EFFECT OF NITROGEN AND POULTRY MANURE ON THE GROWTH AND YIELD CONTRIBUTING CHARACTERS OF BORO RICE (BRRI Dhan 28)

A THESIS

BY

MONIRA KHATUN

Student No. 1605348

Session: 2016-2017

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MASTER OF SCIENCE (MS)

IN

SOIL SCIENCE

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HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR

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DEDICATED TO

MY

BELOVED PARENTS

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The Author

ABSTRACT

An experiment was conducted at the research field in Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, during the Boro season of 2017 to evaluate the effects of poultry manure (PM) and N fertilizer on the growth and yield of BRRI dhan 28. The experiment was laid out in a Randomized Complete Block Design (RCBD) with six treatments and four replications. The treatments were T_1 (Control), T_2 (Urea @ 0 kg ha^{-1} + PM @ 8 t ha^{-1}), T_3 (Urea @ 75 kg ha^{-1} + PM @ 6 t ha^{-1}), T_4 (Urea @ 150 kgha^{-1} + PM @ 4 t ha^{-1}), T_5 (Urea @ 225 kg ha^{-1} + PM @ 2 t ha^{-1}), T_6 (Urea @ 300 kg ha^{-1} + PM @ 0 t ha^{-1}). Total amount of P, K and S fertilizers were applied as basal dose @ 90, 120 and 45 kg ha^{-1}, respectively during final land preparation but N from urea (300 kg ha^{-1}) was applied as per treatments in there equal splits. Application of PM and N fertilizer significantly influenced the growth and yield contributing characters of BRRI dhan 28. The results of the study also indicated that most of the yield and yield contributing characters such as number of effectives tillers hill^{-1} (16.73), panicle length (23.98 cm), 1000 grains weight (26.04 gm), grain yield (5.40 t ha^{-1}) and straw yield (6.44 t ha^{-1}) were the maximum in treatment T_3 (Urea @ 75 kg ha^{-1} + PM @ 6 t ha^{-1}) and the highest values of other yield and yield contributing characters such as plant height (89.68 cm), number of leaf hill^{-1} (80.71), number of tillers hill^{-1} (12.50) and filled grains panicle^{-1} (125.2) were recorded in T_5, T_2, T_2 and T_2, respectively. The lowest values of all the yield and yield contributing characters were found in T_1 (control). Soil pH, organic matter, total N, available P, exchangeable K and available S content in post-harvest soil were also influenced by the application of poultry manure and N fertilizer. The overall results indicate that application of N fertilizer in T_3 as urea @ 75 kg ha^{-1} in combination with 6 t PM ha^{-1} can produce maximum yield but statistically similar with other combinations. However, further investigation is necessary to make concrete recommendation. The findings of the study suggest that integrated use of PM and N fertilizer is an important for sustainable production of rice.

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LIST OF ABBREVIATIONS

AEZ	=	Agro-ecological zone
@	=	At the rate of
Agric.	=	Agriculture
Agril.	=	Agricultural
BADC	=	Bangladesh Agricultural Development Corporation
BBS	=	Bangladesh Bureau of Statistics
BSMRAU	=	Babgabandhu Sheikh Mujibur Rahman Agricultural university
BRRI	=	Bangladesh Rice Research Institute
C.V.	=	Co-efficient of Variation
e.g.	=	For example
et.al.	=	And others
FAO	=	Food and Agriculture Organization
LSD	=	Least Significant Difference
M.S	=	Master of Science
RCBD	=	Randomized Complete Block Design
UNDP	=	United Nations Development Programme
Viz.	=	Namely
PM	=	Poultry manure

CHAPTER I

INTRODUCTION

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INTRODUCTION

Rice is a vital food material for more than half of the world's population. Among cereals rice is more nutritious and about 40% of world population consumes it as a major source of calorie (Banik, 1999). About 77.07% of cropped area of Bangladesh is used for rice production, with annual production of 33.83 million ton from 11.41 million ha of land, which contribute about 19.60% of the country's GDP (BBS, 2013). But rice production area is decreasing day by day due to high population pressure. The possibility of horizontal expansion of rice production area has come to a standstill (Hamid, 1991). Therefore, attempts should be taken to increase the yield per unit area. For vertical expansion, the use of modern production technologies should be included, among which high yielding varieties and fertilizer management are remarkable ones. Now a days, this crop is grown in about 80% of total cultivated area in Bangladesh (BBS, 1994). Every year the country has to spend lion's share of her foreign exchange to import food. Achieving self-sufficiency in food production and sustaining this in the face of the increasing population pressure continues to be a major goal of agriculturists in Bangladesh. Cropping area of Bangladesh is not possible to increase due to limitation of land source therefore increase in production per unit area is the only way to increase food production. Although about 1.889 m ha of land are used for rice cultivation but the total production was 89341 metric tons during 2015-2017 (BBS, 2017). The total production of rice in Bangladesh is not sufficient to feed her people. Among the top rice growing countries of the world; position of Bangladesh is forth in total rice area; sixth in yield per hectare (Nasiruddin, 1999). Unfortunately, yield is low compared to other rice growing countries like Japan and China where the average yield is 7.12 and 6.73 t ha^{-1}, respectively (FAO, 2012).

Nitrogen is one of the most yield-limiting nutrients in rice production around the world, especially in tropical Asian soils and almost every farmer has to apply N fertilizer to get a desirable yield of rice (Saleque *et al*., 2004). Nitrogen plays a key role in supporting plant activity and increasing the rice yield (BRRI, 1997 and Behera, 1998). Rice plants require a large amount of N at the early and mid-tillering stage to maximize the number of panicles. In order to exploit the full yield potential of modern rice cultivars, N-fertilizer application is necessary in most soils. Nitrogen is the most deficient nutrient element in Bangladesh soils. The efficient N management can increase crop yield and reduce production cost. The farmers mainly uses urea as N fertilizer which accounts for about 75% of the total fertilizers used in Bangladesh (Bhuiya, 1991).

The optimum dose of N fertilizer plays vital role for the growth and development of rice plant and its growth is seriously hampered when lower dose of N is applied, which drastically reduced yield; further, excessive N fertilization encourages excessive vegetative growth which make the plant susceptible to insect pests and diseases which ultimately reduces yield. Many farmer’s use more amount of N fertilizer than needed while they use less amount of other fertilizers such as P, K and S. They seldom use micronutrient fertilizers e.g. Zn and B. This practice in turn produces a negative impact on crop production (Rijpma and Jahiruddin, 2004). Continuous use of inorganic fertilizer deteriorates soil properties, accelerates the depletion of soil organic matter, causes a nutrient imbalance of soil including micronutrient deficiency and reduce the fertility and residual effects remain for long days. Furthermore, chemical fertilizers pollute soil and water making environment even more harmful for both terrestrial as well as aquatic life. Application of inorganic fertilizer has always been expensive inputs for crop production, especially for developing country like Bangladesh. In near future, chemical fertilizer is likely to be even more costly. This situation in turn will pose a serious threat to food security of vast millions of people of Bangladesh. On the other hand if considering organic fertilizers, they have no harmful effect. So, use of poultry manure is beneficial. Because, poultry manure contains appreciable amounts of nitrogen, calcium, magnesium, chlorine, sodium, manganese, iron, copper, molybdenum and arsenic (Kelleher *et al., 2002).*

Poultry manure (PM) may play a vital role in soil fertility and productivity improvement thereby reducing the use of chemical fertilizers and environmental pollution. It is considered a relatively inexpensive source of macro and micronutrients and its application rates are usually determined in terms of the N, P, and/or K provided (Sistani *et al.* 2004). It is used as a soil amendment to add nutrients and organic matter, thereby increasing soil fertility.

Poultry manure is also used as organic source of soil nutrient. Meelu and Singh (1991) showed that 4 t ha^{-1} PM 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. It is true that sustainable production of crops cannot be maintained by using only chemical fertilizers and similarly it is not possible to obtain higher crop yield by using organic manure alone (Bair, 1990). The use of PM and its proper management may reduce the need for chemical fertilizer allowing the small farmers to save part of their cost of crop production. Global environment pollution can also be considerably by reducing the use of chemical fertilizers and increasing the use of poultry manure.

Considering the above points, the present piece of work was undertaken with the following objectives:

1. To determine the effect of nitrogen fertilizer and poultry manure on the growth and yield of boro rice.
2. To find the best integrated dose of nitrogen fertilizer and poultry manure on boro rice production.

CHAPTER II

REVIEW OF LITERATURE

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REVIEW OF LITERATURE

A number of research works on the response of rice to manures and fertilizers have been carried out in the rice growing countries of the world including Bangladesh. A better understanding of the effects of N fertilizer and manure on rice in our soils will facilitate the development of suitable soil management practices for better production of this crop. In this chapter, an attempt has been made to review some of the available research findings in Bangladesh and elsewhere related to the effect of N fertilizer and poultry manure on yield contributing characters.

2.1 Effect of N fertilizer and poultry manure on growth and yield contributing characters of rice

2.1.1 Effect of N fertilizer

Azarpour *et al.* (2014) studied on yield and physiological traits of three rice cultivars (Khazar, Ali Kazemi and Hashemi) due to the effect of N fertilizer (0, 30, 60, and 90 Kg N ha^{-1}). Results of growth analysis indicated that, nitrogen increasing rates of fertilizer caused the increment of growth indexes and yield of rice.

Zhaowen Mo *et al.* (2013) reported that yield formation and growth of "super" rice (Oryza sativa L.) was affected by nitrogen application. The results showed that, N 187.5 kg ha^{-1} had the highest LAI at full heading, CGR from full heading to maturity as well as TDW at maturity, which resulted in a significantly high increase in grain yield from 24.19–29.84% and 5.01–6.26% as compared to N 0 and 225 kg ha^{-1}, respectively.

Yoseftabar (2013) reported that N fertilizer is a major essential plant nutrient and key input for in increasing crop yield. The results showed that panicle number, panicle length, panicle dry matter, number of primary branches, total grain and grain yield increased significantly with nitrogen fertilizer. Application 300 kg N ha^{-1} observed high rate of this parameter.

Uddin *et al.* (2013) found that application of nitrogen at 80 kg ha^{-1} produced the highest total spikelets and maximum grains panicle^{-1} resulted in the highest grain yield. Based on the results it may be recommend that nitrogen should be applied at 80 kg for obtaining the higher grain yield of NERICA 1 rice.

Naidu *et al.* (2013) reported that the highest growth, yield attributes, lesser spikelet sterility and higher grain yield were obtained with the application of 100–50–50 kg ha^{-1} N, P_2O_5, K_2O and these parameters were at their minimum with the supply of 60–30–30 kg ha^{-1} of N, P_2O5, K_2O. The increase in yield with supply of 100–50– 50 kg ha^{-1} N, P_2O_5, K_2O (N_3), compared to supply of 60–30–30 kg ha^{-1} N, P_2O_5, K_2O (N_1) was 15.1 and 15.4% respectively during 2006 and 2007, respectively.

Maqsood *et al.* (2013) reported that the nitrogen application at 100 kg N ha^{-1} provided a maximum paddy yield (4.39 and 4.67 t ha^{-1}) in both years under the climatic conditions of Faisalabad, Pakistan, higher paddy yield and yield components, as well as greater economic benefits, can be obtained at 100 kg N ha^{-1} nitrogen application.

