INFLUENCE OF COMBINED APPLICATION OF ORGANIC INORGANIC NITROGENOUS FERTILIZER ON THE GROWTH, YIELD AND NUTRIENTS CONTENT OF AMAN RICE CULTIVARS

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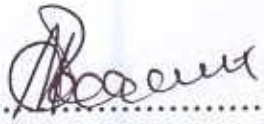

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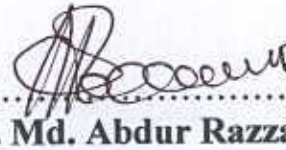

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CERTIFICATE

This is to certify that the thesis entitled "INFLUENCE OF COMBINED APPLICATION OF ORGANIC INORGANIC NITROGENOUS FERTILIZER ON THE GROWTH, YIELD AND NUTRIENTS CONTENT OF AMAN RICE CULTIVARS" submitted to the DEPARTMENT OF AGRICULTURAL CHEMISTRY, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE (M.S.) in AGRICULTURAL CHEMISTRY, embodies the results of a piece of bona fide research work carried out by BIJOY KUMAR SHAHA, Registration. No.07-02438, under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma in any other institution.

I further certify that any help or sources of information received during the course of this investigation have duly been acknowledged.

Dated:
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DEDICATED TO

MY

BELOVED PARENTS

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ABSTRACT

An experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Dhaka-1207, during the period from July to December, 2013 to find out the effect of combined application of different organic and inorganic nitrogenous fertilizers on the growth, yield and nutrient content of two aman rice cultivarswhere the two factorial experiment was laid out in a RCBD design with three replications, factor A : two varieties [V_1-Binasail, V_2-BRRI dhan46], and factor B : different combinations of organic and inorganic nitrogenous fertilizer doses [$\mathbf{T_0}$ = Control (No nitrogen), $\mathbf{T_1}$= PM(poultry manure)$_{25\%}$+ IF(inorganic fertilizer as urea)$_{75\%}$, $\mathbf{T_2}$ = $PM_{50\%}$+$IF_{50\%}$, $\mathbf{T_3}$ = $PM_{75\%}$ + $IF_{25\%}$,$\mathbf{T_4}$= MOC(mustard Oil Cake)$_{25\%}$+ $IF_{75\%}$, $\mathbf{T_5}$ = $MOC_{50\%}$+ $IF_{50\%}$, $\mathbf{T_6}$ = $MOC_{75\%}$+$IF_{25\%}$, $\mathbf{T_7}$= $IF_{100\%}$. The results indicated that most of the growth and yield parameters varied significantly due to varietal differences. BRRI dhan46 produced the highest 1000 grain weight, greatest grain yield and heaviest straw yield among the two varieties. The N, P and K content in grain did not vary significantly between the varieties. Different combinations of organic and inorganic N fertilizers affected significantly the various growth, yield attributes and nutrient content of rice grain. Combination of 50% poultry manure and 50% urea produced the highest number of filled grains panicle^{-1} as well as the highest 1000 grain weight, grain yield and straw yield. The highest N, P and K content in grain were also observed from50% poultry manure and 50% urea treatment.The significantly higher 1000 grain weight, grain yield and straw yield were found from the interaction of BRRI dhan46 and combination of 50% poultry manure and 50% urea. The highest N, P and K content in grain were also observed from the interaction of BRRI dhan46 and combination of 50% poultry manure and 50% urea. Therefore, the results concluded that 50% N as poultry manure and 50% N as urea is helpful to increase the yield as well as to deplete the use of inorganic nitrogen fertilizer in aman season.

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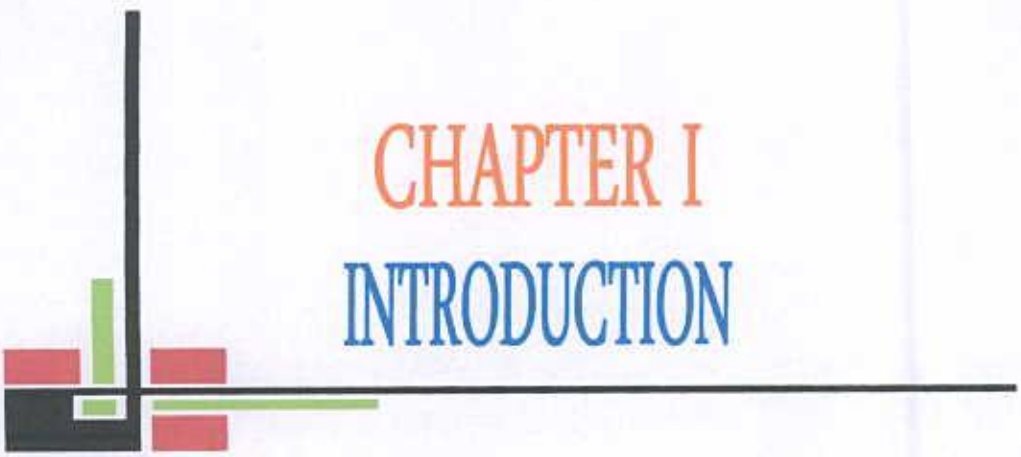
LIST OF ABBREVIATIONS AND ACRONYMS

