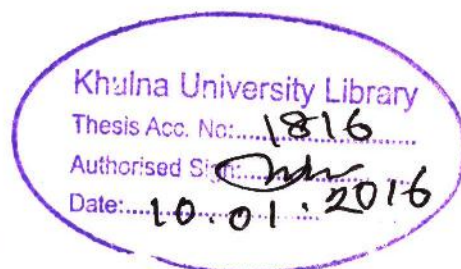


**EFFECT OF DIFFERENT MANURES AND FERTILIZERS
ON BRRI dhan28 IN BORO SEASON**



**A THESIS
BY
MD. ZAHIDUL ISLAM
EXAMINATION ROLL NO. MS-060811**

**A thesis Submitted to the Agrotechnology Discipline, Khulna University
in partial fulfillment of the requirements for the Degree of
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The Author

ABSTRACT

A field experiment was carried out at the Bodo Kashipur, Sorulia, under Tala upzilla of Satkhira district during boro season (Jan-May) of 2008 which was undertaken with the objective of investigating the efficacy of decomposed floating bed/ Dhap materials as a source of organic manures in boro rice cultivation in comparison with other sources of nutrients. The experiment was laid out in a randomized complete block design (RCBD), with three replications. There were 7 treatments viz., T₁: 10 t DFBM (Decomposed floating bed / Dhap materials), T₂: 10 t FYM (Farmyard manure), T₃: 100% RFD (Recommended fertilizer dose), T₄: 50% RFD + 5 t DFBM, T₅: 50% RFD + 5 t FYM, T₆: 5 t DFBM + 5 t FYM and T₇: Control (without manures and fertilizers). The doses of inorganic fertilizers N, P, K, S and Zn were 80, 50, 40, 10 and 5 kg ha⁻¹ respectively. Standard management practices were followed in raising crops. The rice variety BRRI dhan28 differed considerably for treatment variations in terms of crop growth characters as well as yield and yield contributing characters. The highest grain yield (3.06 t ha⁻¹), number of tillers hill⁻¹ and other yield and yield contributing characters except straw yield was obtained in 100% recommended fertilizer dose which was statistically similar to the treatment 10 t decomposed floating bed materials. The lowest grain yield (2.08 t ha⁻¹) was observed in treatment T₇ (control). The highest Plant height (113.63 cm) and the highest biological yield (7.66 t ha⁻¹) was found using the treatment 10 t decomposed floating bed materials ha⁻¹ which was statistically similar with the treatment 100% recommended fertilizer dose. The highest dry matter hill⁻¹ (29.29 g) and straw yield (4.79 t ha⁻¹) was obtained using the treatment 10 t decomposed floating bed materials ha⁻¹. Thus the result indicated that the decomposed floating bed materials could be used as a good source of organic manure which proved available alternative of chemical fertilizers in boro season for the farmers.



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CHAPTER I

INTRODUCTION



Bangladesh is an agro-based country where agriculture is the single largest sector and the mainstay of the country's economy. About 76.47% of the total population live in rural areas and are directly or indirectly engaged in a wide range of agricultural activities (AIS, 2008). The agriculture sector plays a very important role in the economy of the country accounting for 21.10% of total GDP and provides employments for 2,29,31,000 people (AIS, 2008).

Agriculture in Bangladesh is predominated by intensive rice (*Oryza sativa* L.) cultivation. Rice covers almost 80% of the total cropped area and it constitutes about 97% of the total cereal production of the country (Bari *et al.*, 1997). Out of total rice production in this country about 47% comes from boro and the rest 8% and 45% comes from aus and aman crops, respectively (BBS, 2000). The total production of rice in Bangladesh is not sufficient to feed her population. Here lies the necessity of increasing yield of crops without declining soil fertility.

Thus use of balanced fertilizers along with management practices can play a key role in sustaining higher yield of crops under different cropping patterns and also can preserve soil health on a long term basis. The integrated use of organic and inorganic fertilizers might be helpful for sustainable crop production.

Soil organic matter plays a very important role in preserving and maintaining the fertility and productivity of soil. It acts as a reservoir of plant nutrients (mainly for N, P and S) and prevents leaching of the elements which are vital to plant growth. Moreover, the capacity of soil organic matter to buffer soils against rapid changes in pH is well known. The most important role of organic matter for rice production is to supply N and to regulate the immobilization and mineralization of N in the soil. The addition of organic matter is useful in maintaining or increasing the organic substances or nitrogenous compounds in soil which are decomposed slowly but steadily. Organic matter content of Bangladesh soils is low and declining day by day. In addition to being a good source of plant nutrients, organic matter improves the physical, chemical and biological properties of soil and thus helps to increase and conserve the soil productivity. Decomposed floating bed materials (Dhap) are good sources of organic matter and may play a vital role in soil fertility improvement as well as in supplying nutrients especially N, and K with other micro nutrients for crop production (Islam and Atkins, 2007).

In view of the continued need to increase crop yield unit⁻¹area, proper use of inorganic fertilizers and organic manures are essential. It is also essential to look after immediate crop needs in order to build up soil fertility and to conserve good soil health for increasing crop production in future. In addition, global environmental pollution can be controlled considerably by reducing the use of fertilizer and increasing the use of manures. The present study is, therefore, undertaken with the following objective:

- **To investigate the effect of different manures and fertilizers in boro rice cultivation.**

CHAPTER II

REVIEW OF LITERATURE

In Bangladesh and other rice growing countries of the world, a number of researches have been carried out on the response of crops, especially rice to different fertilizers and manures. The farmers are advised to use manures in respect of crops, seasons and soils for boosting yields, but information on the effect of manure with or without fertilizer on grain yield as well as on soil properties are very limited in our country. However, some of the works done in our country and elsewhere of the world are briefly reviewed here.

Effect of fertilizer on grain and straw yield of rice

Patnaik and Sathe (1993) reported that increase of grain yield with the application of sulphur (as gypsum) and K (as muriate of potash) were relatively less than that with N. The highest grain yield was obtained with the application of 150 kg N+ 60 kg K₂O+ 60 kg S.

Haque and Biswas (1990) reported that the grain yield of rice significantly increased due to application of sulphur and the yield increased was boosted up to 56% and 82% over control when sulphur was added with N and NPK treatment respectively.

Singh *et al.* (1990) observed that hogmanure; phosphorus and potassium fertilizer played a significant role in achieving high stable yield of crops. They further reported that hogmanuring coupled with N and P application or with N, P and K application was a good combination, in the same time it can increase N and P utilization efficiency by 6 to 18% and 1 to 10%, respectively.

Mondal *et al.* (1992) conducted a missing element trial to investigate the nutrient requirements for BR11 rice in Sonatala silt loam soil at Bangladesh Agricultural University farm in T. aman season, 1990. They observed a significant response of crop to N, P, K, S, Zn and B. Further they noted that unlike these elements, Cu and Mo did not have positive effect on rice yield.

Islam and Bhuiya (1997) studied the effect of nitrogen and phosphorus on the growth, yield and nutrient uptake of deep-water rice. They observed that nitrogen and phosphorus fertilization significantly increased the number of fertile tiller m^{-2} and also that of grain panicle $^{-1}$, which resulted in significant increase in grain yield. The application of 60 kg N ha^{-1} alone gave 44% yield increase over control.

Islam *et al.* (1997) carried out an investigation with a view to examine the effect of N, P and S application on yield of aus rice and residual effect of P and S on aman rice. They showed that grain yield of rice responded significantly to N and S application. The application of P with N or N+S brought higher grain yield but such effect was not statistically significant. The highest grain yield was obtained with 60 kg N + 30 kg P + 20 kg S ha^{-1} application showing a 27% yield increase over 60 kg N ha^{-1} application alone. Results on aman rice showed S had significant residual effect on grain yield.

Mian and Moslehuddin (1999) reported from their long-term fertilization trial at Bangladesh Agricultural University (BAU) farm from 1978-95 that grain yield of rice increased due to N, P and S application but the rate of increase varied in different season. Reduction of residual S remarkably decreased the yield in aman season. The N P K S Zn treatment maintained its superiority both in T. aman and aus rice.

Nitrogen

Nitrogen is one of the most important factors affecting rice production. Among various nutrients, nitrogen has the strongest influence on the growth and yield of rice. Nitrogen is a primary macro nutrient occurring in soils both in organic and inorganic forms. Plants absorb N mainly in the form of NH_4^+ and NO_3^- . It is an integral component of many essential plant compounds. Nitrogen dramatically stimulates plant growth, especially the above ground vegetative parts of plants. A good supply of nitrogen also stimulates root growth and development, protein content of seed and foliage as well as the uptake of other nutrients. It is essential for carbohydrate use within the plants. It is a major part of all amino acids, enzymes, nucleic acids and chlorophyll (Brady and Weil, 1996).

BRRI (1990) conducted an experiment where N was applied @ 30, 60, 90, 120 and 150 kg ha^{-1} as test doses with zero N as control. All N rates were applied as basal dose. The application of N @ 30 kg ha^{-1} increased grain yield from 2.2 to 2.7 t ha^{-1} . The highest yield of 4.2 t ha^{-1} was obtained with 120 kg N ha^{-1} . However, the N rate up to 150 kg ha^{-1} brought about a yield decline.

Bhale and Salunke (1996) concluded that grain yield increased linearly up to 120 kg N ha^{-1} .

Hussain and Sharma (1991) reported that application of nitrogen increased grain number panicle $^{-1}$ up to 80 kg N ha^{-1} . Nitrogen application @ 120 kg ha^{-1} did not significantly affect the grain number panicle $^{-1}$, and the lowest value was observed in the control.



Murty *et al.* (1992) conducted a field experiment with 6 rice varieties as main plot treatments and 4 levels of N as subplot treatments. It was observed that the mean grain and straw yields were 3.4, 4.2, 5.1, 4.5 and 4.2, 4.8, 6.0, 6.4 t ha⁻¹, respectively by applying of 0, 40, 80, and 120 kg N ha⁻¹.

Raju and Reddy (1993) showed that nitrogen had a significant effect on yield and yield components of rice. Application of N @ 80 and 120 kg ha⁻¹ markedly improved the mean yield of rice by 31.7 and 45.5%, respectively.

Singh and Singh (1993) conducted an experiment on different levels of nitrogen and observed that number of panicles m⁻², panicle length and grains panicle⁻¹ were increased due to application of 60 kg N ha⁻¹.

Ghosh *et al.* (1994) conducted a field experiment in typical lowland situation in farmers field. The results showed that the addition of N increased the number of ear-bearing tillers and number of grains panicle⁻¹. They also found that addition of N increased grain yield significantly.

Azad *et al.* (1995) observed that panicle length increased significantly with the increase of nitrogen levels from 0 to 75 kg N ha⁻¹.

Hossain *et al.* (1995) reported that nitrogen application up to 120 kg N ha⁻¹ increased the grain yield of rice. The increase in yield with 40, 80 and 120 kg N ha⁻¹ over the control was 24, 33 and 34%, respectively. They noted significantly higher yields with 80 and 120 kg N ha⁻¹ than 0 to 40 kg N ha⁻¹.

Chander and Pandey (1996) noted that the application of 120 kg N ha⁻¹ resulted significant increase in grains panicle⁻¹, effective tillers m⁻² and grain yield compared to 60 kg N ha⁻¹.

Kanda and Dixit (1996) reported that the increased levels of nitrogen significantly influenced the grain and straw yields of rice. The maximum grain and straw yields of 4.58 and 6.21 t ha⁻¹ were obtained with 90 kg N ha⁻¹.

Singh *et al.* (1998) studied the performance of the hybrid rice at four levels of N (0, 60, 120 and 180 kg ha⁻¹). They observed that the varieties responded linearly to applied N levels up to 120 kg ha⁻¹.

Rajarathianam and Balasubramanian (1999a) observed that there was no appreciable change in the yield attributes due to application of higher dose of N above 150 kg ha⁻¹.