Haque (2013) conducted an experiment to investigate the effect of five N levels viz. 0, 40, 80, 100 and 140 kg N ha^{-1} and he found the longest plant, highest number of total, effective tillers hill^{-1}, grains panicle^{-1}, grain and straw yields were observed with 100 kg N ha^{-1} followed by 140 kg N ha^{-1}.

Yoseftabar *et al.* (2012) showed that yield and yield components increased significantly with N fertilizer. Interesting in comparison to 100 and 200 kg ha^{-1} level application of higher N–fertilizer 300 kg ha^{-1} showed a positive respond to application of high N on hybrid cultivar. Effect of different split application N–fertilizer was significantly on parameter of above. Sharma *et al.* (2012) found that the highest grain yield of 70.60 q ha^{-1} was attained with an application of 180 kg N ha^{-1}. The lowest yield (44.12 q ha^{-1}) was recorded in the control plot.

Hasanuzzaman *et al.* (2012) conducted an experiment on growth and yield of rice due to evaluate the effect of N–fertilizer (0, 80, 120, 160, 200 kg N ha^{-1}, USG @

75 kg N ha^{-1}). Results indicated that N had a significant effect on effective tillers hill^{-1}, filled grains panicle^{-1} and 1000-grain weight. USG gave the highest effective tillers hill^{-1} (13.63) followed by 120 kg N ha^{-1} (12.11). The highest filled grains panicle^{-1} (154.7) was found from N_2 (USG) which was at par with 160 kg N ha^{-1} (145.8), 120 kg N ha^{-1} (145.4) and 200 kg N ha^{-1} (144.1). Application of N created significantly variation in grain yield, straw yield, biological yield and harvest index. USG gave the highest yield (9.42 t ha^{-1}) which was followed by 160 kg N ha^{-1} (8.58 t ha^{-1}). The increase in yield by the use of USG and 160 kg N ha^{-1} was 76.74% and 60.98%, respectively over the N_0.

Alim (2012) reported that the grain and straw yields were increased with the increase of N rate up to 120 kg ha^{-1} at all the sources. The application of 60 kg N ha^{-1} as urea with 60 kg N ha^{-1} as mustard oil cake (MOC) produced maximum grain and straw yield which was statistically similar to the yield of 50 kg N ha^{-1} as urea with 50 kg N ha^{-1} as MOC. The lowest values were found in control N application.

Abou–Khalifa (2012) evaluated the 5 rice varieties under different N levels (0, 55, 111, 165 and 220 Kg ha^{-1}). Main results induced that maximum tillering, panicle initiation, roots length, heading dates, grains filling rates (GFR) at five stages, LAI chlorophyll content, number of tillers m^{-2}, 1000-grains weight, number of grains panicle^{-1}, panicle length (cm) and grain yield (t ha^{-1}) were the highest value at 220 kg N ha^{-1}.

Salem *et al.* (2011) found that the number of tillers hill^{-1}, days from sowing up to panicle initiation, heading dates, leaf area index, leaf area ratio, chlorophyll content, 1000–grain weight, panicles length, agronomic efficiency, utilization efficiency and grain yield (t ha^{-1}) were increased by increasing nitrogen levels up to 165 kg N ha^{-1}.

Salem *et al.* (2011) reported that the number of tillers hill^{-1}, days from sowing up to panicle initiation, heading dates, leaf area index, leaf area ratio, chlorophyll content, 1000 grains weight, panicles length, agronomic efficiency, utilization efficiency and grain yield (t ha^{-1}) were increased by increasing nitrogen levels up to 165 kg N ha^{-1}.

Salem *et al.* (2011) reported that the number of tillers $hill^{-1}$, days from sowing up to panicle initiation, heading dates, LAI, LAR, chlorophyll content, days 1000 grains weight, panicle length, agronomic efficient, utilization efficiency and grain yield (ton ha^{-1}) were increased by increasing N levels up to 165 kg N ha^{-1}.

Mohaddesi *et al.* (2011) found that the effect of N fertilizer rates had not significant effects on traits except 1000 grains weight in both seasons. Increasing N fertilizer levels up to 300 kg N ha^{-1} resulted in increases in plant height, grain yield, biological yield but these increases were not significant.

Metwally *et al.* (2011) studied to evaluate the response of Egyptian hybrid rice 1 'H1' to N fertilizer. Nitrogen levels were 0, 50, 100, 150, 200, 250, 300, 350, and 400 kg N ha^{-1}. Nitrogen fertilization significantly increased grain yield. The maximum grain yield was obtained with the application of 200 kg N ha^{-1}. Yield components were also significantly affected by N treatments.

Khorshidi *et al.* (2011) reported that the effect of N fertilizer had no significant difference on 1000 seeds weight and number of grains $panicle^{-1}$. The effect of fertilizers on rice yield showed that application of 100 kg of N had the highest yield of 5733 kg ha^{-1}. Data also indicated that yield had the highest positive correlation with panicle and harvest index.

Karim (2011) studied on the effect of N fertilizer (0, 20, 40, 60, 80.100 120 kg N ha^{-1}) in respect to high yield and better seed quality. Growth parameters like plant height (114.37 cm) and tillers $hill^{-1}$ (15.1) had higher at higher level of N. However, plants with moderate level of applied N showed better yield component of the variety where the highest panicle $hill^{-1}$ (11.8), grains $panicle^{-1}$ (140.5) and filled grains $panicle^{-1}$ (130.33) were recorded with 60 kg N ha^{-1}. Better yield components of the variety obtained at 60 kg N ha^{-1} attributed to the highest yield (4.43 t ha^{-1}) of the variety.

Jun *et al.* (2011) conducted an experiment in a rice field with different crop rotation systems and N application rates, surface water N content, N loss via runoff, soil fertility and rice yield were determined. Alfalfa–rice and rye–rice rotation systems enhanced soil nitrogen content, promoted rice N absorption and significantly improved rice yield.

Fageria *et al.* (2011) reported that yield and yield components were significantly increased in a quadratic fashion with increasing N rate. Based on regression equation, maximum grain yield was achieved with the application of 380 mg N kg^{-1} by ammonium sulfate and 271 mg N kg^{-1} by urea. Grain yield and yield components were reduced at higher rates of urea (>300 mg kg N) but these plant parameters' responses to ammonium sulfate at higher rates was constant. In the intermediate N rate range (125 to 275 mg kg^{-1}), urea was slightly better compared to ammonium sulfate for grain yield.

Awan *et al.* (2011) carried out an experiment to study the effect of different nitrogen levels (110, 133 and 156 kg ha^{-1}) in combination with different row spacing (15 cm, 22.5 cm and 30 cm). Treatment RS2N3, where 156 kg N ha^{-1} were applied with 22.5 cm row to row and plant to plant spacing had maximum values of plant height (79.07 cm), tillers m^{-2} (594), panicle length (25.40cm), number of grains $panicle^{-1}$ (132.97), grain yield (5.46 t ha^{-1}), straw yield (9.66 t ha^{-1}) and least value of sterility percentage (5.7 %).

Mizan (2010) reported that the highest plant height (983.32 cm) was obtained form 160 kg N ha^{-1} followed by 120 kg N ha^{-1}.

Mannan *et al.* (2010) studied to determine the optimum N level as well as to find out the genotype having high yield potential. The plant height, tiller number, number of panicles, panicle length, spikelet sterility and straw yield increased with the increase of N levels up to 75 kg N ha^{-1}. Maximum plant growth at the highest level of N caused lodging of plant which increased spikelet sterility and lower grains $panicle^{-1}$ and ultimately decreased grain yield.

Kandil *et al.* (2010) found that the increasing N fertilizer levels up to 80 kg N ha^{-1} resulted in marked increases in number of tillers m^{-2}, panicle length, panicle weight, filled grains $panicles^{-1}$, 1000 grains weight, grain and straw yields ha^{-1} and harvest index in both seasons. The addition of 144 or 192 kg N ha^{-1} recorded the tallest plants and the highest number of panicles m^{-2} without significant differences. The increase in plant height and straw yield ha^{-1} with the heaviest 1000 grains weight, highest grain yield ha^{-1} and HI in both seasons.

Hoshain (2010) observed that number of effective tiller, number of grains $panicle^{-1}$, grain yield and straw yield were significantly increased with the increasing rates of N 120 Kg ha^{-1} as urea where harvest index increased from up to N 80 Kg ha^{-1} application.

Salahuddin *et al.* (2009) found gradual increase in panicle length (24.50 cm), grains $panicle^{-1}$ (110) and grain yield (4.91 t ha^{-1}) due to the increase in N levels up to 150 kg ha^{-1} and declined thereafter. Thousand grains weight was not significantly influenced by application of different levels of N.

Hossain *et al.* (2008) reported that different N rates also significantly affected the aromatic rice cultivars. All the yield components were significantly increased up to 90 kg N ha^{-1}. Nonetheless, maximum grain yield (3.62 t ha^{-1}) was observed from 60 kg N ha^{-1}.

Islam *et al.* (2009b) found significant variation on morpho–physiological attributes of BINA dhan 5, Tainan 3 and BINA dhan 6 due to four N levels. Plant height, tillers $hill^{-1}$, leaves $hill^{-1}$, LA $hill^{-1}$ (cm^2), DM of root, stem and leaves $hill^{-1}$, TDM $hill^{-1}$ and chlorophyll content in leaves (at 74 DAT), were increased with the split application of N. Among the treatments, T_4 showed the best performance and grain yield (45.25 g $hill^{-1}$) compared to control (30.61 g $hill^{-1}$). Full dose of urea (215 kg urea ha^{-1}) applied at three equal split at 15, 30 and 55 DAT was found to be the most beneficial one for the all the rice genotypes.

Nori *et al.* (2008) studied to assess the grain yield and straw nutritive quality of MR 211 and MR 219 rice varieties due to five N rates (0, 120, 160, 200 and 240 kg N ha^{-1}). Increases in N application was found to increase ($P<0.01$) the grain yield, total spikelets m^{-2}, spikelets panicle^{-1} and straw crude protein from 4.56% to a maximum level of 8.45%.

Islam *et al.* (2008) conducted a field experiment found that the application of N fertilizer significantly influenced the plant height, number of tillers, effective tillers, panicle length, grains panicle^{-1} and grain yield. The highest grain yield 4.27 t ha^{-1} was recorded with the N_4 (100 kg N ha^{-1}).

Hossain *et al.* (2007b) reported that the N levels also exerted significant effect on all the yield parameters, except for panicle length and 1000 grains weight. The highest grain yield was obtained from the application of 75 kg ha^{-1} of the recommended dose of N and the lowest from the control treatment (0 kg ha^{-1}) of rice cv. BRRI dhan 32.

Hossain *et al.* (2007a) reported that the greatest plant height and highest number of tillers hill^{-1} were observed with the application of 69 kg N ha^{-1}, which was significantly followed by 51.75, 34.5 and 17.25 kg N ha^{-1}, respectively and the lowest was observed in control treatment (0 kg N ha^{-1}).

Abbasi *et al.* (2007) found that the highest number of fertile tiller was obtained in the fifth and sixth treatments with double and triple split application of 120 kg N ha^{-1}. They suggested that triple split application of 80 kg N ha^{-1} could be best for rice production.