AEZ	=	Agro- Ecological Zone
@	=	At the rate
BARI	=	Bangladesh Agricultural Research Institute
BAU	=	Bangladesh Agricultural University
BBS	=	Bangladesh Bureau of Statistics
BINA	=	Bangladesh Institute of Nuclear Agriculture
BRRI	=	Bangladesh Rice Research Institute
cm	=	Centi-meter
CV	=	Coefficient of Variance
cv.	=	Cultivar (s)
DAT	=	Days After Transplanting
^0C	=	Degree Centigrade
et al.	=	And others
FAO	=	Food and Agriculture Organization
g	=	Gram (s)
DMRT	=	Duncan's Multiple Range Test
IRRI	=	International Rice Research Institute
hr	=	Hour(s)
K_2O	=	Potassium Oxide
Kg	=	Kilogram (s)
LSD	=	Least Significant Difference
LAI	=	Leaf area Index
m	=	Meter
m^2	=	Meter squares
mm	=	Millimeter
MOP	=	Muriate of Potash
N	=	Nitrogen
No.	=	Number
NS	=	Non-significant
%	=	Percentage
P_2O_5	=	Phosphorus Penta Oxide
S	=	Sulphur
SAU	=	Sher-e-Bangla Agricultural University
$t\ ha^{-1}$	=	Ton per hectare
TSP	=	Triple Super Phosphate
var.	=	Variety
Wt.	=	Weight
Zn	=	Zinc



CHAPTER I

INTRODUCTION

CHAPTER 1

INTRODUCTION

Rice (*Oryza sativa L.*) belongs to cereal crops under Gramineae family. Nearly half of the population of the world use rice as their main food. Millions of people in Asia subsist entirely on rice and over 90% of the world's rice is grown and eaten in Asia (BBS, 2013). It plays a vital role in the economy of Bangladesh providing significant contribution to the GDP, employment generation and food availability. In Bangladesh, rice is the most extensively cultivated cereal crop. It provides about 75% of the calories and 55% of the protein in the average daily diet of the people of our country (Bhuiyan *et al.* 2002). The climatic and edaphic conditions of Bangladesh are favorable for rice cultivation throughout the year. It provides nearly 48% of rural employment, about two-third of total calorie supply and about one-half of the total protein intakes of an average person in the country (BBS, 2013). About 75% of the total cropped area and over 80% of the total irrigated area is planted to rice. Thus, rice plays a vital role in the livelihood of the people of Bangladesh. Among the rice growing countries, Bangladesh occupies third position in rice area and fourth position in rice production (BRRI, 2012). But the average yield is quite low compared to that in other leading rice growing countries.

The second largest part of the total production of rice comes of Aman rice after Boro. Bangladesh earns about 31.6% of her gross domestic product (GDP) from agriculture (BBS, 2008) in which rice is the main crop. Agriculture in Bangladesh is characterized by intensive crop production with rice based cropping systems. Rice is grown in three seasons namely Aus (mid-March to mid-August), Aman (mid-June to November) and Boro (Mid December to mid-June). The largest part of the total production of rice comes from Aman rice. T. aman rice covers about 50.92% of the rice areas of Bangladesh of which modern T. aman varieties covers 60% (BBS, 2005). In ganges tidal floodplain Agro ecological zone-13 T. aman is the main crop. Agro ecological condition of this area favours the large-scale cultivation of T. aman rice.

Variety is the most important factor in rice production. Selection of potential variety, planting in appropriate method and application of optimum amount of nutrient elements, can play an important role in increasing yield and national income. Variety itself is a genetic factor which contributes a lot in producing yield and yield components of a particular crop. Yield components are directly related to the variety and micro-environments in which it grows. In the year 2010 among the aman rice varieties modern varieties covered 69.15% and yield was 2.4t ha^{-1} on the other hand local varieties covered 31.91% and yield was 1.37t ha^{-1}(BBS, 2011). It was the farmers who have gradually replaced the local indigenous low yielding rice varieties by HYV of rice developed by BRRI only because of getting 20% to 30 % more yield $unit^{-1}$ land area (Shahjahan, 2007).