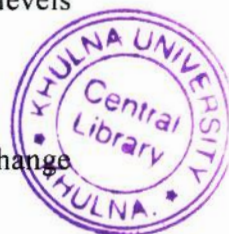
Rajarathianam and Balasubramanian (1999b) reported that higher grain yield was produced by hybrid rice (CoRH-2) with the application of 200 kg N ha⁻¹. However, application of 250 kg N ha⁻¹ reduced the grain yield significantly.

Nazimi *et al.* (1995) described that rice crop were strongly influenced by urea where at 46 kg N ha⁻¹ decreased unfilled grains panicle⁻¹ and on the other hand, increased filled grains panicle⁻¹.

Chopra and Chopra (2000) reported that application of either 80 or 120 kg N ha⁻¹ improved the entire yield attributes compared to the control.

Phosphorus

Plant absorbs P in the form of H₂PO₄⁻, HPO₄²⁻ and PO₄³⁻. Adequate phosphorus nutrition enhances many aspects of plant physiology, including the fundamental processes of photosynthesis, N-fixation, flowering, fruiting (including seed production) and maturation. It is an essential component of the organic compound often called the energy currency of living cell adenosine tri phosphate (ATP) (Brady and Weil, 1996). Considerable numbers



of works have been done on the effects of phosphorus on rice in different parts of the world. Some of them are cited below.

Ranjha *et al.* (1993) conducted a field trial in 1991 where phosphorus was applied at the rate of 0, 20, 40, 60, 80 and 100 kg P_2O_5 ha⁻¹ along with N (150 kg ha⁻¹), K_2O (100 kg ha) and $ZnSO_4$ (12 kg ha⁻¹). They observed that growth parameters like number of tillers hill⁻¹, grain and straw yield and 1000-grain weight increased significantly with increasing rate of P application.

Hussain *et al.* (1994) conducted a pot experiment on rice and wheat crops to see their response to P application. Phosphorus as SSP was applied @ 0, 13, 20, 26 and 0, 11, 22, 33 mg kg⁻¹ soil to rice and wheat, respectively. Recommend basal doses of N and K were also applied. Grain and straw yields and productive tillers of rice and wheat increased significantly with P application.

Mahajan *et al.* (1994) conducted a pot experiment on utilization of fertilizer phosphorus by some rice varieties as influenced by phosphorus fertilization in black soil. Grain yield was the highest with 80 kg P_2O_5 ha⁻¹.

Subba Rao *et al.* (1995) reported that phosphorus when applied @ 50 mg P kg⁻¹ soil as SSP increased the grain and straw yields significantly.

Kumar and Singh (2001) reported that the significant response of rice to P was observed only up to 26.2 kg P ha⁻¹ and application of P in all seasons recorded maximum rice equivalent yield (79.6 q ha⁻¹) which was at par with treatment receiving P in both year rabi (70.8 q ha⁻¹) and treatment receiving P in first year kharif and rabi (70.8q ha⁻¹).

Dongarwar *et al.* (2003) conducted an experiment in Bhandara, Maharashtra, India during Kharif 2000-2001 to investigate the requirement of phosphorus for rice production. They observed that there was a significant increase in grain yield with successive increase in P fertilizer. The highest grain yield (53.05 q ha^{-1}) was obtained with the application of 75 kg P ha^{-1} .

Potassium

Considerable number of works has been done on the effects of K on rice in different parts of the world. Some of them are cited below.

Thakur *et al.* (1993) performed a field experiment at Rajendra Agricultural University Farm, Pusa (Bihar) to find out the effect of application of potash on wetland rice. The results indicated that with an increase in the potassium level up to 66 kg ha^{-1} there was an increase in number of total tillers m^{-2} .

Sharma and Baruch (1997) conducted a field experiment in Assam, India, with rice cv. Krisna. The rice was given 25, 50, 75 or 100 kg K ha^{-1} as basal or 2 or 3 splits. Split application of K increased grain yield compared to a single basal dose.

Razzaque *et al.* (1990) performed a field experiment in two soil series (Lokdeo and Ghatail) in Mymensingh and the results indicated significant positive influence of potassium on rice in both the soil series. The highest straw yield was recorded with 83 kg K ha^{-1} .

Vijayalakshmi and Mathan (1994) observed that direct application of $25 \text{ kg K}_2\text{O}$ increased grain yield significantly. They also found that grain yield was not increased by further K application.

Mukhopadhyay and Mukhopadhyay (1995) found that gypsum and pyrite were equally effective in increasing rice yield when applied @ 20 kg sulphur ha⁻¹.

Mandal and Halder (1998) conducted a pot experiment on rice cultivar BR 11 using all combinations of 0, 4, 8 or 12 kg Zn and 0, 5, 10 and 20 kg S ha⁻¹. They reported that addition of 8 kg Zn + 20 kg S ha⁻¹ gave the best performance in growth and yield of crop.

Haque and Chowdhury (2004) observed that dry matter yield of rice plants significantly increased at both maximum tillering and panicle initiation stage in treatment with rice straw and S applied together. There were significant increases in all yield contributing attributes of the crop except, 1000- grain weight in both rice straw and S treatments over control. Grain and straw yields of rice significantly increased due to application of rice straw and S together over control treatment.

Zinc

Zinc deficiencies are widespread throughout the world, especially in neutral and calcareous soils in the rice land of Asia (Tisdale *et al.*, 1999). Zinc is a micronutrient and plants absorb zinc in the form of Zn²⁺. The normal concentration of Zn in the leaf concentration exceeds 400 ppm. A number of works have been done on the effects of zinc on rice in different parts of the world. Some of them are cited below.

Ahmed and Hossain (1999) reported from three years field experiments of wheat-mungbean-rice crop sequence that application of Zn along with NPKS increased rice yield.

Arif *et al.* (1996) conducted a field trial with rice (cv. Rio paranaiba) using 0, 5, 10, or 20 kg Zn ha⁻¹ and 0, 0.5, 1.0 or 2.0 kg B ha⁻¹. They observed that seed yield was not affected by the treatments, but the grain yield was highest with 10 kg Zn ha⁻¹.

Ullah *et al.* (2001) conducted a field experiment with different levels of zinc sulphate on the yield of rice cv. BRRI dhan 30. Results showed that application of ZnSO₄ increased plant height, tiller number, 1000-grain weight, grain and straw yield, and Zn content in grain and straw.

Singh and Singh (2002) conducted a field experiment at the North Eastern Hill University, Shillong, Meghalaya, India to elucidate the distribution, adsorption and utilization of Zn in wetland soils, and its uptake by plant from nutrient solutions. It is concluded that the use of zinc fertilizers increased the yield of rice in wet land soils of Meghalaya.

Swarup and Yaduvanshi (2004) conducted an experiment from 1994-2001 on wet season rice (*Oryza sativa* L.) and winter season wheat (*Triticum aestivum* L.) cropping system at Bhaini Majra Experiment Farm, Kaital India. The N, P, K and Zn dose as per treatments (120 kg N, 26 kg P, 42 kg K and 4.5 kg Zn ha⁻¹) were applied as urea, single super phosphate, muriate of potash and zinc sulphate respectively. They found that zinc application increased the yield of rice.

Effect of manure on grain and straw yield of rice

Gupta (1995) showed that application of pig manure (10 t ha⁻¹) produced the highest grain yield (4.5 t ha⁻¹) followed by poultry manure and FYM which produced yields of

4.1 and 3.9 t ha⁻¹ of rice grain respectively. The increase in rice yield with organic manure was 34 to 55% over the control and 5-22% over NPK fertilizers.

Effect of FYM (cowdung) on grain and straw yield of rice

Considerable work has been done in India, China, Thailand, Philippines and other countries of the world with respect of the use of farmyard manure (FYM) as alternative or supplementary source of nutrients.

Collecting the residual effect of FYM in a four years study on integrated nutrient management in rice-wheat cropping sequence Bhandari *et al.* (1992) found that rice, when fertilized with 100% NPK followed by wheat with 100% NPK, the yield of wheat was 4.39 t ha⁻¹ but this figure was 4.53 t ha⁻¹ when rice fertilized with 50% NPK + 50% N from FYM was followed by wheat with 100% NPK.

Brar and Dhillon (1994) observed that grain yield of rice increased significantly with the increase levels of FYM. The highest yield (6.7 t ha⁻¹) was obtained using 40 t FYM ha⁻¹ over 4 years. Average yield of rice was significantly higher when FYM was applied in 4 equal splits than as a single application.

Singh *et al.* (2001) reported that the application of 10 t FYM ha⁻¹ produced 4.64% higher grain yield than the control.

Rajput *et al.* (1992) observed that the application of farmyard manure increased the grain yield significantly in comparison to control.

Mullis *et al.* (2000) observed that the highest grain and straw yields from the treatment 40 fly ash + 10 t FYM ha⁻¹. Application of increasing rates of fly ash improved soil properties and nutrient availability, as well as the nutrient uptake of the rice.



Kant and Kumar (1994) observed that application of FYM significantly increased the number of effective tillers hill^{-1} , number of grain panicle $^{-1}$, and 1000-grain weight over control. At the maximum level of FYM (30 t ha^{-1}) the increase of 48% tiller hill^{-1} , 14% number of grains panicle $^{-1}$ and 4.5% weight of grains over control were recorded. They also reported that higher rate of FYM (30 t ha^{-1}) resulted 22% increase in grain yield over control.

Misra *et al.* (1996) revealed that green manuring with *Sesbania aculeata* or application of 20 t FYM ha^{-1} gave the highest yields in both years.

Rathore *et al.* (1996) showed that grains per panicle were significantly higher in FYM treated plots compared with the unfertilized control. They also found that 1000-grain weight and number of panicle m^{-2} were significantly higher in FYM treated plots compared to the control.

Singh (2001) cited that yield and yield attributes of rice significantly increased over control after application of FYM and lac mud. He also found that the recommended rate of chemical fertilizer could be reduced to half by adequate supplement of organic manure in the form of lac mud or FYM.

Verma (1991) reported that incorporation of FYM increased significantly the concentration of N, P and K in paddy grain and straw.

Bhuiyan (1994) carried out a long-term research at BRRI and reported that the application of cowdung @ $5 \text{ t ha}^{-1} \text{ yr}^{-1}$ improved rice productivity as well as prevented the soil resources from degradation.

Combined effect of fertilizer and manure on growth and yield of rice

Through appropriate use of fertilizer and organic manure the concept of integrated nutrient management is the continuous improvement of soil productivity. In Bangladesh, only limited attempts have been made in this perspective.

Ahmed and Rahman (1991) reported that the application of organic matter and chemical fertilizers increased tiller number, panicle length, grain and straw yield of rice.

Ali (1994) carried out an experiment with rice at several locations of Bangladesh during 1989-90 and showed fertilizer use efficiency over 20 kg grains kg^{-1} nutrient supply. Improving the soil condition with organic manure and proper fertilization had further increased the production level in the subsequent years to more than 6 tons grain ha^{-1} . The highest yields were obtained with the application of the recommended NPK fertilizer + 15 t FYM ha^{-1} and the lowest in the control.

Malik and Jaisal (1993) observed that statistically identical grain yield of rice under 58 kg N ha^{-1} applied through prilled urea and half dose of prilled urea + half dose FYM and 58 kg N ha^{-1} as urea + 29 kg N ha^{-1} from FYM.

Suzuki *et al.* (1990) laid out a long term experiment and showed that the organic fertilizer was more useful than the inorganic fertilizers in view of long-term application, even though the amount of N, P and K contents were the same when the compost was applied additionally to the organic manure.

Bharadwaj and Tyagi (1994) reported that the highest grain yield was obtained with an application of recommended NPK fertilizers + 15 t FYM ha^{-1} and the lowest from control.

Swarup (1991) conducted a pot experiment on sodic soil and stated that substantial increase in Zn, Fe and Mn availability were obtained with FYM in conjunction with gypsum.

Sharma and Mitra, (1991) reported a significant increase in N, P and K uptake and also the nutrition status of soil with 5 t ha⁻¹ of FYM in rice based cropping system.