Manzoor *et al.* (2006) evaluated the nine different N levels i.e. 0, 50, 75, 100, 125, 150, 175, 200 and 225 kg ha^{-1} for observing the field performance of rice. Plant height, productive tillers hill^{-1}, panicle length, grains panicle^{-1}, 1000 grain weight and paddy yield showed increasing trend from 0 kg N ha^{-1} up to 175 kg N ha^{-1}. The yield parameters including paddy yield, grains panicle^{-1} and 1000 grain weight started declining at 200 kg N ha^{-1} level and above. Maximum paddy yield (4.24 t ha^{-1}) was obtained from 175 kg ha^{-1} N application treatment which also produced highest values of grains panicle^{-1} (130.2) along with a maximum 1000 grain weight (22.92 gm). The plant height (139.8 cm) along with productive tillers hill^{-1} (23.42) and panicle length (29.75 cm) was the maximum at 225 kg N ha^{-1}.

Dwivedi *et al.* (2006) conducted a field experiment on growth and yield of rice to evaluate the effect of N level. They found that 184.07 kg ha^{-1} N (urea) was the optimum rate for highest yield.

Amin *et al.* (2006) found significant variation on growth, tillering and yield of three traditional rice varieties due to variable doses of N fertilizer compared with that of a modern variety at BSMRAU, Salna, Gazipur. Application of 60 kg N ha^{-1} produced more TDM and lesser ineffective tillers. Application of 30 kg N ha^{-1} appropriate for low responsive traditional varieties produced the highest yield (4451 kg ha^{-1})

Rahman *et al.* (2005) reported that recommended 100% dose of N increasing the highest grain yield (4.80 t ha^{-1}) which was as par with 75% recommended dose of N producing 4.75 t grain ha$^{-1.}$

Naik and Paryani (2005) reported that the plant height and grain yield were increased with application of N up to 150 kg ha^{-1}. The highest number of grains panicle^{-1} (157.9), yield of grains (64.4 q ha^{-1}) and straw (94.4 q ha^{-1}) were produced significantly from rice hybrids PHB- 71.

Muhammad *et al.* (2005) reported that the highest number of plant height (116.55 cm), number of spikelet panicle^{-1} (118.85) and straw yield (11.00 t ha^{-1}) were obtained from 150 kg ha^{-1} urea.

Mashkar and Thorat (2005) conducted a field experiment to study the effects of different N levels (0, 40, 80 and 120 kg N ha^{-1}, respectively) on N, P and K uptake and grain yield of scented rice cultivars (Pula Basmati 1, Kasturi, Indrayani and Sugandha). The different levels of N had significant effect in augmenting the uptake of N, P and K nutrients and grains as well as straw yield of rice. Application of 120 kg N ha^{-1} recorded significantly higher N, P and K uptake in rice compared to the rest of the N levels. Every increment of 40 kg N ha^{-1} from 0 to120 kg N ha^{-1} increased the nutrient content and uptakes.

Sidhu *et al.* (2004) reported that N fertilizer substantially increased the mean grain yield of Basmati up to 40 kg N ha^{-1} in the fallow Basmati- wheat Sequence while 60 kg N ha^{-1} reduced Basmati yield. Compared to the treatment No, the mean grain yield of Basmati was increased by 0.31, 0.40 t ha^{-1} at doses of 20 and 40 kg N ha^{-1}.

Subhendu *et al.* (2003) conducted a field experiment during kharif season at Hyderabad, India. They found that application of N 120 kg ha^{-1} as urea in equal splits during transplanting, tillering, panicle initiation and 50% of flowering resulted in the highest 1000 grains weight (22.57 g).

Singh and Shivay (2003) evaluated that increasing level of N significantly increased the number of tiller $hill^{-1}$. Mondal and Swamy (2003) observed that highest harvest index by applying N (120 kg ha^{-1}) as urea in equal splits during transplanting, tillering, panicle initiation and flowering. Lawal and Lawal (2002) found that grain yield of rice significantly increased by 80 kg ha^{-1} N (urea) application.

Bayan and Kandasamy (2002) observed that effective tillers $hill^{-1}$ was significantly affected by the level of N and recommended doses of N (Urea) in four splits at 10 days after sowing, active tillering, panicle initiation and at heading stages recorded significantly lower dry weight of weeds and increased crop growth viz., effective tillers m^{-2}.

2.1.2 Effect of poultry manure

The role of poultry manure for crop production has been reviewed and discussed in this section. A review of available literature on the use of manure for soil-fertility management showed that manure is a good source of plant nutrients. The effects of the poultry manure on crop production have been reviewed in the following.

Ogbodo (2005) conducted a study to compare the response of rice to organic and inorganic manures at Abakaliki, Southeastern Nigeria, between 2002 and 2003 cropping seasons (April-November).However, organic manure application doses of over 20 t/ha reduced plant growth and grain yield. Sewase sludge and poultry droppings at 20 t/ha were therefore concluded to be a viable alternative to urea in rice production in the study area.

Reddy *et al.* (2004) carried out a field experiment for years (2001 and 2002) on the farmers field in Koler district (eastern dry zone, Karnataka, India) to study the effect of different organic manures on growth and yield of paddy under tank irrigation. Application of PM (9 t ha^{-1}) to paddy produced grain yields at per with recommended dose of fertilizers + 10 tons FYM, but both were higher (67 and 69%) respectively than FYM. Poultry manure produced better growth components, viz, plant height, number of tillers $hill^{-1}$, total dry matter $plant^{-1}$ and yield components like number of panicle $hill^{-1}$ and panicle length.

Vanaja and Raju (2002) observed that the treatment with PM 2 t ha^{-1} + 75% recommended fertilizer N showed the highest dry matter yield at flowering, grain and straw yields at maturity with values of 95.1, 55.0 and 73.9 q ha^{-1} which were increased by 92.9, 112.6 and 96.0 percent, respectively over control.

Singh *et al.* (2001) carried out a field experiment during the rainy and winter seasons of 1998-99 to study the effect of PM under irrigated condition with N in rice-wheat cropping system in an Alfisols of Bilaspur, Madhya Pradesh. India. The treatments consisted of PM alone and in combination with nitrogen fertilizer. Root and shoot biomass at different growth stages increased with the application of N and PM alone and in combination. Root and shoot biomass was higher in N 100% through PM and N 25% through urea.

Rajni *et al.* (2001) conducted a pot experiment in a glasshouse during kharif season to assess the response of rice to different treatment combinations of vermicompost (VC), poultry manure (PM) and nitrogen (N) fertilizers. They proposed that agronomic efficiency was higher in case of integrated treatments than using fertilizer alone. Finally they concluded that the combined application of 2/3N through manure has a greater potential for fertilizer management for rice crops.

Babu *et al.* (2000) observed that application of FYM, NPK fertilizers, PM and FYM + N all resulted significantly higher grain and straw yields than the control and FYM + N produced the higher rice yield, longest and heaviest panicles, heaviest grain weight and highest net returns for both Rasi and KRH-1 cv. of rice.

David and Biswas (1996) found that when PM 10 t ha^{-1} was applied, the dry matter yield of wheat and total P uptake were increased P utilization was increased when PM was applied with mineral P. Dry matter was the highest with P_20_5 80 kg + PM 20 t/ha.

Govindasamy *et al.* (1994) reported that the use of poultry litter was more economical at high target yields of rice than at low target yields and it was more economic in use of fresh litter than composted litter.

Budhar *et al.* (1991) reported the effect of farm wastes on low land rice. They found that grain yield of IR 60 was the highest with application of PM (6.63 t/ha) followed by *Sesbania rostrata* (6.64 t/ha) and the lowest with no manure application (5.17 t/ha). They also found that the plant height was significantly influenced by the basal incorporation of farm wastes.

Calendacion *et al.* (1990) observed that the high total yield was produced by rice following NPK 220-70-70 kg + PM 12 t ha^{-1}. They concluded that rice and potatoes could be profitably grown in rotation. Application of PM to potatoes improved soil fertility for the following rice crop.

Reddy *et al.* (2004) conducted a field study for two years 2001 and 2002 on the farmers field in kolar district (eastern dry zone, Karnataka, India) to study the effect of different organic manures on growth and yield of paddy under tank irrigation. Poultry manure and sewage sludge produced better growth components, viz, plant height, number of tillers hill^{-1}, panicle length and 1000 grains weight.

Channabasavanna and Biradar (2001a) observed that grain yield increased with each increment of PM application and was maximum in 3 t PM ha^{-1} which was 26 and 19% higher than that of the control during 1998 and 1999, respectively and the increase was significant up to 2 t poultry manure ha^{-1}.

Channabasavanna and Biradar (2001b) conducted an experiment with four sources of organic manure (FYM 7 t ha^{-1}, rice husk 5 t ha^{-1}, PM 2 t ha^{-1} and press mud 2 t ha^{-1}), one control and 3 levels of zinc (0, 25 and 50 kg $ZnSO_4$ ha^{-1}). Application of PM with 25kg $ZnSO_4$ ha^{-1} recorded significantly higher yields over rest of the treatments. The residual effect was more prominent when rice husk was applied. They also cited that organic manure increased panicle hill^{-1} and seeds panicle^{-1}.

Singh *et al.* (1998) reported that the rice grain yield was highest in 40:25:15 NPK + 10 + PM ha^{-1}. The poultry manure was more effective than the FYM. Wheat yield was highest due to residual effect of PM.

Singh *et al.* (1996) carried out a field experiment in India where irrigated rice was given 60, 120 or 180 kg N ha^{-1} as poultry manure, urea or PM + urea. In first year, PM did not perform better than urea but in the third year, 120 and 150 kg N as PM produced significantly higher grain yields than the same rates as urea.

Gupta (1995) showed that application of pig manure (10 t ha^{-1}) produced the highest grain yield (4.5 t ha^{-1}) followed by PM and FYM which produced yields 4.1 and 3.9 t ha^{-1} of rice grain, respectively. The increase in rice yield with organic fertilizer was 34 to 55% over the control and 5 to 22% over NPK fertilizers.

2.1.3 Combined effect of N fertilizer and poultry manure

Asit *et al.* (2007) conducted a field experiment to investigate the effect of six long-term (34-year) fertilizer and farmyard manure (FYM) treatments (Control, N, NP, NPK, NPK + S, NPK + FYM) at three physiological stages of wheat growth on the microbial biomass carbon (MBC), nitrogen (MBN) and dehydrogenase, mineralizable N and phosphatase activities in soil. It was found that a balanced application of NPK + FYM gave the highest values for the measured parameters and lowest at control. Values were generally highest at tillering, followed by the flowering and dough stages. A significant positive interaction between fertilizer treatments and physiological stages of wheat growth was observed, being highest at maximum tillering due to application of NPK + FYM.

Muneshwar *et al.* (2007) used integrated inorganic fertilizer N and well decomposed cattle manure (CM) or 30-35 days old *Parthenium* (*Parthenium hysterophorus* L.), a weed grown off site as green manure (GM) under repeated applications of fertilizer P and urea N for eight years in a rice (*Oryza sativa* L.) wheat (*Triticum estivum* L.) sequence and studied the transformation of fertilizer P applied to soil at the National Research Center for Weed Science, Jabalpur, India. Based on the results, it appeared that, repeated applications of 53 kg super-phosphate P resulted in a marked increase in Olsen P linearly with time. Conjunctive use of urea fertilizer N with organic manure resulted in a larger increase in Olsen P in the Vertisol. Studies further revealed that the greater accumulation of fertilizer P applied in excess to crop removal occurred in inorganic P in the plots receiving only fertilizer N. However, plots receiving fertilizer N along with organic manures led to P accumulation predominantly in organic forms. It is suggested that organic manure with chemical fertilizer increased soil available Olsen P which enhanced the yield in rice-wheat cropping system.