Nitrogen plays a key role in rice production and it is required in large amount. Nitrogen is the most important limiting nutrient in rice production and has heavy system losses when applied from inorganic sources in puddle field (Fillery*et al.*, 1984). Nitrogen has a positive influence on the production of effective tiller per plant, yield and yield attributes (Jashim*et al.*, 1984, BRRI, 1990). It is necessary to find out the suitable rate of nitrogen fertilizer for efficient management and better yield of rice. A suitable combination of variety and rate of nitrogen is necessary for better yield (BRRI, 1990). Rice plant cannot produce higher grain yield without addition of fertilizer in the crop field (BRRI, 2011). Among the nutrients, nitrogen is the kingpin in rice farming (Alam*et al.*, 2012) for crop growth and development (Ahsan, 1996). However, only optimum dose of N applied can play a vital role on the growth and development of rice plant (Hasanuzzaman*et al.*, 2009). The absorption patterns of applied nitrogen vary with growth stages. About 52 to 60 % of total plant nitrogen in the high yielding plants has been absorbed by early panicle formation stage, and 70 to 80 % by heading stage; 20- 30 % nitrogen is absorbed during the ripening period (De Datta, 1981). So, it is necessary to improve the efficiency of applied nitrogenous fertilizer utilization by rice plant (Miah and Panaullah, 1999).

It is well known that inorganic fertilizers supply only nutrients in soil but organic manure supplies nutrients and at the same time improves soil quality. The longterm impact of chemical fertilizers on soils and environment is harmful. Use of unbalanced nutrients in the soils may be harmful in the long run causing soils an unproductive one. 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). Proper identification and management of soil fertility problems are prerequisite for boosting crop production and sustaining higher yields over a long period of time. So use of organic manure in integration with inorganic fertilizers is very important in improving soil fertility and crop productivity. But sufficient information is not available about appropriate sources of organic manure and proper combination of organic and inorganic fertilizers suitable for rice based cropping system in Bangladesh to increase yield and improve soil fertility. Among the available organic sources of N, poultry manure and mustard oil cake are rich in N content(Alim,2012). Oil cake has the potential for improving soil and water conservation sustaining soil productivity and enhancing crop yields. It also plays an important role in improving the nutrient supply capacity for achieving higher yield of aman rice.

A suitable combination of organic and inorganic sources of nutrients is necessary for sustainable agriculture that can ensure food production with high quality. Nambiar (1991) views that integrated use of organic manure and chemical fertilizers would be quite promising not only in providing greater stability in production, but also in maintaining better soil fertility. Poultry manure is another good source of nutrients in soil. Meelu and Singh (2001) showed that 4 t/ha poultry manure along with 60 kg N/ha as urea produce grain yield of crop similar to that with 120 kg N/ha as urea alone. Soil organic matter improves the physicochemical properties of the soil and ultimately promotes crop production. Evidences from different AEZ of the country have shown a decrease in the content of organic matter by the range of 15 to 30% over the last 20 years (Miah, 1994). Therefore, it would not be wise to depend only on inherent potentials of soils for higher crop production. More recently, attention is focused on the global environmental problems; utilization of organic wastes, FYM, compost, vermicompost and poultry manures as the most effective measure for the purpose.The application of different fertilizers and manures influences the physical and chemical properties of soil and enhances the biological activities. It is also positively correlated with soil porosity and enzymatic activity. Organic fertilizer enhances soil porosity

by increasing regular and irregular pores and causes a priming effect of native soil organic matter. 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 higher yield (Sarvanan*et al.*, 1987).

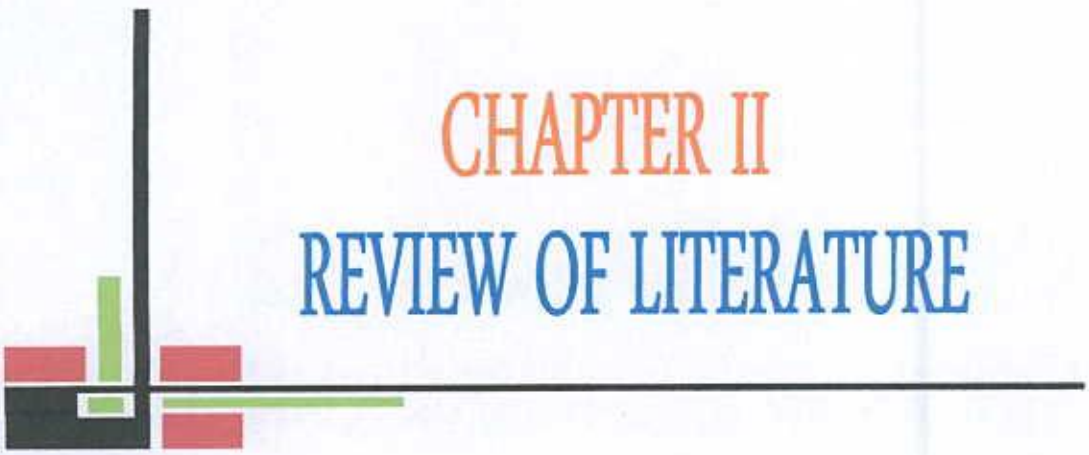
High market price and uncertainty in supplies, limit the application of chemical fertilizers for crop production in Bangladesh. The use of organic manures and their proper management may reduce the need of chemical fertilizers thus allowing poor farmers to save in part the cost of the production. In addition, organic matter improves the physical, chemical and biological properties of soil and conserve the soil productivity.