Tahir *et al* (1991) conducted an experiment with rice cv. Basmati 385 grown on a sandy clay loam at Faisalabad in 1980 with various combinations of NPK, ZnSO₄ and FYM. Yield was 1.71 t ha⁻¹ without fertilizers and 4.32 t ha⁻¹ with 60 kg N, 40 kg P₂O₅, 30 kg K₂O but 5 t FYM ha⁻¹ without inorganic fertilizers produced 3.54 t grain ha⁻¹ and gave the highest value.

Hussain and Jilani (1992) reported higher yield of paddy and wheat with FYM + prilled urea, than that with prilled urea alone.

Ali *et al.* (1994) carried out several experiments on integrated nutrient management at different places of Bangladesh. They reported that boro rice receiving total chemical fertilizers was followed by aman rice receiving the same. The combined yield increase were 96% and 86% for grain and straw respectively over control.

Mondal *et al.* (1992) also reported that the highest mean rice grain yield of 3.37 t ha⁻¹ was obtained with an application of 75% of the recommended NPK rate + 10 t FYM ha⁻¹.

Ghosh *et al.* (1994) in experiment with rice reported an increase in grain yield when inorganic N fertilizer (50 kg N ha⁻¹) was applied alone or when a combination of organic (10 t FYM ha⁻¹) and inorganic N fertilizer (29 kg N ha⁻¹) were applied as compared with organic sources (20 t FYM ha⁻¹) alone.

Rao and Moorthy (1994) observed that combined application of organic and inorganic fertilizer was found to increase the grain yield of rice over organic or inorganic fertilizers applied alone. Application of organic and inorganic fertilizers in equal proportions was found to produce higher and sustained yield in irrigated rice.

Sarkar *et al.* (1994) reported that the highest mean rice yield (3.4 t ha^{-1}) was obtained with the application of 75% of the recommended NPK rate + 10 t FYM.

Swarup and Singh (1994) reported that gypsum and FYM improved significantly the grain yield of rice and substantially decreased pH and ESP (Exchangeable sodium percentage) of soil profile compared to the control. Gypsum 25 percent GR (Gypsum requirement) + FYM was significantly better than gypsum 50% GR as par with gypsum 50% GR + FYM in decreasing soil p^H and ESP and improving yields. Increasing N dose from 100 to 150 kg ha^{-1} significantly improved the yield of rice.

Alok *et al.* (1995) conducted a long term field experiment from 1984 with rice wheat cropping system. They reported that during the initial years (1984-85) 25 to 50 % substitution of fertilizers through organic sources reduced the rice yield by 6 to 23% compared with 100% NPK fertilizers alone. In the following years 25 to 50 % N through FYM or *Sesbania aculeata* green manure along with 50 to 75% fertilizers gave either equal or more rice yield compared to 100% fertilizer alone.

Kamiyama *et al.* (1995) reported that the application of chemical fertilizers with FYM produced the highest grain yield of rice.

Rajput (1995) observed that the application of organic matter through farm wastes with 50% or more N gave higher grain yield than the addition of organic matter (OM) alone.

Singh *et al.* (1996) reported that in a field experiment in 1987- 89 in Ludhiana, Punjab, India, where irrigated rice was given 60, 120 or 180 kg N ha⁻¹yr⁻¹ as poultry manure, urea or poultry manure + urea. In the first year, 120 and 150 kg N as poultry manure produced significantly higher grain yields than the same rates as urea. Poultry manure sustained the grain yield of rice during the three years while the yield decreased with urea.

Guoqing *et al.* (1999) observed in a long-term experiment in rice based cropping system that high crop yields were sustainable over a period of 12-16 years through the continuous application of inorganic NPK fertilizer and yields were mainly restricted by insufficient N nutrient. Supplementing NPK fertilization with organic manure could further increase rice yield.

Choubea *et al.* (1999) studied the effect of chemical fertilizer alone or with FYM on the rice yield. They gave 30:15:15 kg NPK alone or with 5 t FYM ha⁻¹ or 60: 30:30 kg NPK alone or with 6 t FYM ha⁻¹. They observed that the yield were highest with the higher NPK + FYM rate.

Sarkar and Singh (1997) showed that average rice yield was the highest with the recommended rate of NPK followed by the application of 50% NPK + FYM (5 t ha⁻¹).

Baruch and Talukdar (1999) conducted a pot experiment to study the direct and residual effect of FYM and fertilizer on pH, organic carbon, nutrient status of soil (NPK) and their uptake by rice crops and yield. A significant increase in the available NPK, uptake of NPK and yield in the treatments receiving both the organic and inorganic sources was noticed. Moreover, organic matter treated soil showed a better residual effect as compared to the chemical fertilizer applied soil.

Saitoh *et al.* (2001) conducted an experiment to evaluate the effect of organic fertilizers (cow and poultry manure) and pesticides on the growth and yield of rice and revealed that the yield of organic manure treated and pesticide-free plot was 10% lower than that of chemical fertilizer and pesticide-treated plot due to a decrease in the number of panicles. Yearly application of manure increases the total carbon and nitrogen concentration in the soil.

Reddy and Shivaraj (1999) carried out an experiment and applied 0.05:0.025:0.025 t NPK ha⁻¹, 5 or 10 t FYM ha⁻¹ or 3 t poultry manure ha⁻¹ where yields were the highest with 5 t FYM followed by 10 t FYM.

Brahmachari and Mondal (2000) reported that the highest grain yield of rice was obtained when both organic and inorganic sources of nutrients N: P: K at 0.03:0.06:0.03 t ha⁻¹ and 10 t FYM ha⁻¹ were applied.

Channabasavanna and Biradar (2001) conducted an experiment with 4 sources of organic manure (FYM 7 t ha⁻¹, rice husk 5 t ha⁻¹, poultry manure 5 t ha⁻¹ and press mud 2 t ha⁻¹) with one control and 3 levels of zinc (0, 25 and 50 kg ZnSO₄ ha⁻¹). Application of poultry manure with 25 kg ZnSO₄ ha⁻¹ recorded significantly higher yields over rest of the treatments. They also cited that organic manure increased panicles hill⁻¹.

Mondal *et al.* (1990) conducted a field trial in 1984-85 with rice grown in sandy clay loam soil and reported that application of 40 kg N ha⁻¹ or N + P₂O₅ + K₂O @ 40 +20 +20, 60+ 40+ 40 or 80 + 60 +60 kg ha⁻¹ gave yields of 3.17, 3.40, 3.59 and 4.0 t ha⁻¹ without FYM, respectively. The number of panicles m⁻² and spikelets panicle⁻¹, percentage of filled grains and 1000 - grain weight were increased with increasing NPK rates and FYM application.



The effect of water hyacinth compost and decomposed floating bed materials on growth and yield of rice

When the water recedes the floating bed (organic manure) tends to be flatten on soil. The beds then transformed into semi-solid minute particles and spread over the soil. Crops belonging to winter season can be raised on this soil without any tillage and fertilizer. In this way, more benefit can be achieved with less input from non-floating stage (Haq *et al.*, 2004).

The relatively high mineral content of the water hyacinth , comparable to that of many crop species, suggests that this plant could make a good soil additive as well as a die supplement. In a study comparing water hyacinth with commercial fertilizer, Parra and Hortenstein (1974) found that water hyacinth applications produced as good or better crop yields than did application of commercial fertilizers for certain soil types. Basak (1948) found that the nutrient content of water hyacinth compost was approximately four times greater than that of farmyard manure and twice as great as compost prepared from town refuse and night-soil.

Khan and Sarwar (2002) reported that the state of aggregation of soil increases significantly with increasing water hyacinth compost in the soil. It was 27% higher than the control. Cation exchange capacity increased markedly with increasing the content of water hyacinth. Very slight change in pH was obtained with increase in the content of water hyacinth. Fresh weight of rice grain increases slightly with increasing content of water-hyacinth compost. It was 4.42% higher than control.

Rashid and Iftekhhar (1992) also reported that the degree of aggregation of soil and water holding capacity increased due to water hyacinth compost.

Fresh water hyacinth plant contains 95.5% moisture, 0.04% N, 1.0% ash, 0.06% P_2O_5 , 0.20% K_2O , 3.5% organic matter. On a zero-moisture basis, it is 75.8% organic matter, 1.5% N, and 24.2% ash. (Matai and Bagchi, 1980).

According to Basak (1948) the chemical composition of water hyacinth compost manures (dried) is N 2.05%, P_2O_5 1.10%, K_2O 2.50%, CaO 3.91 % and C/N ratio 13.

In a review of utilization of water hyacinth it is stated that the laterite soils of the old alluvium of Bengal and some types of silt comprising the new alluvial tracts are deficient in K, P and lime. So water hyacinth, either rotted or ashed, is a valuable manure for them. For light, well-drained soils the rotted material may be preferred; for heavy low-lying lands the ash may be used with advantage. Hyacinth compost contains on an average (dry matter basis): N 2.05%; P (as P_2O_5) 1.1%; K (as K_2O) 2.5%; Ca (as CaO) 3.9%; and the C/N ratio is 13. Bulk of hyacinth compost is twice as rich as town compost and four times as rich as farmyard manure in K. It is eminently suitable for jute and rice fields, for vegetable gardening and fruit growing (Anonymous, 1952.).

According to Parra (1975) residual effects of hyacinth resulted in higher C, N, K, Ca, Mg and Mn content of all soils. The Zn content of it was being increased and exchangeable Al is being reduced subsequently.

Water hyacinth appeared to enhance nutrient uptake through a possible improvement of the root environment in addition to maintaining a source of plant nutrients (Parra and Horstenstine, 1974).

Knipling *et al.*, (1970) analyzed waterhyacinth which contained 1.75% N, 0.63% P, 3.07%K, 3.06% Ca, and 0.63% Mg on a dry weight basis. This nutrient content indicated that dried waterhyacinth would have utility as a soil amendment and nutrient source in crop production.

The addition of harvested waterhyacinth to the soil with the subsequent release of nutrients to crops would enhance plant growth and help maintain soil organic matter. The average dry weight composition of waterhyacinth examined in the study was : 19.2% ash, 34.9% C, 1.61% N, 0.31% P, 3.81% K, 1.66% Ca, 0.56% Mg, 0.56%Na, 2568 ppm Al, 2772 ppm Fe, 286 ppm Mn, 58 ppm Zn, and 9 ppm Cu. The Cr content varied from 0 to 35 ppm and Pb was from 0 to 20 ppm. Water content of the fresh plant was 95% by weight. (Jose and Charles, 2000).

Eight samples of organic matter were collected from different dhaps in order to determine the chemical properties of the floating beds. Decomposed floating water hyacinth layers were analyzed. The ammoniacal-nitrogen content ranges from 60 to 282 ppm against a critical value of 150 for growing healthy vegetables (SRDI, 2005). The values were low in four samples. This is probably because the samples were analyzed in the laboratory of the Bangladesh Soil Resources Development Institute in Dhaka after they had dried out and, in retrospect it would have been better to have performed this part of the assay closer to the point of collection (Islam and Atkins, 2007).

Potassium was found in excess in some samples and at optimum levels in others. Phosphorus was low in all samples, as were manganese and iron, but levels of other micro-nutrient were satisfactory. Organic matter ranges from 20.76 to 42.88 percent, a very high proportion for any growing medium. The observed pH ranges from 6.9 to 7.4, neutral and therefore favorable for most crops (Islam *et al.*, 2007).

CHAPTER III

MATERIALS AND METHODS

The field experiment was carried out during boro season (Jan-May) of 2008 at the Bodo Kashipur, Sorulia, under Tala upzilla of Satkhira district.

The climate of the experimental area was characterized by low temperature and humidity during rabi season and relatively high temperature, humidity and heavy rainfall with occasional gusty winds during kharif season.

The soil of the experimental area was medium low land, fairly leveled, well drained, silty loam.