Singh *et al.* (2005) conducted multi-locational experiments at eight farmers field covering five villages (Pairaguri, Puturu, Gidhibill, Kuliyana and Deoli) of east Singhbhum, Jharkhand, India in kharif seasons of 2001 and 2002 to study the effect of integrated nutrient management (INM) practices on transplanted rice yield and nutrient uptake and soil fertility status. Results showed that the grain and straw yield of transplanted rice were significantly influenced by INM practices. T_5-soil test based NPK (80:60:30) + 5 tons FYM/ha + cowpea as green manure recorded the highest grain yield. The total N, P and K uptake by rice was higher with INM practices over the farmers practice. The highest N, P and K uptake by rice was recorded under T_5. Available N, P and K content in farmers' field was improved under INM practices compared to its initial soil fertility.

A study was undertaken to evaluate the effects integrated use of organic wastes such as press mud, farmyard manure (FYM), and green manure (*Crotalaria juncea*) along with chemical fertilizer on the yield and quality of sugarcane in High Ganges River Floodplain soils of Bangladesh. Chlorophyll a and chlorophyll b contents of cane leave tissues were slightly increased by organic manure and green manure (Boktiar and Sakurai, 2005).

Mahavishnan *et al.* (2004) conducted a field experiment during the Kharif season of 2000 in Andhra Pradesh, India to investigate the effects of organic fertilizer sources on the growth and yield of rice cv. BPT-5204. The experiment included N: P: K at 75, 100 and 125% of the recommended rate (RDF, 120: 60: 40 kg /ha), combine with farmyard manure (FYM) at 10 t /ha; poultry manure at 5 t /ha and glyricidia (*Gliricidia* sp.) at 10 t /ha, alone with control and fertilizer application based on test crop response (N: P: K at 104: 52: 74 kg /ha). The crop growth and yield were higher with 125% RDF + poultry manure and 100% RDF + poultry manure compared to other treatments.

Vipin-Kumar (2003) carried an experiment in Nigeria to determine the effect of goat manure on upland rice. The applications of 10 t ha^{-1} and 20 t ha^{-1} of goat manure produced 1.49 t ha^{-1} and 1.58 t grain yields, respectively in the second year. These yields were as good as those obtained with application of chemical fertilizer only or the application of 10 t ha^{-1} of goat manure produced the highest grain yield increase but resulted in more weed and stem borer infestation in those plots.

Chettri *et al.* (2002) conducted an experiment on rice cultivation under chemical fertilizer with or without FYM. They found that the highest number of effective tillers, grains per panicle, percentage of filled grains, 1000 grains weight and grain yield (44.05 q ha^{-1}) were obtained from the application of 60, 30, 30 and 10 kg N, P_2O_5, K_2O and FYM ha^{-1}.

Rajni Rani *et al.* (2001) conducted a pot experiment in a glasshouse of Varanasi, Uttar Pradesh, India during kharif season to assess the response of rice to different combinations of vermi compost (VC), poultry manure (PM) and nitrogen (N) fertilizers. Results showed that all integrated treatments significantly increased plant height, number of effective panicles pot^{-1} and dry weight $panicle^{-1}$ over the treatment having full N dose through urea.

Dwivedi and Thakur (2000) conducted experiment in Bihar , India to study the effect of organic and inorganic fertilizer levels on the productivity of rice and found that treatment with 100: 60: 40 kg NPK ha^{-1} recorded significantly higher grain yields (43.25 and 44.38 q ha^{-1}) than the lower fertilizer rates (75 and 50% NPK). They also stated that the interaction between organic and inorganic fertilizer was significant and saved 50 and 25% NPK.

Ram *et al.* (2000) reported that the use of 30 or 60 kg N ha^{-1} from organic sources in a total application of 120 kg N ha^{-1} increased grain and straw yields, N uptake and recovery, grain nutritive value, decreased soil pH and increased soil fertility and economic returns.

Abedin Miah and Moslehuddin (1999) conducted a long-term fertility trial in Sonatala silt-loam soil at Bangladesh Agricultural University farm, Mymensingh to evaluate the effects of continued fertilization and manuring on soil properties and yield of crops. Grain yield of rice increased due to N, P, K and S application but rate of increase varied in different season Residual S remarkably decreased the yield in aman season. The yield of aman showed a decreasing trend over the years but the yield of aus remained almost static. The NKSZn treatment maintained its superiority both in T. aman and aus rice although the performance of FYM was very close to NPKSZn treatment. In general, the response of T. aman to S containing treatments showed a decreasing trend over the years. The availability of P, S and Zn increased in soil due to long continued application. Phosphorus fertilization also improved the micronutrient status of soil. No considerable change in K status was noted due to K application. Nutrient balance study showed a severe loss of most of the nutrients through soil degradation.

Devi *et al.* (1997) conducted a field trial (1987-93) to develop a system for integrated nutrient supply for a rice-rice cropping sequence. Application of 45: 45: 45 kg NPK ha^{-1} as mineral fertilizers and 45 kg N ha^{-1} as FYM in the kharif seasons followed by 90: 45: 45 kg mineral NPK ha^{-1} in the rabi seasons gave the highest yields in all years except 1993.

Nahar *et al.* (1996) conducted a field experiment to compare organic and inorganic fertilizers. They reported that grain yield of rice increased markedly due to application of organic fertilizer. They showed that the highest yield (4.37 t ha^{-1}) was obtained in organic fertilized plots.

CHAPTER III

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHODS

An experiment was conducted at western side of medical center and near the water tank of HSTU, Dinajpur, during the boro season of 2017 to study on the performance of growth variability, yield potentialities of rice as influenced by the combinations of poultry manure and urea fertilizer. This chapter presents a brief description of the soil, crop, experimental design, treatments, cultural operations, collection of soil and analytic methods followed in the experiment. This chapter has been divided into a number of sub–heads describe as below:

3.1 Experimental site

The experiment was conducted at western side of medical center and near the water tank of HSTU, Dinajpur, during February to May of 2017. Geographically the experimental site is located between 25.13^0N latitude and 88.23^0E longitudes and at elevation of 37.5 m above the sea level. The land belongs to the Old Himalayan Piedmont plain (AEZ-1) (UNDP and FAO, 1988).

3.2 Weather and climate

The climate of the experiment location was subtropical usually the rainfall is even during kharif season (March-September) and scanty in rabi season (October-February).The atmospheric temperature was moderately low during the rabi season and increased as the season proceeds towards kharif season with occasional gusty winds. The weather, rainfall, temperature and relative humidity during the period is favorable for conducting the experiment.

3.3 Soil

Generally the soil of the experiment field was sandy loam and contains sand (%), silt (%), and clay (%) are 58, 28, and14 respectively (Table 2). The soil of the field experiment was sandy loam with pH 6.57. The initial soil (0-15 cm depth) test revealed that the soil contained 0.085% total nitrogen, 1.49% organic matter, 15.10 ppm available phosphorus, 0.09meq/100g exchangeable potassium and 11.33 ppm available sulfur (Table 3).

Table 1: Morphological description of soil

Morphological features	**Characteristics**
Location	HSTU, Dinajpur
AEZ (UNDP,1988)	AEZ-1:Old Himalayan Piedmont Plain
Land type	High land
General soil types	Non-calcareous brow floodplain soils
Topography	Level
Drainage	Well drainage
Flood level	Above flood level

Table 2: Physical characteristics of soil

Particle size description	**Values**
Sand (%)	58
Silt (%)	28
Clay (%)	14
Textural Class	Sandy loam

Table 3: Chemical characteristics of initial soil of field experiment

Characteristics	Analytical data
pH	6.57
Organic matter (%)	1.49
Total N (%)	0.085
Available phosphorus (ppm)	15.10
Exchageable potassium (meq/100g)	0.09
Available sulfur (ppm)	11.33

3.4 Preparation of seedbed

A piece of high land was selected in the research field in Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur for raising seedlings. The land was puddled well with country plough followed by cleaning and leveling with ladder.

3.5 Seed sowing

Sprouted seeds were sown in the wet nursery bed on 30th December, 2016. Proper care was taken to raise the seedlings in the nursery bed. Seeds were collected from Bangladesh Agricultural Development Corporation (BADC), Dinajpur branch office.

3.6 Preparation of experimental field

The land was prepared by repeated ploughing with a power tiller followed by a country plough. Every ploughing was followed by laddering which helped breaking the clods and leveling the land. Weeds, stubbles and crop residues were removed from the land.

3.7 Layout of the experimental land

The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. Each block was sub–divided into six unit plots. The treatments were randomly distributed to the unit plots in each block. The total number of plots was 24 (6×4). The unit plot size was 2.5 m × 2m. Block to block distance was 1 m and plot to plot distance was 0.5 m. The layout of the experiment has been shown in Fig. 3.1.