Considering the above facts, the present research was under taken with the following objectives:

(I) To compare the effects of the different combination of organic manures and inorganic nitrogenfertilizer on growth, yield and yield contributing characters of aman rice cultivars.

(II) To select the suitable combination of nitrogenous fertilizer in the crop field of aman rice cultivars.

(III) To observe the effect of organic and inorganic nitrogenous fertilizer on the nutrient content of aman rice cultivars.



CHAPTER II

REVIEW OF LITERATURE

CHAPTER 2

REVIEW OF LITERATURE

Organic manure and inorganic fertilizer is the essential factor for sustainable soil fertility and crop productivity because is the store house of plant nutrients. Sole and combined use of poultry manure, mustard oil cake and inorganic fertilizer acts as a source of essential plant nutrients. Experimental evidences in the use of poultry manure, mustard oil cake and nitrogen, phosphorus, potassium and sulphur showed an intimate effect on the yield and yield attributes of rice. Yield and yield contributing characters of rice are considerably influenced by different doses of N fertilizer and poultry manure & mustard oil cake and their combined application. Some literature related to the study are reviewed below-

2.1 Effect of variety

A study was undertaken to evaluate the growth performance and grain quality of six aromatic rice varieties BRRI dhan34, BRRI dhan38, Kalizira, Chiniatop, Kataribhog and Basmati grown under rainfed conditions by Ashrafuzzaman*et al.* (2009). They found that Kalizira was the tallest (107.90 cm) of all the studied varieties. It had shown no significant difference with BRRI dhan38 (107.80 cm) and BRRI dhan34 (106.70 cm). BRRI dhan34 showed the highest number of panicles per hill (11.67) followed by Kalizira (11.33).The rice varieties differed significantly ($P<0.05$) with respect to leaf chlorophyll content, plant height, internode length, thousand grain weight and grain and straw yields. Varieties differed in morphological and yield and yield contributing traits. Thousand grain weight and grain yield both were highest in BRRI dhan38. Basmati required shorter days to maturity and Kalizira longest days to maturity.

Kamal *et al.* (1988) carried an experiment with BR3, IR20, and Pajam and found that number of grains panicle^{-1} were 107.6, 123.0, and 170.9, respectively for the three varieties.

Number of panicles was the result of the number of tillers produced and the proportion of effective tillers, which survived to produce panicle (Hossain*et al.*, 2008).

An experiment was carried out by Alam *et al.* (2012) at Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi during the kharif season to study the effect of variety, spacing and number of seedlings hill^{-1} on the yield potentials of transplant aman rice. The experiment consisted of three high yielding varieties viz. BRRI dhan32, BRRI dhan33 and BR11, four levels of spacing viz. 10 cm × 25 cm, 15 cm × 25 cm, 20 cm × 25 cm and 25 cm × 25 cm and four levels of number of seedlings hill^{-1} viz. 2 seedlings hill^{-1}, 3 seedlings hill^{-1}, 4 seedlings hill^{-1} and 5 seedlings hill^{-1}. A split-split plot design was used with three replications assigning the variety on the main plot, spacing to the sub-plots and number of seedlings hill^{-1} to the sub-sub plots. Variety had significant effects on almost all the yield component characters and yield. Among the varieties BRRI dhan33 gave significantly the tallest plant (113.17 cm), which is statistically identical with BR11 (111.25 cm).The highest number of total tillers hill^{-1} (12.23) was produced by BR11 and the lowest number of total tillers hill^{-1} (10.17) was produced by BRRI dhan32. All the yield components characters (tillers hill^{-1}, effective tillers hill^{-1}, panicle length, weight of 1000-grain and grain yield) except number of fertile spikelets panicle^{-1} were highest in case of variety BR11 and hence it produced the highest grain yield (5.92 t ha^{-1}).

Hossain and Alam (1991) found that the plant height in modern *Boro*rice varieties of BR3, BR11 and Pajam were 90.4, 94.5, 81.3 and 90.7 cm, respectively.

Idris and Matin (1990) reported that number of total tillers hill^{-1} was identical among the varieties studied.

BRRI (2006) studied the performance of BR14, Pajam, BR5 and Tulsimala and reported that Tulsimala produced the highest number of filled grains panicle^{-1} and BR14 produced the lowest number of filled grains panicle^{-1}.

Bhuiya (2000) reported that plant height varied variety to variety *viz.*Binasail, Binadhan 4 and Binadhan 19 with different plant spacing *viz.* 20 cm x 10 cm, 20 cm x 15 cm and 20 cm x 20 cm.

BRRI (2004) reported that the filled grains panicle^{-1} of different modern varieties were 95-100 in BR3, 125 in BR4, 120-130 in BR22 and 110-120 in BR23 when they were cultivated in transplant *Aus* season. They reported that three modern upland rice varieties namely, BR20, BR21 and BR24 were suitable for high rainfall belts of Bangladesh. Under proper management, the grain yield was 3.5 ton for BR 20, 3.0 ton for BR21 and 3.5 ton for BR24 ha^{-1}. They also reported that grain yields of the modern rice varieties in *Aus* season under transplant condition ranged from 4.0-4.5 t ha^{-1} for BR3, 5.5 - 6.5 t ha^{-1} for BR4, 2.5-5.5 t ha^{-1} for BR23 and 4.0-4.5 t ha^{-1} for IR20.