BRRI dhan28, a high yielding variety of rice was used as the test crop in this experiment. The variety was released by Bangladesh Rice Research Institute, Joydebpur, Gazipur in 1994. Life duration of this variety is about 140 days in boro season. Insect and pest attacks are comparatively less in BRRI dhan28.

The treatments employed for the experiment were as follows.

T₁ = Decomposed floating bed (Dhap) materials (10 t ha⁻¹)

T₂ = Farmyard manure (FYM) (10 t ha⁻¹)

T₃ = Recommended fertilizer dose (RFD) (100%)

T₄ = Recommended fertilizer dose (RFD) (50%) + Decomposed floating bed (Dhap) materials (5 t ha⁻¹)

T₅ = Recommended fertilizer dose (RFD) (50%) + Farmyard manure (FYM) (5 t ha⁻¹)

T₆ = Decomposed floating bed (Dhap) materials (5 t ha⁻¹) + Farmyard manure (FYM) (5 t ha⁻¹)

T₇ = Control (without manures and fertilizers)

The experiment was laid out in a Randomized Complete Block Design (RCBD), with three replications. There were seven different treatment combinations. The treatments were randomly distributed to the unit plots in each block. The unit plot size was 4.0 m × 2.5 m. The spacing between blocks was 1 m and the plots were separated from each other by a space of 75 cm. The spacing between blocks was also be used as irrigation channel.

The experimental land was plowed with the help of a power tiller and was leveled by a ladder carefully to get a well puddle soil. The field layout was made on according to the design.

Quality seeds were collected from local dealer of Khulna.



Seedlings were raised in well prepared seed bed near the experimental plots. After sprouting the seeds were sown in the wet seed bed. Proper care was taken to raise the seedlings in the nursery bed. The seedbed was made ready by ploughing four (4) times with power tiller followed by laddering. The bed was kept wet by irrigation as and when required.

The seedlings were hand transplanted at the age of 40 days, giving three seedlings in each hill. The spacing maintained was 25 cm between rows and 20 cm between hills.

The amount of fertilizer and manure added to each plot was calculated from the recommended dose. Full dose of other fertilizers except urea and full dose of manures were applied as basal dose at the time of final land preparation and thoroughly incorporated to the soil. Urea was top dressed in three equal installments at 15 , 30 and 50 days after transplanting (DAT). The treatments were randomly distributed to each of the experimental field.

Table 1. The doses of fertilizers with their sources.

Nutrient element	Recommended Dose (kg ha ⁻¹)	Sources
N	80	Urea
P	50	TSP
K	40	MP
S	10	Gypsum
Zn	5	Zinc Sulphate

The crop was kept weed free throughout the growing period. Two hand weeding were done to check weed infestation in the experimental field at 30 and 50 days after transplanting (DAT).

A 2-4 cm of standing water was maintained in the field throughout the growing period until grain filling stage. Furadon 5G @ 9.9 kg ha⁻¹ was applied at 21 DAT to control Ufra. Ripcord @ 0.5 liter ha⁻¹ was applied to control Dragon fly. Melathion 57L @ 1.00 liter ha⁻¹ was applied to control green leaf hopper and thrips. Different cultural operations were carried out in the field during period of this investigation.

Data on different growth parameters, yield components and yield were collected following the procedure outlined below:

Destructive plant samplings were done at 15 days interval to determine different plant growth parameters starting from 40 DAT and continued till maturity. At each sampling date were recorded from five randomly selected hills in each unit plot. To avoid border effect, plants were sampled from any of the inner rows.

The crops were harvested at their full maturity when 90% of the grain turned golden yellow in color. Total harvesting was done within one day. Before harvesting 5 hills were

uprooted randomly from each plot for taking yield components data. The harvested crop of each plot was bundled separately, tagged properly and brought to the clean threshing floor. Grain and straw yield were recorded from whole plot basis. The grain and straw weight of each plot was recorded after proper drying in sun. The grain and straw yield were adjusted to 14% moisture level.

Data collection

Data were collected on the following heads at different dates as per experimental requirement:

A. Growth parameters

1. Plant height

Plant height was measured from the base of the plant to the tip of the tallest leaf or panicle of each plant of the sample and the mean of five hills was taken.

2. Tiller number hill⁻¹

Tiller number hill⁻¹ was recorded from 5 hills and the means were calculated. Tiller with at least one leaf was counted. It included both effective and non-effective tiller.

3. Dry matter hill⁻¹

Five hill were uprooted from each unit plot at 45, 60, and 75 days after transplanting (DAT); oven dried at 72° C for 48 hours and weighed to calculate the total dry matter accumulation.

B. Yield and yield contributing characters

1. Number of effective tillers hill⁻¹

The number of tillers bearing panicle of five hills was counted and the means were calculated. The panicles, which had at least one grain were considered as effective tiller.

2. Length of panicle

Panicle length was measured from the based node of rachis to the apex of each panicle. The length of each panicle from five selected hills was measured and means were calculated.

3. Grains panicle⁻¹

Grains were separated from panicles and grain number panicle⁻¹ was counted manually. Presence of food materials in the spikelet was considered as grain and total number of grains present on each panicle was counted and the means were calculated. It includes both filled and unfilled grains panicle⁻¹.

4. 1000 - grain weight

One thousand clean dried grains from the seed stock of each plot were counted separately and weighed by an electric balance and adjusted at 14% moisture level. The moisture content was also measured with an electrical moisture meter taking 10-12 grain from the sample. Grain moisture content (MC) was adjusted by using the following formula.

$$\text{Grain weight (at 14\% moisture content)} = \frac{(100 - \text{sample MC}) \times (1000 - \text{grain weight at sample MC})}{100 - 14}$$

5. Grain yield

Grain obtained from whole plot basis were threshed and grains were dried well and weighed. The weights were adjusted at 14 % moisture level. Dry weight of grains of each plot was converted to kg ha⁻¹. Grain yield was measured using Triple Balance and converted the yield into 14% field moisture content (FCM) by using the following formula.

$$\text{Yield (at 14\% moisture content)} = \frac{10(100-\text{FCM})}{100-14} \times \frac{\text{Plot yielding}}{\text{Plot area (m}^2\text{)}}$$

6. Straw yield

Total straw yield of the harvest area of each plot was determined. Sample straw of each plot was dried in oven at 72° C for 48 hours and converted the sample into total straw yield. The weights were adjusted at 14% moisture levels.

7. Biological yield

Grain yield and straw yield were all together regarded as biological yield. Biological yield was calculated with the following formula:

$$\text{Biological yield (t ha}^{-1}\text{)} = \text{Grain yield (t ha}^{-1}\text{)} + \text{straw yield (t ha}^{-1}\text{)}$$

After recording data from five plant samples, the sample yield was included with the respective plot yield and finally converted in hectare yield.

8. Harvest index (HI)

The harvest index (HI) was computed as the ratio of economic yield (grain yield) to the biological yield (grain yield + straw yield). The harvest index (%) was calculated by the empirical formula given below (Gardner *et al.*, 1985)

Harvest Index (HI) (%) = Economic yield / Biological yield X 100

Statistical analysis

Quantitative information on growth and yield performance of rice was subjected to Analysis of Variance (ANOVA) and means of the parameters were compared using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSION

Results for the effect of different types and levels of manures and fertilizers on different crop characteristics, yield components and yield of rice during boro season as a source of organic manure are illustrated in this chapter.

Effect of different manures and fertilizers on growth

Plant height

The effect of different types and levels of manures and fertilizers on plant height was shown in table 2. Plant height increased progressively reaching a maximum or peak at 75 DAT irrespective of treatments; thereafter it nearly reached a plateau. Variation in plant height was observed among the treatments. It was observed that the treatment of using decomposed floating bed (dhap) materials performed best among all other treatments, although it is found statistically similar to 100% recommended fertilizer dose.

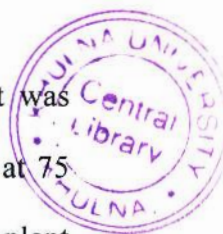


Table 2. Plant height (cm) of BRR1 dahn28 at different growth stages as influenced by manures and fertilizers.

No	Treatments		Plant height (cm)			
	Manure and/or fertilizer	Amount	45 DAT	60 DAT	75 DAT	At Harvest
1	Decomposed floating bed (Dhap) materials	10 t ha ⁻¹	86.19a	109.39a	112.17a	113.63a
2	Farmyard manure	10 t ha ⁻¹	68.81c	92.98de	95.65de	96.02de
3	Recommended fertilizer dose	100%	84.05a	108.43a	110.63a	111.73a
4	Recommended fertilizer dose + Decomposed floating bed (Dhap) materials	50%+5 t ha ⁻¹	75.57b	102.06b	105.61b	105.75b
5	Recommended fertilizer dose + Farmyard manure	50%+5 t ha ⁻¹	70.39c	94.41cd	98.48cd	98.20cd
6	Decomposed floating bed (Dhap) materials + Farmyard manure	5 t + 5 t ha ⁻¹	72.34bc	97.60c	100.68c	100.72c
7	No manure/fertilizer (control)	0	63.99d	90.36e	93.57e	92.25e
Level of significance			0.01	0.01	0.01	0.01
CV (%)			2.63	2.09	1.81	2.42

In a column, means followed by the same letter(s) are not significantly different at $P=0.05$ by Duncan's multiple range test.

Tiller number hill⁻¹

Tiller production varied significantly for different treatments. The dynamics of tiller production over time has been shown in table 3. In all the treatments tiller number decreased almost exponentially up to 60 DAT i.e. flowering time and thereafter it nearly reached a plateau. The highest number of tillers hill⁻¹ at 45 DAT was found 22.83 and at harvest 16.36 using recommended fertilizer dose. It was observed that

the statistically similar highest tillers hill⁻¹ at 45 DAT 21.08 and second highest at harvest (15.26) using decomposed floating bed (dhap) materials. The decomposed floating bed (dhap) materials as a source of organic manure performed well in comparison to other treatments.

According to Roy and Satter (1992) the mortality rate of secondary and tertiary tillers was much higher during the later phases of growth.

Table 3. Tiller number of BRRI dahn28 at different growth stages as influenced by manures and fertilizers.

Treatments			Tiller number hill ⁻¹			
No	Manure and/or fertilizer	Amount	45 DAT	60 DAT	75 DAT	At Harvest
1	Decomposed floating bed (Dhap) materials	10 t ha ⁻¹	21.08ab	15.89a	15.39b	15.26b
2	Farmyard manure	10 t ha ⁻¹	16.973d	13.53cd	13.03e	12.81d
3	Recommended fertilizer dose	100%	22.83a	16.83a	16.45a	16.36a
4	Recommended fertilizer dose + Decomposed floating bed (Dhap) materials	50%+5 t ha ⁻¹	19.86b	14.75b	14.61c	14.66b
5	Recommended fertilizer dose + Farmyard manure	50%+5 t ha ⁻¹	19.31bc	14.25bc	14.14cd	13.95c
6	Decomposed floating bed (Dhap) materials + Farmyard manure	5 t + 5 t ha ⁻¹	17.50cd	13.75bcd	13.64d	13.60c
7	No manure/fertilizer (control)	0	15.83cd	13d	12.50e	12.35d
Level of significance			0.01	0.01	0.01	0.01
CV (%)			5.46	3.73	2.4	2.43

In a column, means followed by the same letter(s) are not significantly different at $P=0.05$ by Duncan's multiple range test.

Dry matter accumulation

Dry matter accumulation was recorded at 15 days interval starting at 45 DAT till 75 DAT and at harvest. Dry matter production (g hill^{-1}) over time has been shown in table 4. The result demonstrated that dry matter accumulation over time varied in a considerable extent due to different treatments. Contribution of using 10 t decomposed floating bed (dhap) materials as a source of organic manure to higher dry matter accumulation was very apparent in the present study and it performed better even over the treatment of recommended fertilizer dose.

Table 4. Dry matter hill^{-1} (g) of BRRI dhan28 at different growth stages as influenced by manures and fertilizers.