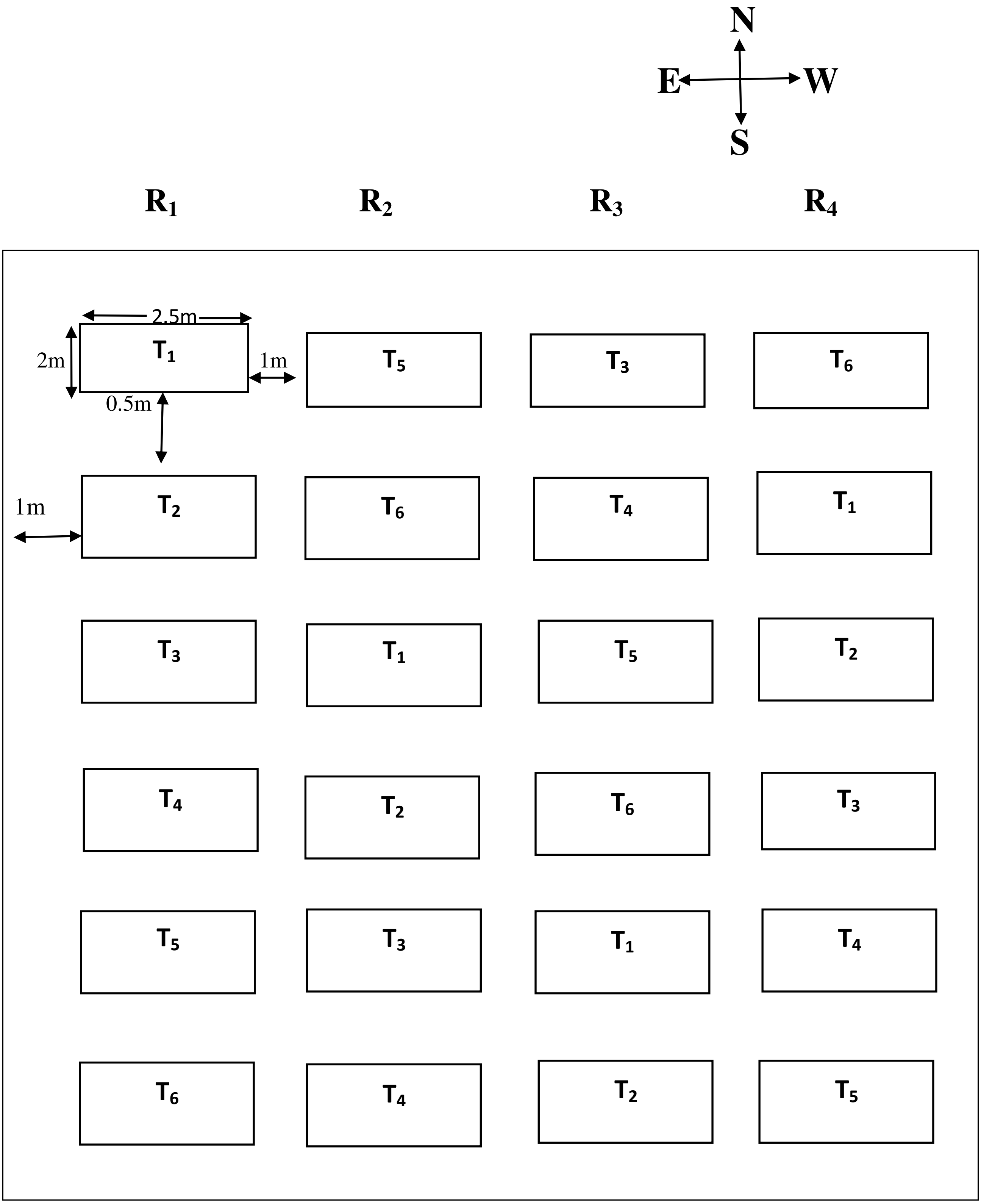

Fig. 3.1 Layout of experimental field

3.8 Experimental treatments

The following six treatments including control treatment were included in the present experiment where the treatments were the combinations of PM and N fertilizers. The percentage of N fertilizer and poultry manure were taken as per recommended dose and farmers practiced dose which were urea 300 kg ha^{-1} and PM 8 t ha^{-1}. The experiment consists of six treatments with four replications mentioned in conventional system i.e.

T_1= $N_{0\%}PM_{0\%}$ T_4= $N_{50\%}PM_{50\%}$

T_2= $N_{0\%}PM_{100\%}$ T_5= $N_{75\%}PM_{25\%}$

T_3= $N_{25\%}PM_{75\%}$ T_6= $N_{100\%}PM_{0\%}$

Here,

T_1= Urea @ 0 kg ha^{-1} + PM @ o t ha^{-1}

T_2= Urea @ 0 kg ha^{-1} + PM @ 8 t ha^{-1}

T_3= Urea @ 75 kg ha^{-1} + PM @ 6 t ha^{-1}

T_4= Urea @150 kg ha^{-1} + PM @ 4 t ha^{-1}

T_5= Urea @ 225 kg ha^{-1} + PM @ 2 t ha^{-1}

T_6= Urea @ 300 kg ha^{-1} + PM @ 0 t ha^{-1}

P, K, and S fertilizer were applied in all the plots as a basal dose according to the fertilizer recommendation guide as follows

TSP =90 kg ha^{-1}

MoP =120 kg ha^{-1}

Gypsum =45 kg ha^{-1}

3.9 Uprooting of seedlings

The seedbeds were made wet by application of water on the previous day of uprooting the seedlings. The seedlings were uprooted carefully without causing dry injury to the roots. The uprooted seedlings were kept on soft mud under shade.

3.10 Transplanting of seedlings

On 14 February, 2017, seedlings were transplanted in the experiment field keeping plant to plant distance 20 cm and row to row distance 25 cm.

3.11 Intercultural Operations

3.11.1 Fertilizer application

Poultry manure was applied as per treatment 7 days before of transplanting. The full dose of TSP, MoP, and gypsum were applied one day before transplanting. Nitrogen as urea was applied as per treatments in three equal splits. The first split of urea was applied 15 day after transplanting. The second split of urea was applied as top dressing after 30days of transplanting and the third split of urea was applied after 45 days of transplanting (panicle initiation stage).

3.11.2 Weeding

The crop was infested with some weeds during the early stage of crop establishment. First weeding was done at 15 days after transplanting followed by second and third weeding at 30 days and 45 days after transplanting, respectively.

3.11.3 Irrigation

Necessary irrigations were provided to the plots from as and when required up to the milking stage of the rice plant.

3.11.4 Harvesting

The rice crop was harvested at maturity on 27th May, 2017. The harvested crop was threshed plot–wise. Grain and straw yields were recorded separately plot wise and moisture percentage was calculated after sun drying. Dry weight for both grain and straw were also recorded.

3.12 Data collection

The data on the following growth and yield contributing characters of the crop were recorded on 30 May, 2017:

i. Plant height
ii. Number of leaf hill^{-1}
iii. Number of tiller hill^{-1}
iv. Number of effective tillers hill $^{-1}$
v. Panicle length

vi. Number of filled grains panicle^{-1}
vii. 1000 grains weight
viii. Grain yield
ix. Straw yield
x. Biological yield

3.12.1 Plant height

The plant height was measured from the ground level to the top of the panicle. Plants of 10 hills were measured and average for each plot.

3.12.2 Number of leaf hill^{-1}

Ten hills were taken at random from each plot and the number of leaves hill^{-1} were counted.

3.12.3 Number of tiller hill^{-1}

Ten hills were taken at random from each plot and the number of plants hill^{-1} was counted.

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

Ten hills were taken at random from each plot and the number of tillers hill $^{-1}$ was counted and thereafter the numbers of effective tillers hill^{-1} was determined.

3.12.5 Panicle length

Measurement was taken from basal node of the rachis to apex of each panicle. Each observation was an average of ten panicles

3.12.6 Number of grains panicle^{-1}

Presence of any food material in the spikelet was considered as grain and numbers of grains present in each panicle were counted. Five panicles were taken at random to count grains and averaged.

3.12.7 1000 grains weight

One thousand clean dried grains were counted from the seed stock per plot and weighed by using an electric balance.

3.12.8 Grain yield

Grains obtained from the harvest area of 1m x lm from the middle of each unit plot were sun dried and weighed carefully and converted to t ha^{-1}.

3.12.9 Straw yield

The collected straw from each plot was sun dried properly to record the final straw yield $plot^{-1}$ and finally converted to t ha^{-1}.

3.12.10 Biological yield

Grain and straw yields are altogether regarded as biological yield. The biological yield was calculated with the following formula:

Biological yield= Grain yield (t ha^{-1}) + Straw yield (t ha^{-1})

3.13 Analysis of soil sample

3.13.1 Soil pH

Soil pH was determined using a glass electrode pH meter at 1:2.5, soils: water ratio. The suspension was allowed to stand for one hour with occasional shaking before determination (Jackson, 1967).

3.13.2 Organic matter

Organic carbon of soil was determined by wet oxidation method (Black 1965). The organic matter content was calculated by multiplying the percent organic carbon with the Van Bemmelen factor 1.73 (Piper 1966).

3.13.3 Total N

Total nitrogen content was determined by Micro-kjeldahl method where soil was digested with 3 ml concentrated H_2SO_4 and 1.1 g catalyst mixture (K_2SO_4: $CuSO_4.5H_2O$: Se powder in the ratio of 100:10:1). Nitrogen in the digest was determined by distillation with 40% NaOH followed by titration of distillate trapped in H_3BO_3 with 0.01 N H_2SO_4 (Page *et al.*, 1989).

3.13.4 Available P

Available P was extracted by 0.03 N NH_4F and 0.025 N HCl and determined calorimetrically using molybdate blue ascorbic acid method (Bray and Kurtz, 1945).

3.13.5 Exchangeable K

Potassium was determined from the ammonium acetate extract using flame photometer as described by Page *et al*. (1989).

3.13.6 Available S

Sulphur was determined by extracting the soil sample with 0.01M of $Ca(H_2SO_4)_2$. The S content in the extract was established turbid metrically and the intensity of turbid was measured by spectrophotometer at 420 wave length.

3.14 Statistical Analysis

The Data were analyzed by SPSS statistical program. Analysis of variance was used to analyze the data least significant difference (LSD) was used for mean separation (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSIONS

CHAPTER IV

RESULTS AND DISCUSSION

An experiment was conducted at western side of medical center and near the water tank of HSTU, Dinajpur, during the Boro season of 2017 to evaluate the effect of different levels of N fertilizer in combination with poultry manure on the performance of growth variability, yield potentialities of BRRI dhan 28. The data have been depicted in various tables and figures. Results are discussed below under the following sub-heads.

4.1 Growth and yield contributing characters of BRRI dhan 28

4.1.1 Plant height

Application of N fertilizer and PM significantly influenced the plant height of BRRI dhan 28 (Table 4). Plant height ranged from 69.52 to 89.68 cm. The tallest plant of 89.68 cm was found in T_4 treatment and was statistically similar with T_5, T_6, T_3 and T_2 treatments with the values of 89.68, 89.19, 87.83, 86.18 and 81.82 cm, respectively. The shortest plant height of 69.52 cm was found in T_1 (control). The treatments may be ranked in the order of $T_4 > T_5 > T_6 > T_3 > T_2 > T_1$ with respect of plant height. Poultry manure (PM 4 t ha^{-1}) performed better in producing plant height in combination with N fertilizer (150 kg ha^{-1}). Yoseftabar (2013) reported that the plant height increased significantly with N fertilizer. Similarly, Pramanik and Bera (2013) also found higher plant height in N 150 kg ha^{-1}.

4.1.2 Number of leaf hill^{-1}

A significant variation in leaf no. hill^{-1} of BRRI dhan 28 was recorded due to the application of N fertilizer and PM in different combinations (Table 4). The treatment T_5 produced the highest number of leaves (78.03 hill^{-1}), which was statistically alike to the treatments T_2 (80.71 hill^{-1}), T_3 (66.41 hill^{-1}) and T_4 (72.70 hill^{-1}), respectively. They all produced the higher number of leaf over control. The lowest (41.56 hill^{-1}) number of leaf was found in T_1 treatment. Results revealed that combined application of manures and fertilizers exerted considerable increasing effect on the number of leaf hill $^{-1}$.

4.1.3 Number of tillers hill^{-1}

The number of tiller hill^{-1} was significantly influenced due to application of N fertilizer and PM (Table 4). It ranged from 8.043 to 12.50 (hill^{-1}). The highest number of tiller of 12.50 (hill^{-1}) was found in T_2 which was statistically similar with T_5, T_3 T_4 and T_6 treatments with the values of 12.46, 12.37, 12.03 and 10.70 (hill^{-1}), respectively. The less number of tiller (8.043 hill^{-1}) was found in T_1 (control). The treatments may be ranked in the order of $T_2 > T_5 > T_3 > T_4 > T_6 > T_1$ with respect of tiller number. Poultry manure (4 t ha^{-1}) performed better in producing maximum number of tiller in combination with N fertilizer (150 kg ha^{-1}).

4.1.4 Number of effective tillers hill^{-1}

Poultry manure and N fertilizer significantly influenced on the number of effective tillers hill^{-1} as shown in Table 4. The treatment T_3 produced the highest number of effective tillers (16.73 hill^{-1}), which was statistically identical to the treatments of T_5 (15.80 hill^{-1}) and T_6 (16.27 hill^{-1}). The treatments T_2 (14.20 hill^{-1}) and T_4 (13.93 hill^{-1}) were found statistically similar to each other. The control treatment recorded the lowest (10.13 hill^{-1}) effective tillers. Rashid *et al.* (2011) also found that the effect of N fertilizer, cowdung, PM and urban wastes single or their interaction influence the growth and yield of transplant *Boro* rice where N_{50} PM_{50} produced 43.39% higher number of effective tiller hill^{-1} than control treatment. These results are well corroborated with the findings of Rajni *et al.* (2001) who found increased number of effective tillers hill^{-1} with the integrated use of vermicompost, poultry manure and nitrogenous fertilizers.