Sultana (2008) observed that number total of tillers hill^{-1} was not significantly affected by variety. Apparently more number (11.07) of total tillers was produced by the variety BR14 than BR26 (10.90).

Takita (2009) reported that Nerica rice has erect panicles even after maturity which can favor high canopy photosynthesis with less light interception by these panicles than droopy panicles.

Hasanuzzaman *et al.* (2009) in a study found that the length of panicle in late transplanted Aman rice ranged from 23.59 to 21.30 cm.

Refey *et al.* (1989) reported that weight of 1000-grains differed among the cultivars studied.

Miah *et al.* (1993) reported that plant height differed significantly among BR 3, BR 11, BR 22, Nizershail, Pajam, and Badshabhog varieties in Aman season (Jul-Dec). Tiller number varied widely among the varieties and the number of tillers/plant at the maximum tiller number stage ranged between 14.3 and 39.5 in 1995 and 12.2 and 34.6 in 1996.

RARC (2011) conducted an experiment where rice cv. NERICA L19 and ROK10 and subjected to four different herbicides at different rates with different active ingredients, there NERICA L19 was high yielding and weed competitive.

Hossan (2005) observed that grain yield was significantly differed due to variety. It was evident from the result that BRRI dhan4l produced the higher grain yield (5.02 t ha^{-1}) than BRRI dhan31.

Jesy (2007) observed that weight of 1000-grains was not significantly affected by variety. Apparently BRRI dhan4l produced the higher weight of 1000-grains (23.42 g) than BRRI dhan40 (23.39 g).

Hossain and Alam (1991) reported that the grain yield of six modern varieties of *Boro* rice namely BR3, BR11, BR14, IR8, Pajam and BR16 differed significantly in a varietal trail at haor area were 4.59, 5.3, 5.73, 4.86, 3.75 and 4.64 t ha^{-1}. They also studied farmers production technology in haor area and found that the grain yield of modern varieties of *Boro*rice were 2.12, 2.18, 3.17, 2.27 and 3.05 t ha^{-1} respectively with BR14, BR11, BR9, IR 8 and BR3.

2.2 Effect of nitrogen on rice

Nitrogen is considered as an essential primary plant nutrient required in larger amounts for the growth and development of plant occurring in soils both in organic and inorganic forms. It is an important component of biologically important organic molecules in plants viz. proteins, nucleic acids, purines, pyrimidines, and coenzymes (vitamins), among many other compounds. Based on the redox conditions, plants absorb N mainly in the form of NH_4^+ and NO_3^-. Application of N to soil can bring a dramatic change in plant growth especially in the vegetative parts of plants. A sufficient supply of N also has its effects on stimulating the growth and development of plant roots, protein content of seed and foliage as well as the uptake of other nutrients. It is essential for carbohydrate use within the plants (Brady and Weil, 1996).

Singh *et al.* (2008) conducted field experiments in Patna, Bihar, India, from 2001-2002 to 2003-04, to study the effect of irrigation and nitrogen (N) fertilizers on yield, water use efficiency and nutrient balance in a rice based cropping system. Application of optimum levels of irrigation and N fertilizer increased the rice-equivalent yield by 8.40, 6.38 and 6.90% over the sub-optimum level in the cropping systems.

Xiao-Fei *et al.* (2008) studied the effects of N rate on N metabolism in rice. The N rate had significant effects on nitrate reductive activity.

Liangjun *et al.* (2007) observed the effects of different N fertilizer application and the results indicated that yield was significantly influenced by the different N fertilizer application regimes. The regime with highest yield was at the basal to panicle application ratio of 58.34:41.66 and equal split panicle application at the fourth and second leaf age from the top. There were highly significant positive correlations between yield, total N uptake and agronomic N use efficiency.

Sharma and Sharma (2006) conducted a field study for 2 years (1995-96) at the Indian Agricultural Research Institute, New Delhi on a sandy clay loam soil and showed that the application of NP increased the total grain production of a rice wheat-mugbean cropping system by 0.5-0.6 t/ha, NK by 0.3-0.5tha-1 and NPK by 0.8-0.9 t/ha compared to N alone, indicating that the balanced use of primary nutrients was more advantageous than their imbalanced application. The application of farm yard manure along with NPK further increased the total productivity of the rice-wheat-mugbean cropping system by 0.3-0.6t ha-1, the organic C by 0.13%, the available N by 10.7 kg/ha, the available P by 4.7 kg/ha and the available K by 15 kg/ha compared to NPK after two crop cycles of the system. The results of the present study thus indicate that integrated nutrient management involving FYM and NPK fertilizer is must for the sustainability of a cropping system.