Treatments			Dry matter hill^{-1}		
No	Manure and/or fertilizer	Amount	45 DAT	60 DAT	75 DAT
1	Decomposed floating bed (Dhap) materials	10 t ha^{-1}	14.29a	20.14a	29.29a
2	Farmyard manure	10 t ha^{-1}	4.28d	8.80cd	16.37a
3	Recommended fertilizer dose	100%	12.74a	18.57a	27.61b
4	Recommended fertilizer dose + Decomposed floating bed (Dhap) materials	50%+5 t ha^{-1}	9.03b	11.44b	23.73c
5	Recommended fertilizer dose + Farmyard manure	50%+5 t ha^{-1}	5.01cd	9.6bc	18.60cd
6	Decomposed floating bed (Dhap) materials + Farmyard manure	5 t + 5 t ha^{-1}	6.53c	10.05bc	20.65c
7	No manure/fertilizer (control)	0	3.63d	6.96d	14.90e
Level of significance			0.01	0.01	0.01
CV (%)			13.9	9.36	7.54

In a column, means followed by the same letter(s) are not significantly different at $P=0.05$ by Duncan's multiple range test.

Effect of different manures and fertilizers on yield and yield contributing characters

Effective tillers hill⁻¹

As number of tillers hill⁻¹, number of effective tillers hill⁻¹ varied significantly due to fertilization by different types and levels of manures and fertilizers. Here it was also noticed that decomposed floating bed (dhap) materials performed almost same as the recommended fertilizer dose and the resulted number of effective tillers hill⁻¹ was 15.37 and 16.81 sequentially and these two treatments were statistically similar (Table 5).

Panicle length

Though the degree of variation was low, the panicle length varied significantly due to fertilization by different manures and fertilizers. performed The highest panicle length (24.84 cm) was observed in recommended fertilizer dose than all other treatments. The second highest value (24.10 cm) was found in the treatment with decomposed floating bed (dhap) materials which was statistically similar to the treatments T₄ (50% recommended fertilizer dose (RFD) + 5 t decomposed floating bed (Dhap) materials ha⁻¹).

Total grains panicle⁻¹

Total grains varied significantly for various treatments (Table5). It varied from 108.95 to 164.90. The highest number of total grain was obtained in the treatment T₃ (100% recommended fertilizer dose) which was statistically similar to the treatment T₁ (10 t decomposed floating bed (Dhap) materials) and that of lowest was observed in treatment T₇ (control). T₃ and T₁ are statistically superior to all other treatments.

Filled grains panicle⁻¹

Application of different types and levels of fertilizers and manures significantly affected the number of filled grains panicle⁻¹ (Table 5). The number of filled grains panicle⁻¹ varied from 97.89 to 150.76. The highest number of filled grains panicle⁻¹ was noted in treatment T₃ (100% recommended fertilizer dose) which was statistically similar to the treatment T₁ (10 t decomposed floating bed (Dhap) materials) and that of lowest was observed in treatment T₇ (control). T₃ and T₁ are statistically superior to all other treatments. Again the treatment T₁ (10 t decomposed floating bed (Dhap) materials) was statistically similar to the treatment T₄ (50% recommended fertilizer dose + 5 t decomposed floating bed (Dhap) materials).

1000-grain weight

Data on yield components revealed that fertilization by different types and levels of manures and fertilizers influenced markedly the grain weight (Table 5). In the present study it was observed that decomposed floating bed (dhap) materials as a source of organic manure performed well among the treatments. Though the highest grain weight (24.55g) was found using recommended fertilizer dose, the decomposed floating bed (dhap) materials as a source of organic manure also performed better resulting 23.71 g which was statistically similar to the treatment T₃ (100% recommended fertilizer dose) and that of lowest was observed in treatment T₇ (control). T₃ and T₁ are statistically superior to all other treatments.

Grain yield

Grain yield responded significantly to various treatments (Table 5). It varied from 2.08-3.06 t ha⁻¹. The highest grain yield (3.06 t ha⁻¹) was obtained in the treatment T₃ (100% recommended fertilizer dose) which is statistically similar to the treatment T₁ (2.87 t ha⁻¹) and that of lowest was observed in treatment T₇ (control). T₃ and T₁ are statistically superior to all other treatments.

Ahmed and Rahman (1991) reported that rice grain yield increased with the application of organic matter and chemical fertilizer. A significant increase in rice grain yield due to application of nitrogen fertilizers was reported by (Rao and Moorthy, 1994; Hossain *et al.*, 1995; Islam *et al.*, 1995; Singh *et al.*, 1998; Kamiyama *et al.*, 1995)

Straw yield

Like grain yield, the straw yield also varied remarkably due to different types and levels of fertilizers and manures (Table 5). The highest straw yield was obtained in the treatment T₁ (10 t decomposed floating bed (Dhap) materials). The treatment T₃ was (100% recommended fertilizer dose) statistically similar to the treatment T₄ (50% recommended fertilizer dose + 5t decomposed floating bed (Dhap) materials) and that of lowest was observed in treatment T₇ (control). T₁ was statistically superior to all other treatments.

A significant increase in rice straw yield with the increasing application of N was reported by Kanda and Dixit (1996). Application of organic matter and chemical fertilizer increased straw yields of rice was also reported by Ahmed and Rahman (1991) and Ali (1994).

Biological yield

Data on yield components revealed that fertilization by different types and levels of manures and fertilizers influenced markedly the biological yield (Table 5). In the present study it was observed that decomposed floating bed (dhap) materials as a source of organic manure performed well among the treatments and the highest biological yield was found 7.66 (t ha⁻¹) using decomposed floating bed (dhap) materials as a source of organic manure which was statistically similar to the treatment T₃ (100 % recommended fertilizer dose) that of lowest was observed in treatment T₇ (control). and T₁ were statistically superior to all other treatments. The biological yields ranked in the order of T₁>T₃>T₄>T₆>T₅>T₂>T₇.

Azim *et al.*, (1999) reported a significant increase in biological yield of rice due to application of manures and fertilizers.

Harvest Index

Application of different types and levels of fertilizers and manures significantly affected the harvest index (Table 5). The harvest index varied from 37.50 to 40.71. The highest harvest index was noted in treatment T₃ (100% recommended fertilizer dose).

Table 5. Effect of manures and fertilizers on yield components and yield of BRRI dhan28.

No.	Treatment		Effective tillers hill ⁻¹ (no)	Panicle length (cm)	Total grains panicle ⁻¹ (no)	Filled grains panicle ⁻¹ (no)	1000-grain weight (g)	Grain yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)	Biological yield (t ha ⁻¹)	Harvest index (%)
	Manure and/or fertilizer	Amount									
1	Decomposed floating bed (Dhap) materials	10 t ha ⁻¹	15.37ab	24.10b	156.96ab	141.84ab	23.71ab	2.87ab	4.79a	7.66a	37.50
2	Farmyard manure	10 t ha ⁻¹	13.04cd	22.34d	125.44e	111.90d	22.18b	2.18c	3.40d	5.58d	38.95
3	Recommended fertilizer dose	100%	16.81a	24.84a	164.90a	150.76a	24.55a	3.06a	4.45b	7.51a	40.71
4	Recommended fertilizer dose + Decomposed floating bed (Dhap) materials	50%+5 t ha ⁻¹	14.19bc	23.57bc	151.16bc	138.32b	23.57ab	2.65b	4.22b	6.87b	38.68
5	Recommended fertilizer dose + Farmyard manure	50%+5 t ha ⁻¹	13.51c	23.06cd	140.69cd	128.77c	23.17ab	2.35c	3.58cd	5.92cd	39.53
6	Decomposed floating bed (Dhap) materials + Farmyard manure	5 t + 5 t ha ⁻¹	13.15cd	22.57d	133.30de	121.03cd	22.83b	2.33c	3.84ce	6.17c	37.68
7	No manure/fertilizer (control)	0	11.87d	21.34e	108.95f	97.89e	19.94c	2.08c	3.05e	5.13e	40.42
Level of significance			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
CV (%)			5.99	1.76	5.15	4.17	3.69	5.91	4.07	3.33	4.48

In a column, means followed by the same letter(s) are not significantly different at $P=0.05$ by Duncan's multiple range test.



CHAPTER V

SUMMARY AND CONCLUSION

The present study was conducted through field experiment to investigate the efficacy of decomposed floating bed (dhap) materials as a source of organic manures in boro rice cultivation in comparison to other sources of nutrients. The experiment received seven treatments. BRRI dhan28, a high yielding variety of rice was used as the test crop in this experiment.

Summary

The height of plant was maximum at harvest but the rate of increase was higher at early stages of growth. Variation in plant height was observed among the treatments. The best result was found in treatment of using decomposed floating bed (dhap) materials (10 t ha^{-1}).

Application of manures and fertilizers caused a variation in the panicle length of BRRI dhan28 and the effect was significant. The obtained panicle length (24.01 cm) from the treatments of decomposed floating bed (dhap) materials (10 t ha^{-1}) was the nearest value of the highest value (24.84 cm) resulted from the treatments of 100% recommended fertilizer dose.

Filled grains panicle⁻¹ of BRRI dhan28 varied significantly due to various treatments. The highest number of filled grain panicle⁻¹ was obtained in the treatment T_3 (100% recommended fertilizer dose) which was statistically similar to the treatment T_1 (10 t

decomposed floating bed (Dhap) materials) and that of lowest was observed in treatment T₇ (control).

The 1000-grain weight of BRRI dhan28 was significantly affected by different treatments ranging from 19.94 to 24.55g. Though the highest grain weight (24.55g) was found using recommended fertilizer dose (T₃), the decomposed floating bed (dhap) materials as a source of organic manure was statistically similar to the treatment T₃.

Data on yield components revealed that fertilization by different types and levels of manures and fertilizers influenced markedly the grain yield. The highest grain yield was obtained in the treatment T₃ (100% recommended fertilizer dose) which is statistically similar to the treatment T₁ (10 t decomposed floating bed (Dhap) materials) and that of lowest was observed in treatment T₇ (control).

Application of different types and levels of fertilizers and manures significantly affected the straw yield of rice. It was observed that among the treatments T₁ (10 t decomposed floating bed (Dhap) materials) produce the highest straw yield but the treatment T₃ (100% recommended fertilizer dose) also performed well which is statistically identical to the treatment T₄ (50% recommended fertilizer dose + 10 t decomposed floating bed (Dhap) materials) and that of lowest was observed in treatment T₇ (control).

Biological yield responded significantly to various treatments. The highest biological yield (7.66 t ha^{-1}) was recorded in the treatment T_1 (10 t decomposed floating bed (Dhap) materials) which was followed by the treatment T_3 (100% recommended fertilizer dose) and that of lowest was observed in treatment T_7 (control).

The harvest index was affected significantly due to application of different types and levels of fertilizers and manures. The harvest index markedly varied from 37.50 to 40.71. The highest harvest index was noted in treatment of T_3 (100% recommended fertilizer dose).

Conclusion

From the present study it was found that highest grain yield, number of tillers hill⁻¹ and other yield and yield contributing characters except straw yield was obtained using 100% Recommended Fertilizer Dose which was statistically similar to the treatment 10 t Decomposed Floating Bed (Dhap) Materials.

Highest plant height, dry matter hill⁻¹ and straw yield was obtained using decomposed floating bed (Dhap) materials.

Though the BRRI dhan28 is a high yielding variety, comparatively a low yield was found in the present study. It was due to Bacterial Leaf Streak of rice disease which was broke out throughout the country in April, 2008.

As an adverse condition was arose during the investigation, the investigation needs further study. If the same result is found it may enable farmers to replace/reduce the use of chemical fertilizers with decomposed floating bed (Dhap) materials as a source of organic manure as a alternative of chemical fertilizers in boro season.

