dhan 33 as compared to poultry manure and cowdung. It is noticed here that treatment $T_3$ (70% NPKS+3 t ha$^{-1}$ cowdung) failed to produce the highest grain yield due to lodging. Dwivedi and Thakur (2000) reported the grain yield was significantly increased due to application of organic manure and chemical fertilizers. These findings are similar with the work of Rajni Rani *et al*. (2001); Haque *et al.* (2001); Ahmed and Rhaman (1991); Calendacion *et al.* (1990) and Laxminarayan (2000).

### Straw yield

Straw yield of BRRI dhan 33 also varied significantly by different treatments. The straw yield ranged from 3221 to 5470 kg ha$^{-1}$. The highest straw yield (5470 kg ha$^{-1}$) was obtained in the treatment $T_7$ (70% NPKS+ 6 t ha$^{-1}$ dhaincha) and the lowest value (3221 kg ha$^{-1}$) was noted in the treatment $T_0$

(Control). The next highest straw yield (5250 kg ha$^{-1}$) was observed in the integrated use of 50% NPKS fertilizers and 10 t ha$^{-1}$ dhaincha manure treatment $T_6$, which was statistically comparable with treatments $T_5$ and $T_4$ respectively. In terms of straw yield the treatments can be arranged in order to $T_7>T_6>T_2>T_1>T_5>T_4>T_3>T_0$. The percent increase in straw yield range from 69.82 to 36.82 % in different treatments over the control. Ahmed and Rahman (1991) find out that the straw yields of rice increased by the application of organic manure and chemical fertilizers. These findings are similar with the work of Islam (1997) and Khan (1998). It is clear that the use of organic manure with chemical fertilizers encouraged the growth of plants and thereby increasing straw yield.

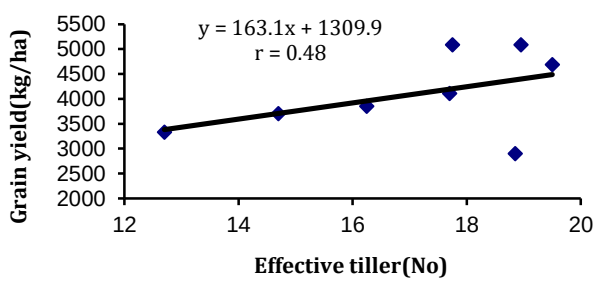
**Table 02. Effect of organic manure and chemical fertilizers on the grain and straw yield of T. Aman rice (cv. BRRI dhan 33)**

| Treatments | Grain | | Straw | |
|---|---|---|---|---|
| | Yield (kg ha$^{-1}$) | Increase over control (%) | Yield (kg ha$^{-1}$) | Increase over control (%) |
| $T_0$ | 2895 d | - | 3221d | - |
| $T_1$ | 4685 a | 61.83 | 4777cd | 48.30 |
| $T_2$ | 4105 b | 41.80 | 5009 bc | 55.52 |
| $T_3$ | 3325 c | 14.85 | 4407 a-c | 36.82 |
| $T_4$ | 3700 bc | 27.81 | 4482 ab | 39.15 |
| $T_5$ | 3850 b | 33.00 | 4519 ab | 40.30 |
| $T_6$ | 5085 a | 75.65 | 5250 ab | 63.00 |
| $T_7$ | 5080 a | 75.47 | 5470 a | 69.82 |
| *SE (±)* | *95.75* | - | *82.05* | - |
| *CV (%)* | *6.62* | - | *5.00* | - |

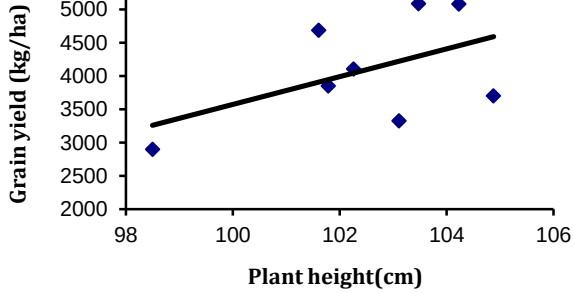
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

### Correlation of yield components with grain and straw yields

Grain yield of a crop is a complex character, which results from interactions of many characters. Grain yield was positively correlated with number of effective tillers, plant height, panicle length and filled grains panicle$^{-1}$. Similarly straw yield was positively correlated with plant height (r=0.86**) and panicle length(r=0.42).




**Correlation between effective tiller and grain yield**




**Correlation between plant height and grain yield**

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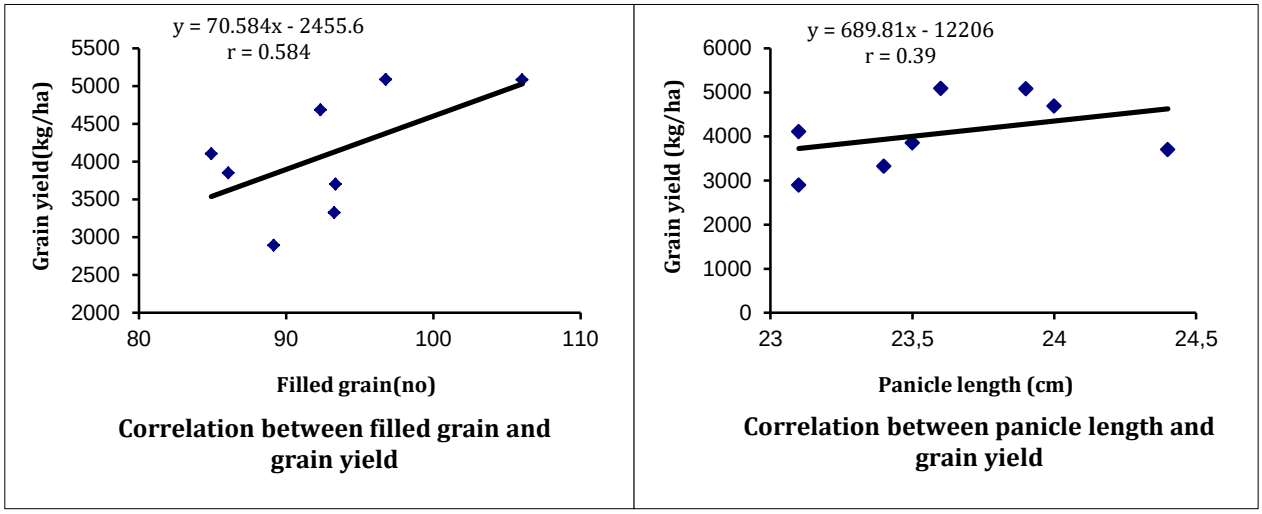


**Figure 01. Correlation between grains yields with yield components of rice**

## IV. Conclusion

From the present study it may be concluded that BRRI dhan 33 responded better to the nutrient supplied from the organic manure in producing grain and straw yields. The study clearly demonstrates that the benefit of using dhaincha as green manure can reduce the N, P, K and S fertilizers for T. Aman rice, giving good growth and yield. BRRI dhan 33 can be cultivated profitably in the Tejgaon silt loam soil by using combined application of 50% NPKS fertilizers with 10 t $ha^{-1}$ dhaincha. The overall findings of this study indicate that the combined use of fertilizer and manure in T. Aman rice should be encouraged for maintaining rice growth, yield and soil fertility.

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