Gautam *et al.* (2005) conducted a field experiment in New Delhi, during kharif of 2002 and 2003 to study the influence of nitrogen and plant spacing on grain yield and quality of aromatic rice. Treatments comprised: 0, 80 and 160 kg/ha and PRH10, PusaSugandha 3, Pusa Basmati 1 cultivars. The results indicated that rice hybrid PRH 10 registered the significantly highest grain yield (51.5q/ha) than inbred aromatic rice, PusaSugandha 3 and Pusa Basmati 1. The highest grain (52.5q/ha) and straw yield (74.05q/ha) were recorded with application of 160 kgN/ha. PusaSugandha 3 and Pusa Basmati 1 were better at the plant spacing of 20x15 cm with 160 and 80kg N/ha.

Chopra and Chopra (2004) showed that nitrogen had significant effects on yield attributes such as plant height, panicle plant^{-1} and 1000-grain weight. Cumulative effect of yield attributing characters resulted in significant increase in seed yield at 120 kg N ha^{-1} over 60 N ha^{-1} and the control.

Bayan and Kandasamy (2002) noticed that the application of recommended doses of N 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. Number of effective tillers/hill increased with top dressing of N (Islam *et al.*, 1996). Effective tillers/hill was significantly affected by the level of N. The highest number of productive tillers/hill was obtained from the highest level (120 kg/ha) of nitrogen (BINA, 1996).

Ehsanullah *et al.* (2001) reported that the application of different levels (75 kg, 100 kg and 125 kg ha^{-1}) of N fertilizers in rice field, resulted the significantly increased 1000 grain weight and straw yield of 125 kg ha^{-1} N application

2.3 Combined effect of organic and inorganic fertilizer on rice

Channbasavana and Biradar (2001) reported that the application of poultry manure @ 3 t ha^{-1} gave 26% and 19% higher grain yield than that of the control 1998 and 1999, respectively. Eneji *et al.* (2001) observed that average across the soils, the level of extractable Fe increased by 5% in chicken manure and 71% in cattle manure; Mn by 61% in chicken manure and 172% in swine manure and Cu by 327% in chicken manure and 978% in swine manure. Mixing these manures before application reduce the level of extractable trace elements.

Singh *et al.* (2001) studied on the effect of poultry manure under irrigated condition with nitrogen in rice-wheat cropping system in an Alfisol of Bilapur, Madhya Pradesh, India. The treatment consisted of poultry manure alone and in combination with nitrogen fertilizer. Root and shoot biomass at different growth stages increased with the application of N and poultry manure alone and combination. Root and shoot biomass was higher in 100% N through poultry manure, followed by 75% N through poultry manure and 25% through urea.

Vanaja and Raju (2002) conducted a field experiment on integrated nutrient management practice in rice crop. Different combinations of chemical fertilizer with poultry manure (PM) 2 t ha^{-1} gave highest grain and straw yield.

Umanah *et al.* (2003) find out the effect of different rates of poultry manure on the growth, yield component and yield of upland rice cv. Faro 43 in Nigeria, during the 1997 and 1998 early crop production seasons. The treatments comprised 0, 10, 20 and 30 t/ha poultry manure. There were significant differences in plant height, internode length, tiller number, panicle number per stand, grain number/panicle, and dry grain yield. There was no significant difference among the treatments for 1000-grain weight.

Channabasavanna (2003) conducted a field experiment to evaluate the efficient utilization of poultry manure with inorganic fertilizers in wetland rice and found that the growth parameters and grain yield increased with each increment of poultry manure application and was maximum at 3 t poultry manure/ha. Poultry manure at 2 ton /ha recorded significantly higher values for seed yield and its attributes. The study proved the superiority of poultry manure over farmyard manure (FYM). It was evident from the study that one ton of poultry manure was equivalent to 7 ton FYM which produced at per seed yields. Agronomic efficiency of N (AEN) at 75% NPK (112.5:56.3:56.3 kg NPK/ha) was equivalent to 2 t poultry manure/ha. The results showed that an increase in poultry manure and fertilizer increased rice seed yield. The AEN decreased with an increase in the application of poultry manure and NPK fertilizer.

Mahavisha *et al.* (2004) investigated a field study during the kharif season of 2001 in Andra Pradesh, India to investigate the effect of organic fertilizer sources on the growth and yield of rice. The crop growth and yield were higher with 125% recommended fertilizer + poultry manure and 100% RDF + poultry manure compared to the other treatments.

Miah *et al.* (2004) found 5.6-6 t/ha-grain yields with application of 2 t/ha poultry manure plus 120 kg N/ha in Boro season.

Reddy *et al.* (2005) carried out a field experiment on black clay soils in Gangavati, Karnakata, India, to evaluate the performance of poultry manure (PM) as a substitute for NPK in irrigated rice (cv. IR 64). The application of PM at 5 t/ha recorded a significantly

higher grain yield (5.25 t/ha) than the control and FYM application at 7.5 t/ha, significantly improved the soil P and K status, and increased the N content of the soil. Poultry manure at 5 t/ha resulted in higher gross returns (30592 Rupees/ha) over other levels of PM and FYM. However, net returns and benefit cost rations were comparable between 5 and 2 t PM/ha, and between 100 and 75% NPK. The application of 2 t PM/ha and 75% NPK. was found economical.