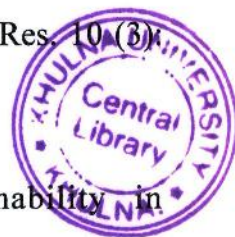
CHAPTER VI

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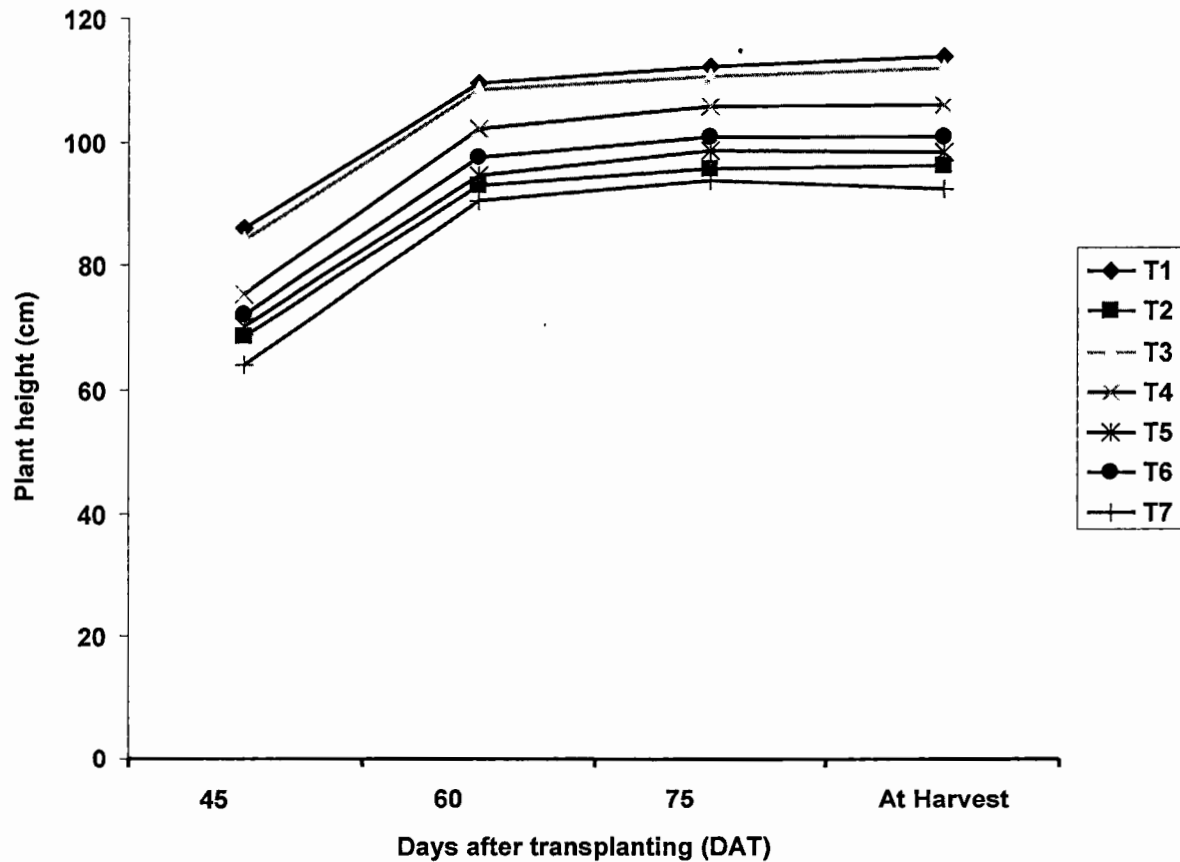
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APPENDICES



Appendix 1. Plant height (cm) over time as affected by manures and fertilizers

T₁ = Decomposed floating bed (Dhap) materials (10 t ha⁻¹)

T₂ = Farmyard manure (FYM) (10 t ha⁻¹)

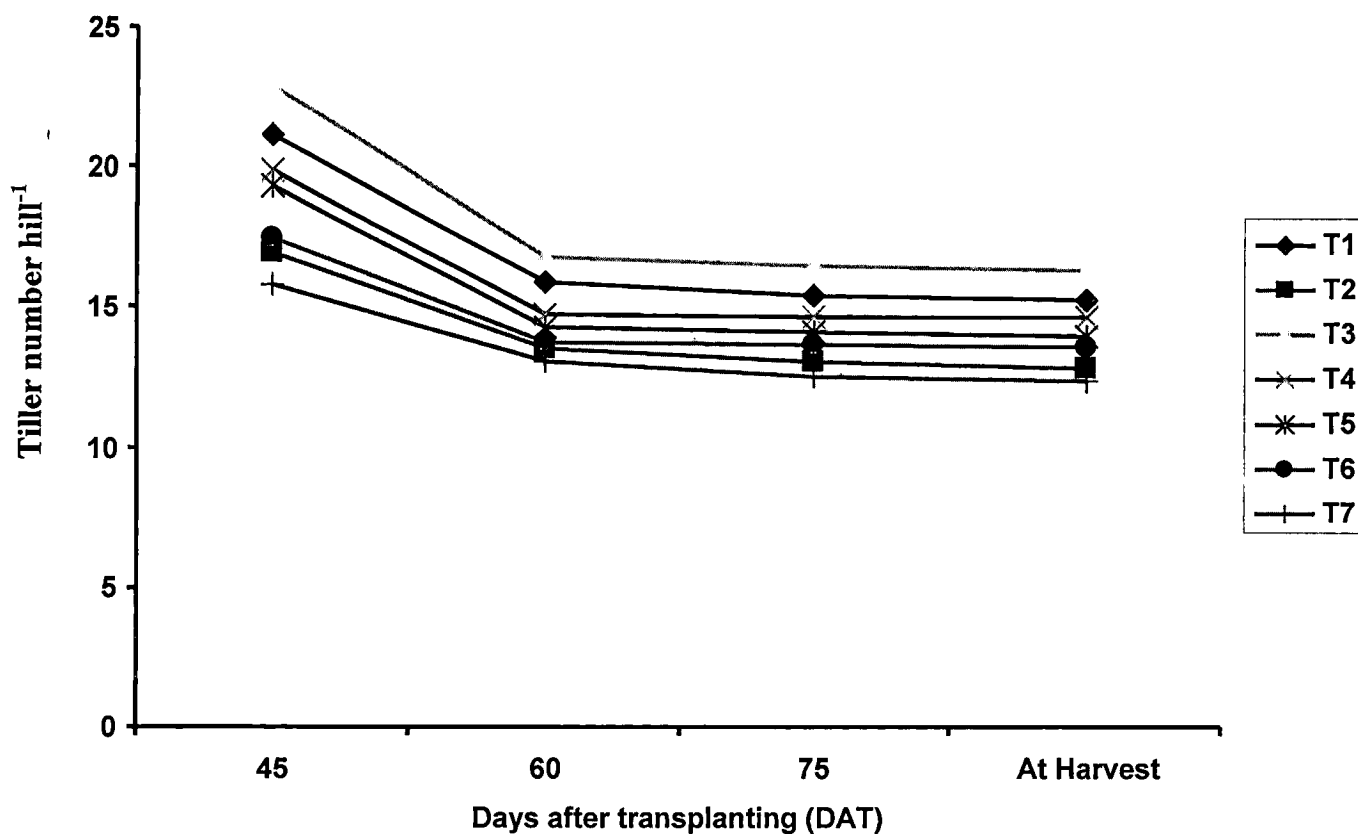
T₃ = Recommended fertilizer dose (RFD) (100%)

T₄ = Recommended fertilizer dose (RFD) (50%) + Decomposed floating bed (Dhap) materials (5 t ha⁻¹)

T₅ = Recommended fertilizer dose (RFD) (50%) + Farmyard manure (FYM) (5 t ha⁻¹)

T₆ = Decomposed floating bed (Dhap) materials (5 t ha⁻¹) + Farmyard manure (FYM) (5 t ha⁻¹)

T₇ = Control (without manures and fertilizers)



Appendix 2. Tiller number hill⁻¹ over time as affected by manures and fertilizers

T₁ = Decomposed floating bed (Dhap) materials (10 t ha⁻¹)

T₂ = Farmyard manure (FYM) (10 t ha⁻¹)

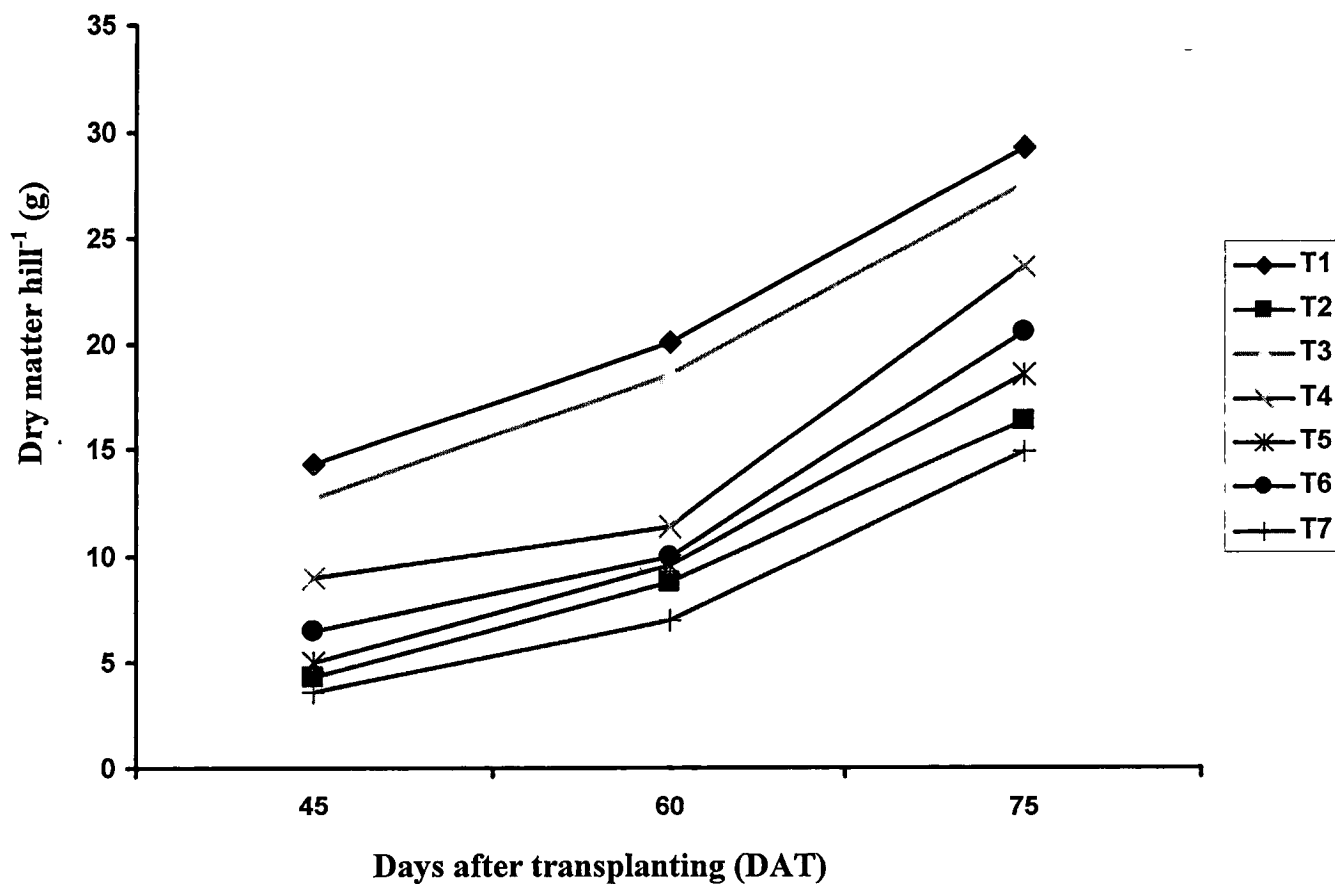
T₃ = Recommended fertilizer dose (RFD) (100%)

T₄ = Recommended fertilizer dose (RFD) (50%) + Decomposed floating bed (Dhap) materials (5 t ha⁻¹)