4.1.5 Panicle length (cm)

Application of N fertilizer and PM showed positive effect but it was statistically insignificant on the panicle length (Table 4) of BRRI dhan 28. The highest panicle length (23.98 cm) was found in the treatment T_3 which was statistically identical to T_5, T_2, T_4 and T_6 with the values of 22.96, 22.90, 22.69, and 22.32cm, respectively. The lowest panicle length (20.02 cm) was observed in T_6. The treatments may be ranked in order of $T_3 > T_5 > T_2 > T_4 > T_6 > T_1$ in terms of panicle length. So, the above findings fully agreed with the findings of Hoshain (2010); Islam (2008) and other researchers of the home and abroad. These results are also in agreement with Atopsol (1989) who found increased panicle length with the application of manures and inorganic fertilizers.

4.1.6 Number of filled grains panicle^{-1}

The effect of PM and N fertilizer on filled grains panicle^{-1} was highly significant (Table 4). All the treatments showed higher number of filled grains compared to that of the control. Treatment T_2 (125.2 panicle^{-1}), produced higher number of filled grains (121.7 panicle^{-1}) which was similar to all the treatments except the control. Results revealed that combined application of manures and fertilizers exerted considerable increasing effect on the number of filled grains panicle^{-1}. Rashid *et al.* (2011) also found significant variation on the production of grains panicle$^{–1}$ due to the effect of N fertilizer, cowdung, PM and urban wastes. Similar results were also reported by Satyanarayana *et al.* (2002) and Mondol *et al.* (1990) who reported that percentage of filled grains panicle^{-1} increased with increasing fertilizers and FYM application.

4.1.7 1000 grains weight

The influence of combined application of manures and fertilizers on 1000 grains weight of BRRI dhan 28 has been shown in Table 4. The 1000 grains weight ranged from 24.30 to 26.04g. The highest values (26.04gm) was noted in T_3 treatment was followed by T_2, T_4,T_5 and T_6 treatment with the values of 25.82, 25.83, 25.63 and 25.78 gm, respectively and the lowest value of 1000 grains weight (24.30gm) was noted in T_1. This study was also similar to the research findings of Hossaen *et al.* (2011) who also found that the combinations of organic and inorganic fertilizer was significantly influenced on the yield and yield attributes of *Boro* rice where the highest weight of 1000 seeds was recorded from 70% NPKS + 2.4 t PM ha$^{–1}$ treatment.

Table 4 Effect of N fertilizer and PM on the yield contributing characters of BRRI dhan 28

Treatments	Plant height (cm)	Number of leaf /hill	Number of tillers /hill	Number of effective tillers/hill	Panicle length (cm)	Filled grains/ panicle	1000 grains wt. (gm)
T_1	69.52 b	41.56 b	8.04 b	10.13 b	20.02	75.93 b	24.30 b
T_2	81.82 a	80.71 a	12.50 a	14.20 ab	22.90	125.2 a	25.82 ab
T_3	86.18 a	66.41 a	12.37 a	16.73 a	23.98	96.87 ab	26.04 a
T_4	89.68 a	72.70 a	12.03 a	13.93 ab	22.69	121.7 a	25.83 ab
T_5	89.19 a	78.03 a	12.46 a	15.80 a	22.96	110.3 a	25.63 ab
T_6	87.83 a	61.15 ab	10.70 a	16.27 a	22.32	101.1 ab	25.78 ab
LSD	8.88	23.34	2.60	4.59	6.40 (NS)	28.85	1.53
CV %	5.81	19.22	12.59	17.38	15.66	15.07	3.29

Figures in column having common letters do not differ significantly at 5% levels of significance

LSD = Least Significant Difference

CV (%) = Coefficient of variation

Here,

T_1 = Urea @ 0 kg ha^{-1} + PM @ 0 t ha^{-1}

T_2 = Urea @ 0 kg ha^{-1} + PM 8 t ha^{-1}

T_3 = Urea @75 kgha^{-1} + PM 6 t ha^{-1}

T_4 = Urea @ 150 kg ha^{-1} + PM @ 4 t ha^{-1}

T5= Urea @ 225 kg ha^{-1} + PM @ 2 t ha^{-1}

T6= Urea @ 300 kg ha^{-1} + PM @ 0 t ha^{-1}

4.2 Yield of BRRI dhan 28

4.2.1 Grain yield

Grain yield was the most important parameter of this study. Application of N fertilizer and PM showed significant effect on the grain yield of rice (Table 5). It was found that the grain yield due to application of N fertilizer and PM varied from 2.107 to 5.403 t ha^{-1}. The highest grain yield (5.403 t ha^{-1}) was recorded in T_3 which was statistically identical with T_2, T_4, T_5 and T_6 treatments with the values of 5.12, 4.98, 4.35 and 4.21 t ha^{-1}, respectively. The lowest value (2.11 t ha^{-1}) was recorded in T_1. The treatments may be ranked in the order of $T_3 > T_2 > T_4 > T_5 > T_6 > T_1$ with respect of grain yield. Rahman *et al.* (2009) found highest grain yield in N (Urea) 80 kg ha^{-1} + PM 3 t ha^{-1}; Nyalemegbe *et al.* (2009) found highest grain yield in both 10 t ha^{-1} CD + Urea fertilizer @ 45 kg N ha^{-1} and 10 t ha^{-1} PM + Urea @ 60 kg N ha^{-1} etc. Similarly, organic + inorganic fertilizer application on Boro rice were also reported by several researchers (Shaha 2014; Sarkar 2014; Liza *et al.* 2014; Hasan 2014; Islam *et al.* 2013; Hoshain 2010; Rahman *et al* 2009; Nyalemegbe *et al.* 2009).

4.2.2 Straw yield

The straw yield was also significantly influenced due to the application of N fertilizer and PM as shown in Table 5. The straw yield obtained from different treatments ranged from 3.31 to 6.44 t ha^{-1}.The maximum (6.44 t ha^{-1}) straw yield was noted in T_3 and it was statistically similar to that of the treatments T_2 (5.70 t ha^{-1})and T_5 (5.34 t ha^{-1}). Treatment T_5 (5.34 t ha^{-1}) was statistically comparable to the treatments T_4 (5.11 t ha^{-1}) and T_6 (5.00 t ha^{-1}).The control treatment recorded the lowest straw yield. Similar trend of the effect of organic (Cowdung) and inorganic (Urea) fertilizer on straw yield was also reported by Shaha (2014) who also conducted his study with the effect of organic + inorganic fertilizer. Similarly, Liza *et al.* (2014) also found that the treatment T_6 (50% RFD + residual effect of CD 2.5 t ha^{-1}, PM 1.5 t ha^{-1}, and Com. 2.5 t ha^{-1}) produced the highest straw yield (7.24 t ha^{-1}) while Hasan (2014); Islam *et al.* (2013); Rahman *et al*

(2009) and other scientists also found similar re- results with the present study where all the researcher conducted their study with the effect of organic + inorganic fertilizer.

4.2.3 Biological yield

Analysis of variance data regarding biological yield was significantly influenced due to the application of N fertilizer and PM as shown in Table 5. The biological yield obtained from different treatments ranged from 5.42 to 11.84 t ha^{-1}. The highest biological yield of 11.84 t ha^{-1} was recorded in T_3 and the lowest value of 5.42 t $ha^{-1}$was noted in T_1. The treatment T_3 produced identical straw yield with T_2, T_4 and T_5, respectively. The biological yield in T_6 with the value of 9.21 t ha^{-1} was identical and significantly lower than that of T_3 treatment (Tab.4.2). The treatments may be ranked in the order of $T_3 > T_2 > T_4 > T_5 > T_6 > T_1$ in terms of biological yield as depicted in Table 5. Similar trend of the effect of organic (Cowdung) and inorganic (Urea) fertilizer on straw yield was also reported by Hoshain (2010) who reported that the highest biological yield was obtained from the combination of 6 t cowdung ha^{-1} with 120 kg N ha^{-1}.

Table 5 Effect of N fertilizer and poultry manure on the yield of BRRI dhan 28

Treatments	Grain yield ($t\ ha^{-1}$)	Straw yield ($t\ ha^{-1}$)	Biological yield ($t\ ha^{-1}$)
T_1	2.11 b	3.31 c	5.42 c
T_2	5.12 a	5.70 ab	10.82 ab
T_3	5.40 a	6.44 a	11.84 a
T_4	4.98 a	5.11 b	10.09 ab
T_5	4.35 a	5.34 ab	9.687 ab
T_6	4.21 a	5.00 b	9.207 b
LSD	1.52	1.06	2.13
CV %	19.19	11.31	12.29

Figures in column having common letters do not differ significantly at 5% levels of significance

LSD=Least Significant Difference

CV (%) = Coefficient of variation

Here,

T_1= Urea @ 0 kg ha^{-1} + PM @ 0 t ha^{-1}

T_2= Urea @ 0 kg ha^{-1} + PM @ 8 t ha^{-1}

T_3= Urea @ 75 kg ha^{-1} + PM @ 6 t ha^{-1}

T_4= Urea @ 150 kg ha^{-1} + PM @ 4 t ha^{-1}

T_5= Urea @ 225 kg ha^{-1} + PM @ 2 t ha^{-1}

T_6= Urea @ 300 kg ha^{-1} + PM @ 0 t ha^{-1}

4.3 Chemical properties of the soil collected after harvesting the crops

4.3.1 Soil pH

The pH values of post-harvest soil was slightly differed from each other treatments but it was insignificant due to application of N fertilizer and PM. The initial soil pH was 6.57 and the pH values of post-harvest soil between 6.51 and 6.58 (Table 6). Treatments T_1, T_3, T_4, T_5, T_6 and T_7 i.e. all the treatments were statistically identical with treatment T_2. The study proved that soil reaction remained same or very slight change after post-harvest soil compared with initial soil.

4.3.2 Organic matter

Due to application of N fertilizer and PM, organic matter content of the post-harvest soil was slightly varied. The organic matter in initial soil was 1.49% (Table 6). The maximum soil organic matter was found in treatment T_3 (1.72%). The lowest soil organic matter content was noted in control treatment T_1 (1.36%). All the treatments were statistically similar with each others.

4.3.3 Total N in soil

The application of nitrogen and PM has positive effect on total nitrogen content in post-harvest soil. The soil nitrogen content in the post-harvest soil varied from 0.068% to 0.086%. The highest result was found in the T_3 (0.086%) treatment and other treatments i.e. T_2, T_4, T_5 and T_6 were statistically similar with the T_3 treatment. The lowest value of 0.068% was recorded in T_1 treatment.

4.3.4 Available P in soil

The available P content in the post-harvest soil was affected by the different treatments. Phosphorus content in the initial soil was 15.10 ppm in post-harvest soil. The highest value of 15.99 ppm was found in T_3 treatment and the lowest value of 15.05 ppm was found in T_1 treatment. The treatments may be ranked in the order of $T_3 > T_2 > T_4 > T_5 > T_6 > T_1$ with respect of phosphorus content. All the treatments were statistically similar with each others.