Miah*et al.* (2006) stated that an application of poultry manure with soil test basis (STB), IPNS and AEZ based fertilizer gave higher grain yield compared to other organic materials.

Kumar and Reddy (2010) conducted an experiment during three consecutive kharif seasons of 2000, 2001 and 2002 at Agricultural Research Station, Neliore in the southern Agro-climatic Zone of Andhra Pradesh to study the effect of organic and inorganic sources of nitrogen on soil fertility, productivity and profitability of lowland rice. Farmyard manure, poultry manure and neem cake were tried as organic sources of nitrogen substituting 25% and 50% of inorganic nitrogen in comparison to 100% inorganic nitrogen. The experiment was laid out in randomized block design, replicated thrice. The combination of 50% N through urea and 50% N through any of the organic sources viz., farmyard manure, poultry manure and neem cake produced significantly higher grain and straw yield, net returns and benefit cost ratio. Integrated supply of N at 50% each through fertilizer and organics recorded higher N uptake than all other combinations. Post-harvest soil fertility status viz., organic carbon, available nitrogen, phosphorus and potassium was highest by substituting 50% N fertilizer with any of the organic source compared to recommended dose of N entirely through inorganic source. Lowest soil organic carbon and available nitrogen was registered with control while, lowest available phosphorus and potassium was with 100% N through urea.

Myint *et al.* (2010) conducted an experiment on rice cultivation at Kyushu University farm. Cow manure (CM), poultry manure (PM), rice straw + urea mix-application (SU), urea (UF) and M-coat, a slow released compound fertilizer (M-coat) were used as the N sources by comparing with no application (Control). Treatments were made with two levels application of each N source at 40 (level I) and 80 kg N ha-1 (level II) excluding M-coat. In all urea

treatments, three split applications were made. A study of soil incubation was conducted for 2 weeks to investigate the mineralized N of applied mineral and organic fertilizer. Plant growth characters, dry matter, yield and plant nutrient accumulations were higher in mineral fertilization than organic. Mineral fertilization was observed in correlation with the larger crop removal. PM-II as an organic matter provided comparatively higher nutrient accumulations which in turn enhanced the growth and yield of rice. CM and SU gave the lower plant growth, yield and nutrient accumulation. Mineralized N was higher in sole mineral N applications. Organic matter with high C/N ratio provided very low mineralized N and its net N mineralization percentage. Negative values of net N mineralization percentage were observed in SU due to N immobilization.

Nyalemegbe *et al.* (2010) studied at the Agricultural Research Centre, Kpong, of the University of Ghana, to find solution to the problem of low rice yields on the Vertisols of the Accra Plains. Rice yields from continuously cropped fields have been observed to decline with time, even with the application of recommended levels of inorganic fertilizers. The decline in yield has been attributed to low inherent soil fertility, which is partly the result of low levels of soil organic matter (OM). As part of the study, cow dung (CD) and poultry manure (PM) were separately applied to the soil at 20 t ha^{-1} solely and also 5, 10 and 15 t ha^{-1}, in combination with urea fertilizer at 90, 60 and 30 kg N ha^{-1}, respectively. Other treatments included a control and urea fertilizer at 30, 60, 90 and 120 kg N ha-1. There was a basal application of phosphorus and potassium to all plots at 45 kg P_2O_5 ha-1 and 35 kg K_2O ha^{-1}, respectively, based on the recommended fertilizer rate of 90 kg N ha^{-1}, 45 kg P2O5 ha^{-1} and 35 kg K2O ha^{-1}, on the Vertisols of the Accra Plains. Studies were also conducted on the redox potential of CD, PM and rice straw (RS). The application of 10 t ha^{-1} CD and urea fertilizer (at 45 kg N ha^{-1}) and 10 t ha^{-1} PM and urea (at 60 kg N ha^{-1}) both gave paddy yields of 4.7 t ha^{-1}, which did not differ significantly from the yield of 5.3 t ha^{-1}, obtained under the recommended inorganic nitrogen fertilizer application of 90 kg N ha^{-1}. This indicates a synergistic effect of OM and urea on soil fertility. The redox potential studies showed that RS had greater propensity to bring about reduced soil condition in paddy fields than CD and PM, while PM brought about greater reduction than CD.