T₅ = Recommended fertilizer dose (RFD) (50%) + Farmyard manure (FYM) (5 t ha⁻¹)

T₆ = Decomposed floating bed (Dhap) materials (5 t ha⁻¹) + Farmyard manure (FYM) (5 t ha⁻¹)

T₇ = Control (without manures and fertilizers)



Appendix 3. Dry matter hill⁻¹ (g) over time as affected by manures and fertilizers

T₁ = Decomposed floating bed (Dhap) materials (10 t ha⁻¹)

T₂ = Farmyard manure (FYM) (10 t ha⁻¹)

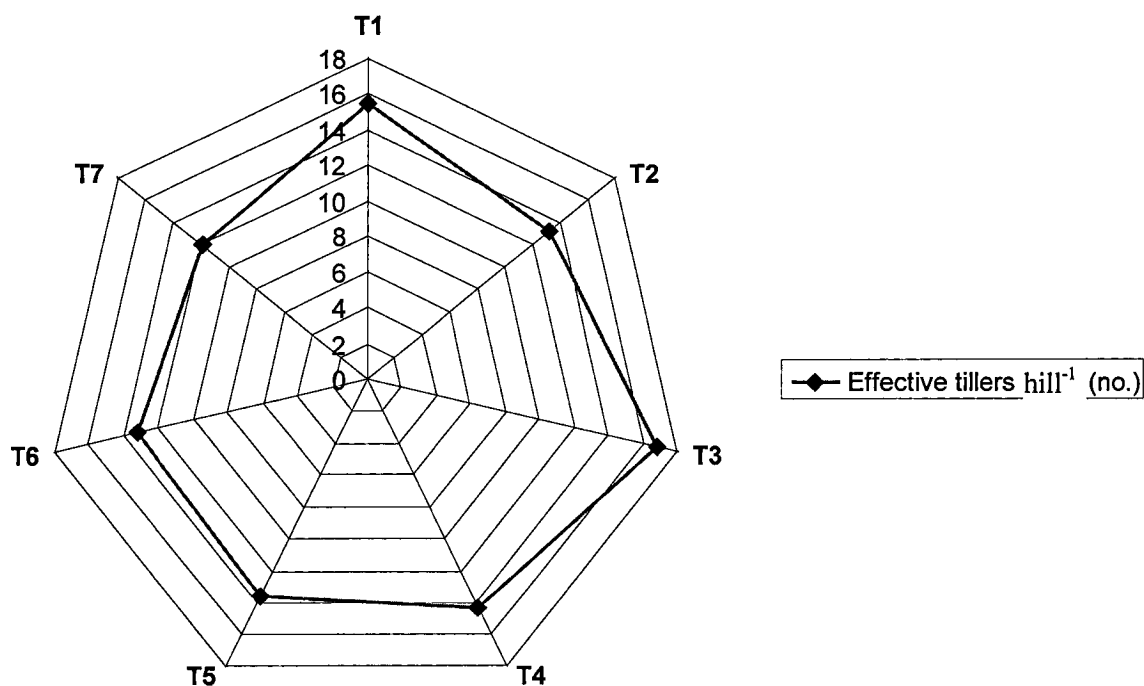
T₃ = Recommended fertilizer dose (RFD) (100%)

T₄ = Recommended fertilizer dose (RFD) (50%) + Decomposed floating bed (Dhap) materials (5 t ha⁻¹)

T₅ = Recommended fertilizer dose (RFD) (50%) + Farmyard manure (FYM) (5 t ha⁻¹)

T₆ = Decomposed floating bed (Dhap) materials (5 t ha⁻¹) + Farmyard manure (FYM) (5 t ha⁻¹)

T₇ = Control (without manures and fertilizers)



Appendix 4. Effective tillers hill⁻¹ (no.) as affected by manures and fertilizers

T₁ = Decomposed floating bed (Dhap) materials (10 t ha⁻¹)

T₂ = Farmyard manure (FYM) (10 t ha⁻¹)

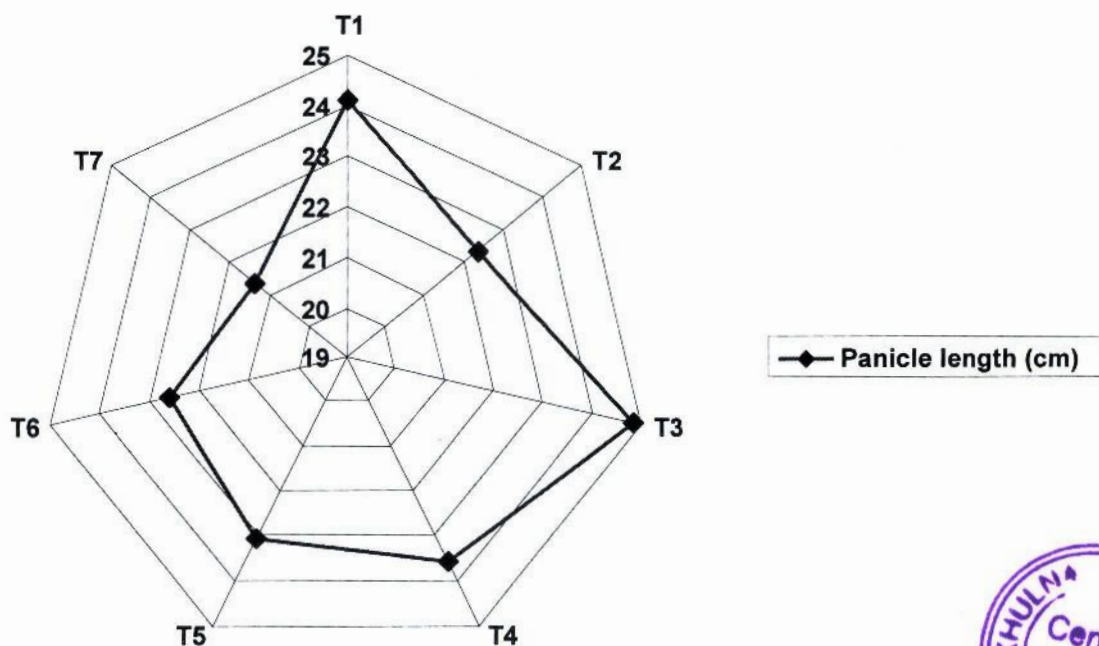
T₃ = Recommended fertilizer dose (RFD) (100%)

T₄ = Recommended fertilizer dose (RFD) (50%) + Decomposed floating bed (Dhap) materials (5 t ha⁻¹)

T₅ = Recommended fertilizer dose (RFD) (50%) + Farmyard manure (FYM) (5 t ha⁻¹)

T₆ = Decomposed floating bed (Dhap) materials (5 t ha⁻¹) + Farmyard manure (FYM) (5 t ha⁻¹)

T₇ = Control (without manures and fertilizers)



Appendix 5. Panicle length (cm) as affected by manures and fertilizers

T₁ = Decomposed floating bed (Dhap) materials (10 t ha⁻¹)

T₂ = Farmyard manure (FYM) (10 t ha⁻¹)

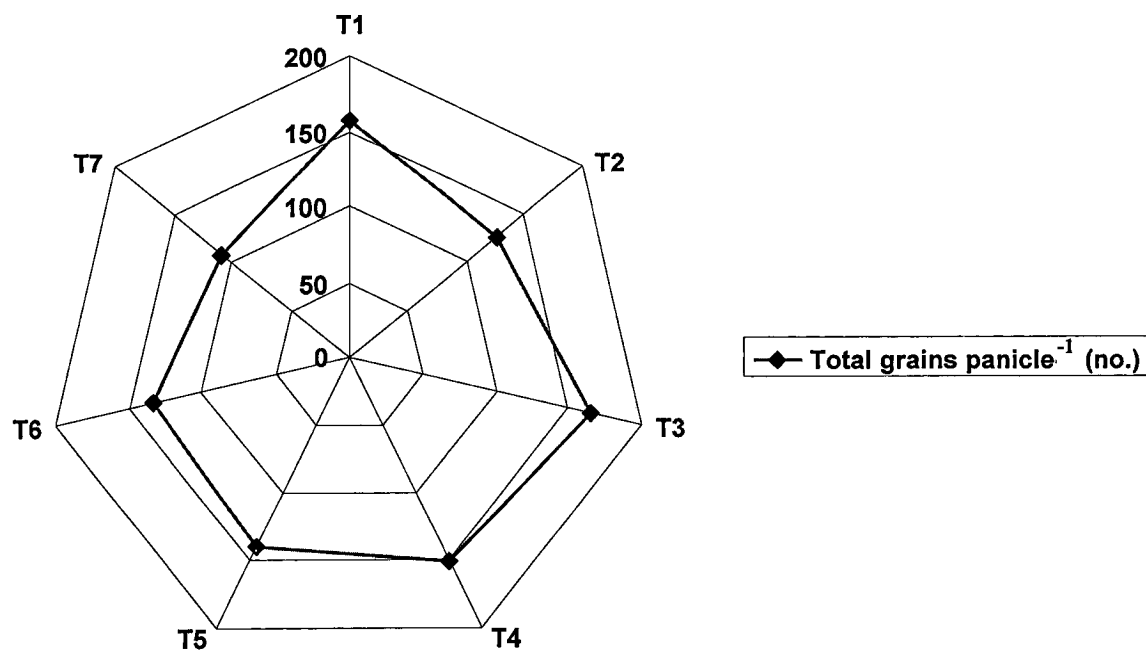
T₃ = Recommended fertilizer dose (RFD) (100%)

T₄ = Recommended fertilizer dose (RFD) (50%) + Decomposed floating bed (Dhap) materials (5 t ha⁻¹)

T₅ = Recommended fertilizer dose (RFD) (50%) + Farmyard manure (FYM) (5 t ha⁻¹)

T₆ = Decomposed floating bed (Dhap) materials (5 t ha⁻¹) + Farmyard manure (FYM) (5 t ha⁻¹)

T₇ = Control (without manures and fertilizers)



Appendix 6. Total grains panicle⁻¹ (no.) as affected by manures and fertilizers

T₁ = Decomposed floating bed (Dhap) materials (10 t ha⁻¹)

T₂ = Farmyard manure (FYM) (10 t ha⁻¹)

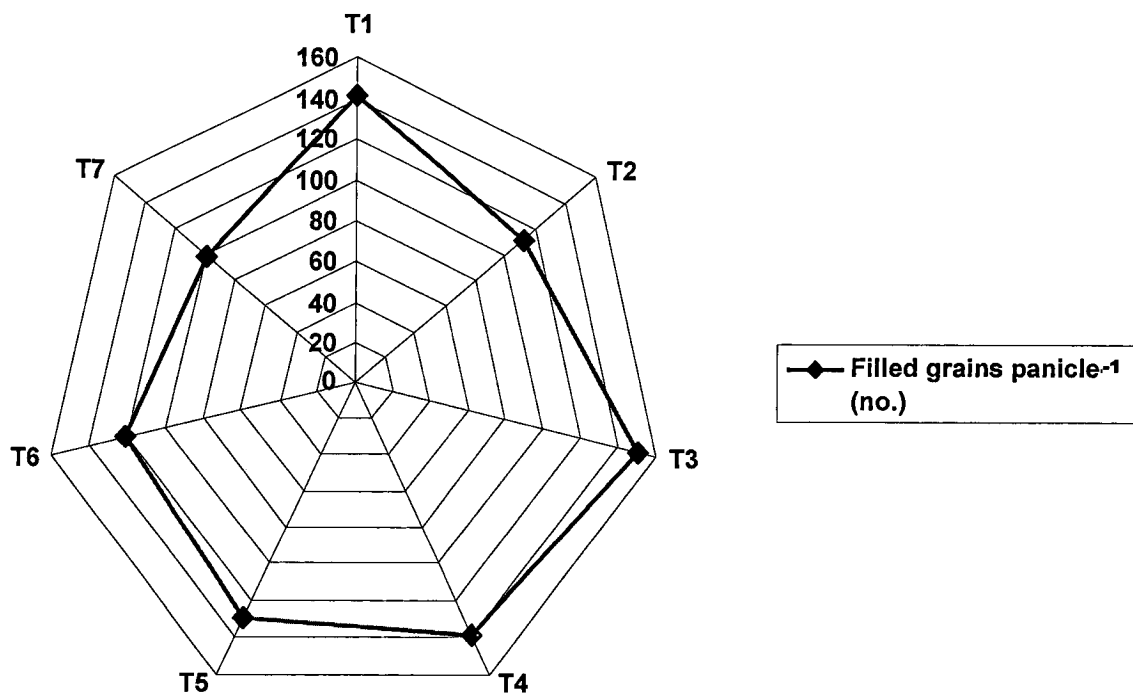
T₃ = Recommended fertilizer dose (RFD) (100%)