4.3.5 Exchangeable K in soil

Exchangeable K content in the post-harvest soil was influenced by the different treatments. The exchangeable K content in initial soil was found in the experimental field was 0.09 m.e./100 g soil. The values of exchangeable K content in post-harvest soil varied between 0.067 and 0.08 m.e./100 g soil (Table 6). The highest value of 0.08 m.e./100 g soil was noted in T_2, T_3 and T_4 treatments, respectively. The lowest exchangeable K content (0.067 m.e./ /100 g soil) was observed in the control treatment T_1.

4.3.6 Available S in soil

Available S content in soil was affected by the different treatments. The available S content in post-harvest soil ranged from 11.29 ppm to 12.31 ppm. The highest S content was found in the treatment T_3 (12.31 ppm) which was statistically identical with all other treatments. The lowest sulphur content (11.29 ppm) was observed in the control treatment. The treatments may be ranked in the order of $T_3 > T_4 > T_5 > T_6 > T_{62} > T_1$ with respect of sulphur content.

Table 6 Effect of N fertilizer and PM on nutrient content of post-harvest soil

Treatments	pH	Organic matter (%)	Total N (%)	Available P (ppm)	Exchangeable K (m.e./100 g soil)	Available S (ppm)
T_1	6.57	1.36	0.068	15.05	0.067	11.29
T_2	6.58	1.68	0.084	15.92	0.08	12.15
T_3	6.56	1.72	0.086	15.99	0.08	12.31
T_4	6.55	1.58	0.079	15.28	0.08	12.30
T_5	6.53	1.48	0.074	15.24	0.07	12.27
T_6	6.51	1.42	0.071	15.12	0.07	12.24
LSD	1.91 (NS)	0.73 (NS)	0.057 (NS)	3.04 (NS)	0.058 (NS)	3.08 (NS)
CV %	15.98	24.48	17.26	10.84	16.93	14.00

Figures in column having common letters do not differ significantly at 5% levels of significance.

LSD=Least Significant Difference

CV (%) = Coefficient of variation

Here,

T_1 = Urea @ 0 kg ha^{-1} + PM @ 0 t ha^{-1}

T_2 = Urea @ 0 kg ha^{-1} + PM @ 8 t ha^{-1}

T_3 =Urea @ 75 kg ha^{-1} + PM @ 6 t ha^{-1}

T_4 = Urea @150 kg ha^{-1} + PM @ 4 t ha^{-1}

T_5 = Urea @ 225 kg ha^{-1} + PM @ 2 t ha^{-1}

T_6 = Urea @ 300 kg ha^{-1} + PM @ 0 t ha^{-1}

4.4 Correlation and regression studies

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}. The correlation matrix and regression lines of these parameters are shown in Appendix- and Figure no.4.1, 4.2, 4.3 and 4.4.

4.4.1 Grain yield and plant height

The relationship between grain yield and plant height has been found out. The correlation co-efficient (R^2=0.62) was found positive significant correlation. The line of regression of Y (grain yield) on X (plant height) having equation Y= 0.12x-6.00 is shown in Figure 4.1. The positive slope indicates that the grain yield and plant height are directly correlated i.e., increase in plant height in an increase in grain yield of rice.

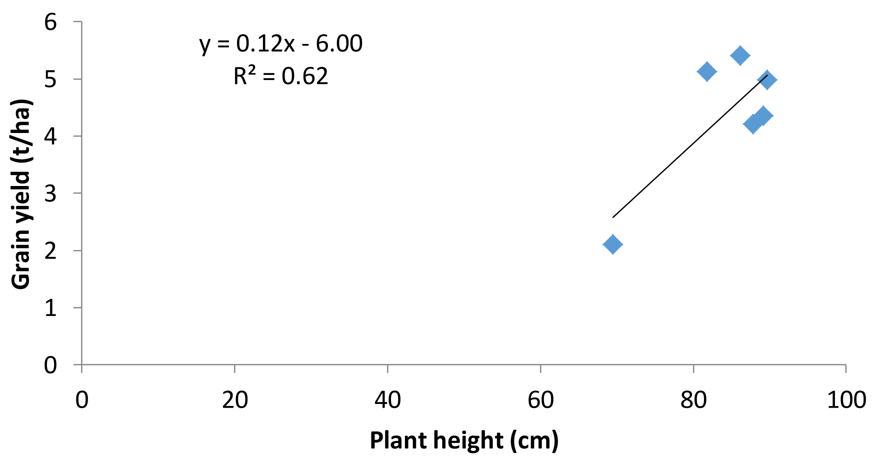

Fig. 4.1 Relationship between grain yield and plant height of BRRL dhan 28

4.4.2 Grain yield and number of leaf hill^{-1}

The relationship between number of leaf hill^{-1} and grain yield has been presented in Figure 4.2. The correlation co-efficient value of them are R^2=0.70. The line of regression of Y (Grain yield) on X (number of leaf) having equation Y= o.o7x-0.30 is shown in Figure 4.2. The positive slope indicates that the grain yield and number of leaf were directly correlated i.e., increase in leaf no. in an increase in grain yield of rice.

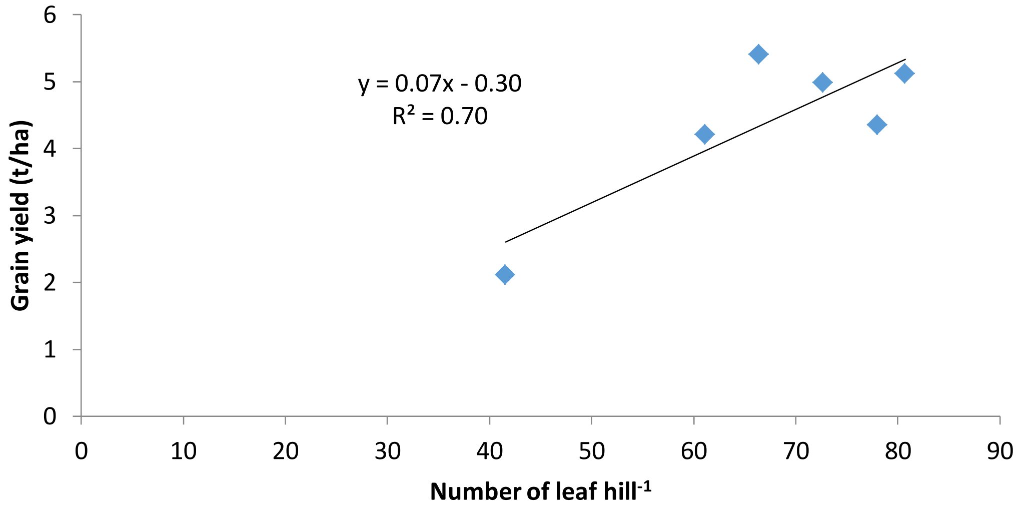

Fig. 4.2 Relationship between grain yield and number of leaf of BRRL dhan 28

4.4.3 Grain yield and number of effective tillers hill^{-1}

The relationship between grain yield and number of effective tillers hill^{-1} has been found out in Figure 4.3 and the correlation co-efficient (R^2=0.54) value showed positive significant correlation between them. The line of regression of Y (grain yield) on X (number of effective tillers hill^{-1}) having equation Y= 0.36x-o.89 is shown in Figure 4.3. From the 4.3, it was found the slope represent positive correlation between grain yield and number of effective tillers hill^{-1}. These results indicated that the both characters were directly correlated i.e. increase in number of effective tillers hill^{-1} in an increase in grain yield of rice.

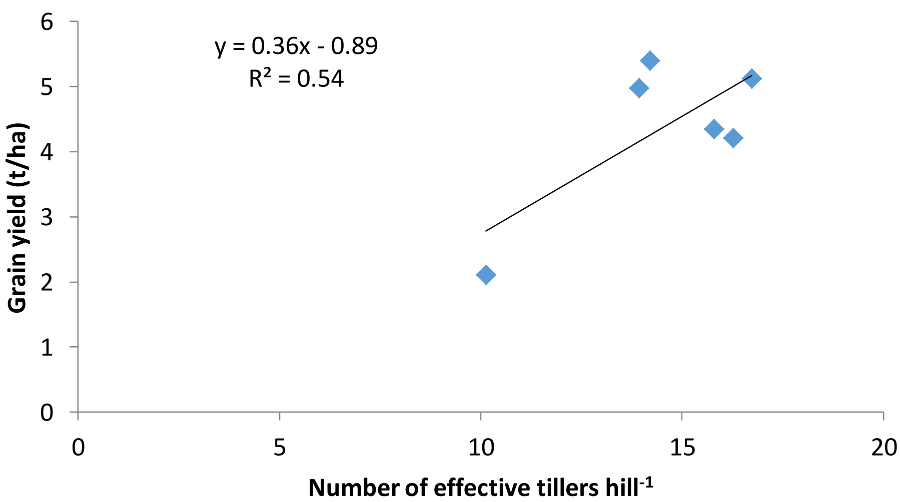

Fig. 4.3 Relationship between grain yield and number of effective tillers hill^{-1} of BRRL dhan 28

4.4.4 Grain yield and number of filled grains panicle^{-1}:

From the line of regression Figure 4.4 it was found that there was positive significant correlation between the number of filled grains panicle^{-1} and grain yield. The correlation co-efficient (R^2=0.59) value proved positive significant correlation between them. The line of regression of Y (grain yield) on X (number of filled grains panicle^{-1}) having equation Y= 0.05x-0.98 is shown in Fig. 4.4. From the 4.4, it was found the slope represent positive correlation between grain yield and number of filled grains. These results indicated that the both characters were directly correlated i.e. increase in number of filled grains panicle^{-1} in an increase in grain yield of rice.

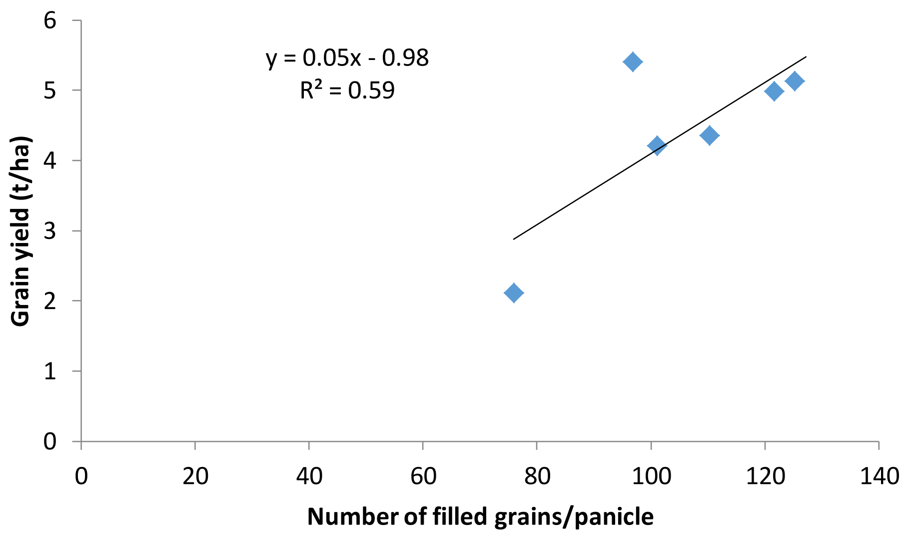

Fig. 4.3 Relationship between grain yield and number of filled grains panicle^{-1} of BRRL dhan 28

CHAPTER V

SUMMARY AND CONCLUSIONS

CHAPTER V

SUMMARY AND CONCLUTIONS

An experiment was conducted at western side of medical center and near the water tank of HSTU, Dinajpur, during the Boro season of 2017 to study on the performance of growth variability, yield potentialities of rice as influenced by the combinations of poultry manure and N fertilizer. Geographically the experimental site is located between 25.13^{0}N latitude and 88.23^{0}E longitudes and at elevation of 37.5 m above the sea level. The land belongs to the Old Himalayan Piedmont plain (AEZ-1) (UNDP and FAO, 1988).The soil was sandy loam in texture having pH 6.57, organic matter content 1.49%, total N 0.085%, available P 15.10 ppm, exchangeable K 0.09meq/100g soil and available S 11.33 ppm.There were six treatment combinations consisting of different doses of N fertilizer applied as urea, in association with poultry manure.