T₄ = Recommended fertilizer dose (RFD) (50%) + Decomposed floating bed (Dhap) materials (5 t ha⁻¹)

T₅ = Recommended fertilizer dose (RFD) (50%) + Farmyard manure (FYM) (5 t ha⁻¹)

T₆ = Decomposed floating bed (Dhap) materials (5 t ha⁻¹) + Farmyard manure (FYM) (5 t ha⁻¹)

T₇ = Control (without manures and fertilizers)



Appendix 7. Filled grains panicle⁻¹(no.) as affected by manures and fertilizers

T₁ = Decomposed floating bed (Dhap) materials - 10 t ha⁻¹

T₂ = Farmyard manure (FYM) - 10 t ha⁻¹

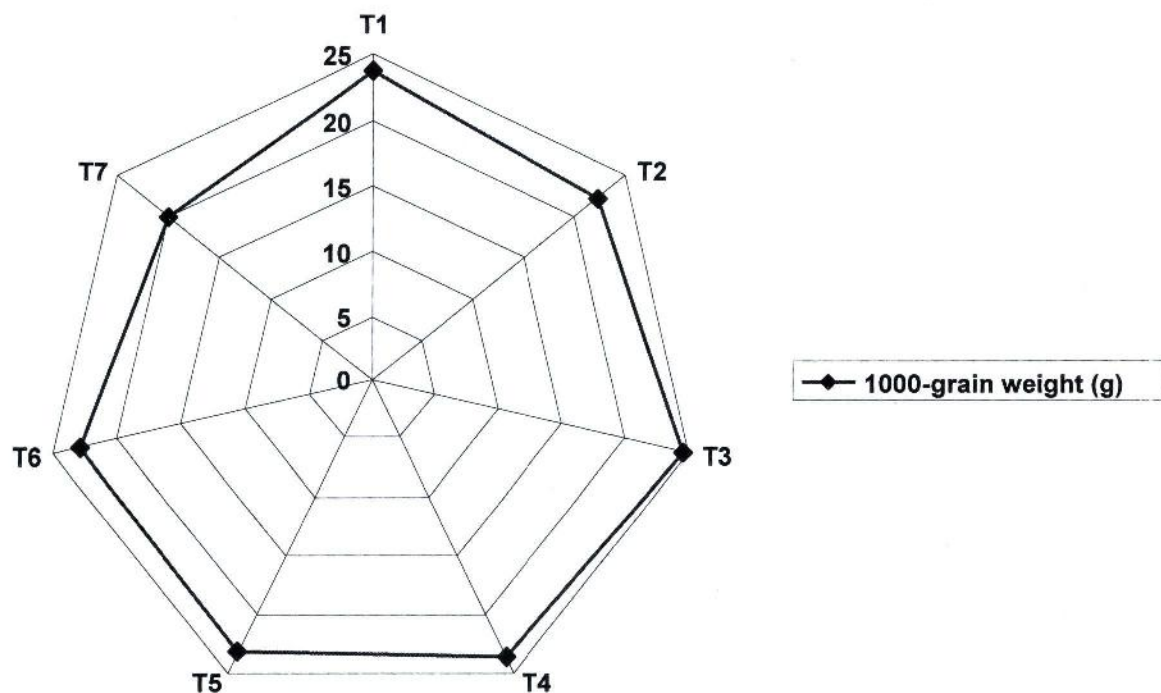
T₃ = Recommended fertilizer dose (RFD) - 100%

T₄ = Recommended fertilizer dose (RFD) - 50% + Decomposed floating bed (Dhap) materials - 5 t ha⁻¹

T₅ = Recommended fertilizer dose (RFD) - 50% + Farmyard manure (FYM) - 5 t ha⁻¹

T₆ = Decomposed floating bed (Dhap) materials - 5 t ha⁻¹ + Farmyard manure (FYM) - 5 t ha⁻¹

T₇ = Control (without manures and fertilizers)



Appendix 8. 1000-grain weight (g) as affected by manures and fertilizers

T₁ = Decomposed floating bed (Dhap) materials (10 t ha⁻¹)

T₂ = Farmyard manure (FYM) (10 t ha⁻¹)

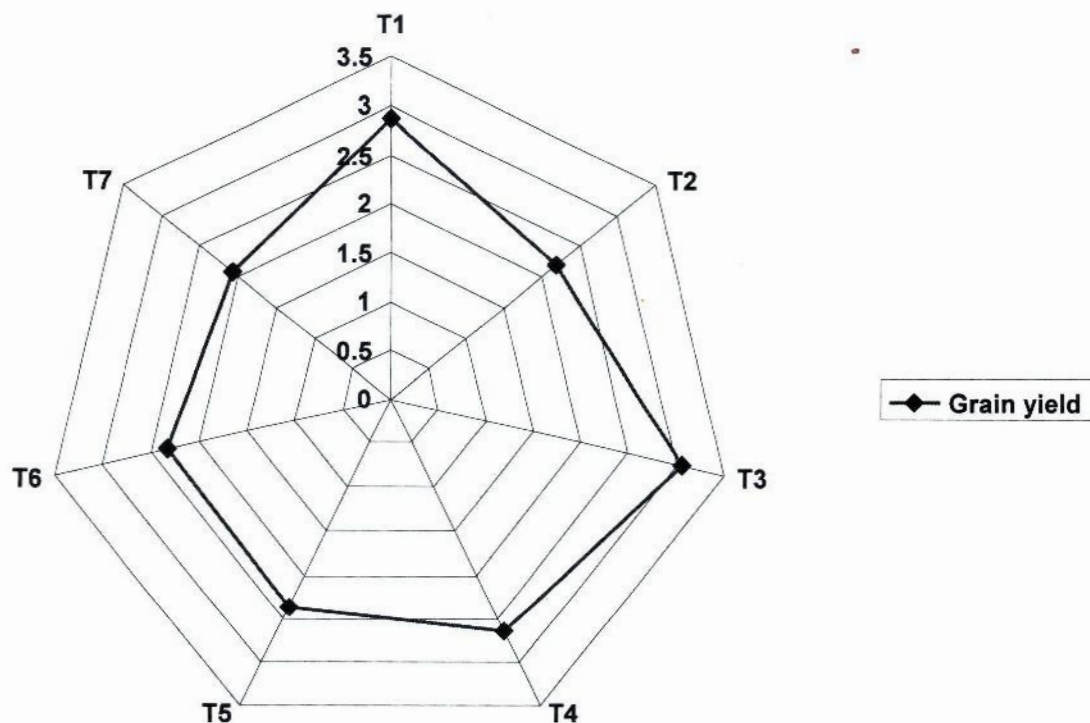
T₃ = Recommended fertilizer dose (RFD) (100%)

T₄ = Recommended fertilizer dose (RFD) (50%) + Decomposed floating bed (Dhap) materials (5 t ha⁻¹)

T₅ = Recommended fertilizer dose (RFD) (50%) + Farmyard manure (FYM) (5 t ha⁻¹)

T₆ = Decomposed floating bed (Dhap) materials (5 t ha⁻¹) + Farmyard manure (FYM) (5 t ha⁻¹)

T₇ = Control (without manures and fertilizers)



Appendix 9. Grain yield (t ha^{-1}) as affected by manures and fertilizers

T₁ = Decomposed floating bed (Dhap) materials (10 t ha^{-1})

T₂ = Farmyard manure (FYM) (10 t ha^{-1})

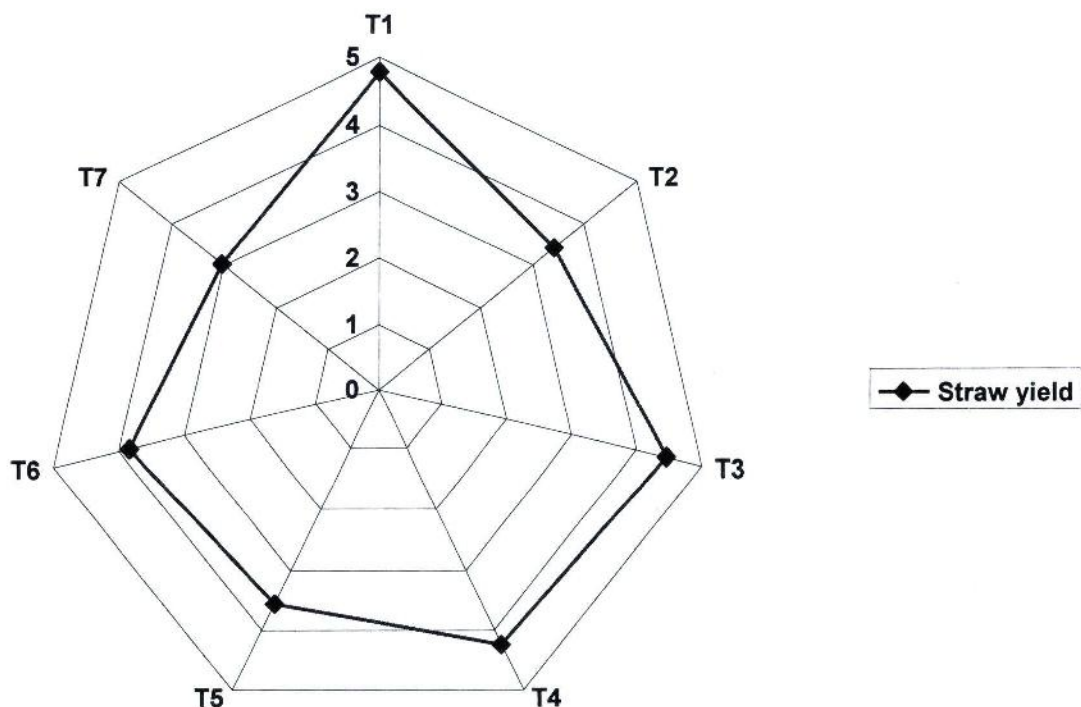
T₃ = Recommended fertilizer dose (RFD) (100%)

T₄ = Recommended fertilizer dose (RFD) (50%) + Decomposed floating bed (Dhap) materials (5 t ha^{-1})

T₅ = Recommended fertilizer dose (RFD) (50%) + Farmyard manure (FYM) (5 t ha^{-1})

T₆ = Decomposed floating bed (Dhap) materials (5 t ha^{-1}) + Farmyard manure (FYM) (5 t ha^{-1})

T₇ = Control (without manures and fertilizers)



Appendix 10. Straw yield (t ha^{-1}) as affected by manures and fertilizers

T₁ = Decomposed floating bed (Dhap) materials (10 t ha^{-1})

T₂ = Farmyard manure (FYM) (10 t ha^{-1})

T₃ = Recommended fertilizer dose (RFD) (100%)

T₄ = Recommended fertilizer dose (RFD) (50%) + Decomposed floating bed (Dhap) materials (5 t ha^{-1})

T₅ = Recommended fertilizer dose (RFD) (50%) + Farmyard manure (FYM) (5 t ha^{-1})

T₆ = Decomposed floating bed (Dhap) materials (5 t ha^{-1}) + Farmyard manure (FYM) (5 t ha^{-1})

T₇ = Control (without manures and fertilizers)