The treatments included T_1 (Control), T_2 (Urea @ 0 kg ha^{-1} + PM @ 8 t ha^{-1}), T_3 (Urea @ 75 kg ha^{-1} + PM @ 6 t ha^{-1}), T_4 (Urea @ 150 k gha^{-1} + PM @ 4 t ha^{-1}), T_5 (Urea @ 225 kg ha^{-1} + PM @ 2 t ha^{-1}), T_6 (Urea @ 300 kg ha^{-1} + PM @ 0 t ha^{-1}). The experiment was laid out in a Randomized Complete Block Design (RCBD) with six treatments and four replications. The size of unit plot was 5.0m^2 (2.5 m × 2.0 m) while block to block and plot to plot distances were 2.0 m and 1.0 m, respectively. The total number of plots were 24 (6 × 4). The row to row and plant to plant distances were also 25 and 20 cm, respectively. Total amount of P, K and S fertilizers were applied as basal dose @ 90, 120 and 45 kg/ha, respectively during final land preparation but nitrogen from urea (300 kg ha^{-1}) was applied as per treatments in three equal splits. Poultry manure was applied 7 days before transplanting. Seedlings were transplanted in the experimental plots maintaining three seedling per hill and plant spacing of 20cm × 20 cm. Intercultural operations were done as and when necessary. At maturity, the crop was harvested. Data were analyzed by SPSS statistical program.

The results revealed that growth and yield characters such as plant height, number of leaf hill^{-1}, number of tillers hill^{-1}, number of effective tillers hill^{-1}, panicle length, filled grain panicle^{-1}, 1000 grains weight, grain yield, straw yield and biological yield responded significantly to integrated application of N fertilizer and PM. Application of N fertilizer and PM significantly influenced the plant height of BRRI dhan 28. The tallest plant of 89.68 cm was found in T_4 treatment was statistically similar with T_5, T_6, T_3 and T_2 treatments with the values of 89.68, 89.19, 87.83, 86.18 and 81.82 cm, respectively. The shortest plant height of 69.52 cm was found in T_1 (control). The treatment T_5 produced the highest number of leaves (78.03 hill^{-1}), which was statistically alike to the treatments T_2 (80.71 hill^{-1}), T_3 (66.41 hill^{-1}) and T_4 (72.70 hill^{-1}). They all produced the higher amounts number of leaf over control. The highest number of tiller of 12.50 was found in T_2 which was statistically similar with T_5, T_3 T_4 and T_6 treatments with the values of 12.46, 12.37, 12.03 and 10.70, respectively. The shortest number of tiller (8.043 hill^{-1}) was found in T_1 (control). The treatment T_3 produced the highest number of effective tillers (16.73 hill^{-1}), which was statistically identical to the treatments T_5 (15.80 hill^{-1}) and T_6 (16.27 hill^{-1}). The treatment T_5 (15.80 hill^{-1}) was statistically comparable to the treatments T_2 (14.20 hill^{-1}) and T_4 (13.93 hill^{-1}). The treatments T_2 (14.20 hill^{-1}) and T_4 (13.93 hill^{-1}) were found statistically similar to each other. The control treatment recorded the lowest (10.13 hill^{-1}) effective tillers. The treatment T_3 produced the highest number of effective tillers (16.73 hill^{-1}), which was statistically identical to the treatments of T_5 (15.80 hill^{-1}) and T_6 (16.27 hill^{-1}). The treatments T_2 (14.20 hill^{-1}) and T_4 (13.93 hill^{-1}) were found statistically similar to each other. The control treatment recorded the lowest (10.13 hill^{-1}) effective tillers. The highest panicle length (23.98 cm) was found in the treatment T_3 which was statistically identical to $T_{5,}$ T_2, T_4 and T_6 with the value of 22.96, 22.90, 22.69, and 22.32cm, respectively. The lowest panicle length (20.02 cm) was observed in T_6. All the treatments showed higher number of filled grains compared to that of the control. Treatment T_2 (125.2 panicle^{-1}), produced higher number of filled grains(121.7 panicle^{-1}) which was similar to all the treatments except the control. The 1000 grains weight ranged from 24.30 to 26.04g. The highest values

(26.04gm) was noted in T_3 treatment was followed by T_2, T_4,T_5 and T_6 treatments with the values of 25.82, 25.83, 25.63 and 25.78 gm, respectively and the lowest value of 1000 grains weight (24.30gm) was noted in T_1 .

Grain yield was the most important parameter of this study. It was found that the grain yield due to application of N fertilizer and PM varied from 2.11 to 5.40 t ha^{-1}. The highest grain yield (5.40 t ha^{-1}) was recorded in T_3 treatment which was identical similar with T_2, T_4, T_5 and T_6 treatments with the values of 5.12, 4.98, 4.35 and 4.21, respectively. The lowest value (2.11 t ha^{-1}) was recorded in T_1. The straw yield obtained from different treatments ranged from 3.31 to 6.44 t ha^{-1}. The maximum (6.44 t ha^{-1}) straw yield was noted in T_3 and it was statistically similar to that of the treatments T_2 (5.70 t ha^{-1}) and T_5 (5.34 t ha^{-1}). Treatment T_5 (5.34 t ha^{-1}) was statistically comparable to the treatments T_4 (5.11 t ha^{-1}) and T_6 (5.00y t ha^{-1}).The control treatment recorded the lowest straw yield.

In the case of post-harvest soil various factors like soil PH, organic matter content, total N, available P, exchangeable K and available S were almost similar like initial soil.

Conclusions

The overall results indicate that application of N fertilizer as urea @ 75 kg ha^{-1} in combination with 6 t PM ha^{-1} can produce maximum yield but statistically similar with T_2, T_4, T_5 and T_6 treatments.

Recommendation:

- Higher levels of organic and inorganic fertilizer as a source of N may be needed to include for further study to make sure the performance of fertilizer for rice production
- Such study is also needed in different agro-ecological zones (AEZ) of Bangladesh for regional adaptability.

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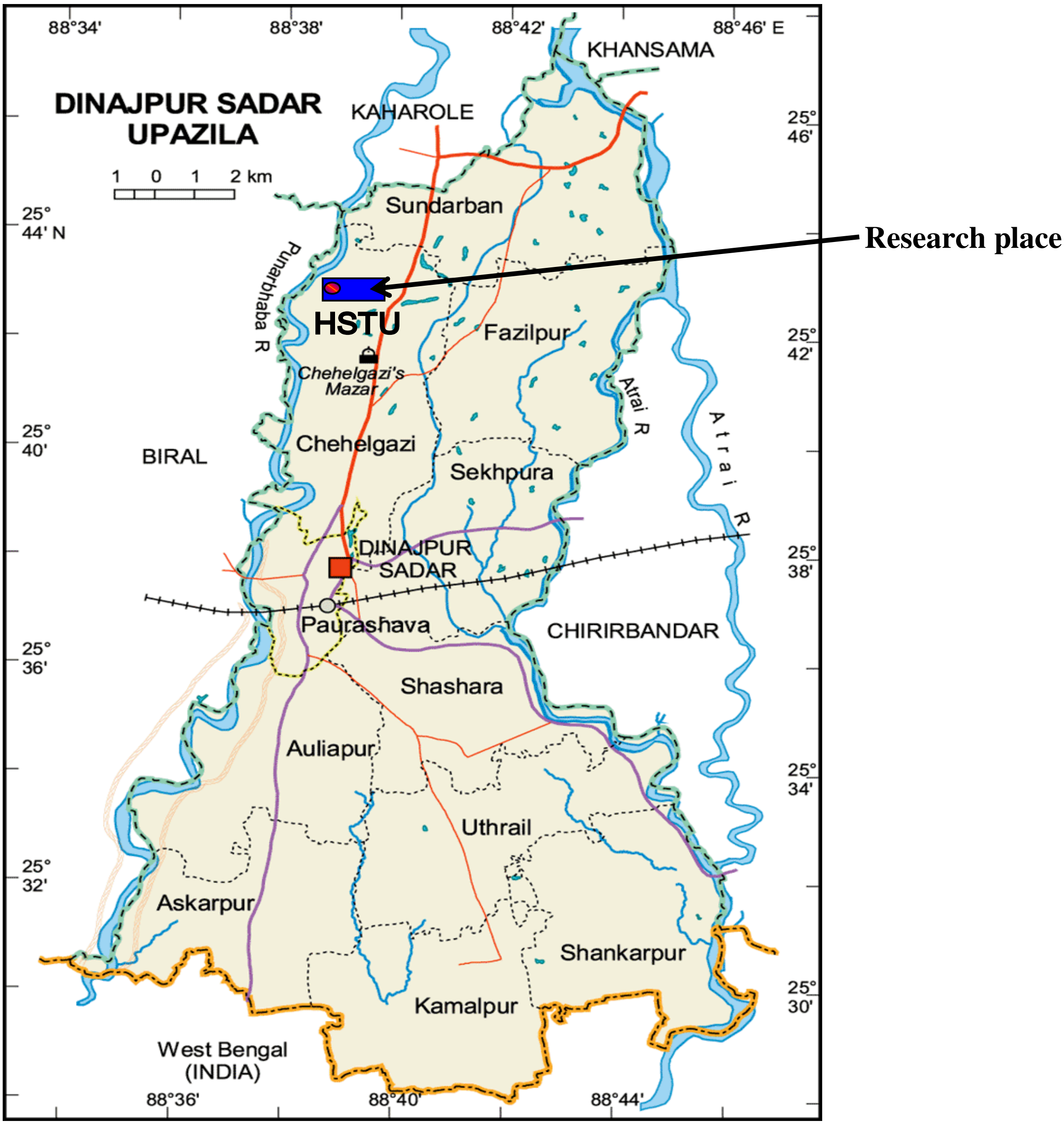
APPENDICES

APPENDICES

Appendix I. Location of the experimental site (map of Dinajpur Sadar Upazila showing the research plot)



Appendix II Monthly recorded air temperature, relative humidity and rainfall during research period (From December, 2016 to May, 2017)

Year	Month	**Air Temperature (^{0}C)			**Relative Humidity (%)	**Rainfall (mm)
		Maximum	Minimum	Average		
2016	December	26.4	12.1	19.3	85	7
2017	January	25	9.7	174	81	4
	February	31.7	11.7	21.4	77	0
	March	31.7	12.2	21.9	78	97
	April	37.2	16.1	26.6	83	207
	May	36.1	21.6	28.8	80	96

**Monthly average

Source: Wheat Research Centre, Nasipur, Dinajpur

Appendix III. Some Photographs of Experimental Site