Yadav*et al.* (2009) studied at Kumarganj, Faizabad to assess the impact of organic manures on performance of (*Oryza sativa* L.)-wheat (*Triticumaestivum* (L.) Fiori&Paol.) system. Among different organic farming treatments, incorporation of crop residues in both the crops+greenmanuring+phosphorus solubilising microbes (PSM)+poultry manure (PM) 5 t/ha+neem cake 0.2 t/ha, resulted in highest values of growth and yield components, yield and net return. This treatment gave 16.1, 16.6, 13.1, 13.1 and 44.5% higher yield of rice and 19.7, 17.0, 14.5, 7.5 and 26.8% higher yield of wheat over T1, T2, T3, T4 (organics) and T6 (inorganics) respectively. Maximum amount of balance or un-utilized NPK was computed with inorganics treatment (T6). All the organic farming treatments improved soil health as evident by increased organic carbon and reduction in soil pH. Highest values of organic carbon (0.64%) after 5 years of experimentation was recorded with wheat residues+FYM 10 t/ha+0.2 t/ha neem cake in rice and rice residue+pressmud 10 t/ha in wheat (T3). Treatment with crop residue+greenmanuring+poultry manure 5 t/ha+PSM+neem-cake 0.2 t/ha also proved most remunerative and gave 15.46, 16.08, 14.17, 8.87 and 36.48x103 Rs/ha higher net return over T1, T2, T3, T4 and T6, respectively. Highest benefit: cost ratio (1.60) was also recorded with this treatment.

Reddy and Kumar (2007) conducted an experiment during 1999, 2000 and 2001 kharif seasons in Andhra Pradesh, India, to study the relative efficiency of organic and inorganics sources of N on the growth, yield and N uptake of lowland rice. The combination of 50 percent N through urea and 50 percent N through different organic sources (farmyard manure, poultry manure and neem cake) produced significantly taller plants, more number of tillers, higher quantity of dry matter, more number of panicles m^{-2}, longer panicles, greater number of grains $panicle^{-1}$ and higher test weight than all other combinations. The conjunctive use of 50 percent N fertilizer as urea along with 50 percent N as farmyard manure, poultry manure or neem cake produced significantly higher grain as well as straw yields of rice during all the three years. Integrated supply of N at 50 percent each through fertilizer and organics recorded higher N uptake than all the other combinations.

Mahavishnan *et al.* (2004) conducted a field study on the effect of nutrient management through organic and inorganic sources on the yield of rice. They found that the yield and yield contributing components were higher with the application of 125% recommended doses of fertilizer RDF + poultry manure (PM) compared to other treatments.

Sengar *et al.* (2000) stated that the application of chemical fertilizers in combination with manures improved the fertility status of the soil. They evaluated the efficiency of different fertilizers in rainfed lowlands at the Zonal Agricultural Research Station, Jagdalpur, Madhya Pradesh, India and found that application of N fertilizer and manure significantly increased the yield and NPK uptake by rice compared with the control and NPK treatment.

Liang *et al.* (1999) observed that the results from long term experiment in rice based cropping system where high crop yields were sustainable over period of 12-16 years through the continuous application of inorganic NPK fertilizers and yields were mainly restricted by insufficient N nutrient supplementing NPK fertilization with organic manure could further increase rice yield. Soil physical and chemical properties were either unaltered or improved soil physical condition.

Sarker and singh (1997) reported that soil pH was decreased to 6.5-6.6 by application of organic fertilizers alone compared with the pH 6.7. However a combination of organic plus inorganic fertilizers increased soil pH to 6.6-6.8. Organic fertilizers alone or in combination with inorganic fertilizers increased the level of organic carbon in the soil as the total N,P and K content of soil.

Sanzo *et al.* (1997) observed that application of standard rates of 200 kg N, 80 kg P and 90 kg K/ha or 15,30 or 45 cattle manure (t/ha) with or without 50% or 100% of the standard rate of application N. Yield generally increased with increasing rates of manures with better result in combination with NPK with 45 t manure there was no significant difference in yield between N rates.

Zhang and Peng (1996) showed that the content of soil organic matter and total N,P and K were raised, soil nutrients were activated, soil fertilizers were enhanced, nutrient absorption by rice was increased and rice yields were heightened by combined application of organic and inorganic fertilizers.

Jeony *et al.*(1996) observed that rice was given 110 kg N + 120 kg P+ 130 kg K/Ha(100% NPK) alone or with 5 t/ha rice straw or half these NPK rate (50% NPK) alone or 5 t rice straw, 20 t compost + 20 t fermented pig manure. Pig manure + compost, 3 t oil cake or 5 t/ha fermented chicken manure. Application of organic manure + 50% NPK gave grain yield of 9 to 17% lower than these were obtained with 100% NPK rate. Grain content alkali digestion value and gel consistency were unaffected by treatments. Amylase content of grain was lower in plant given straw, compost or compost + pig manure compared with 100% NPK treatment. In general, organic fertilizer did not improve rice cooking quality and tests.

Gupta (1995) conducted a field trial on different organic manure in India and reported that the application of field manure (10 t/ha) produced the highest grain yield (4.5 t/ha) followed by PM and FYM which produced yield of S.

Singh *et al.* (1995) reported that cattle manure significantly improves rice yield but was less efficient than urea. The combination of cattle manure and urea showed no positive interaction effects. Total N uptake by rice was also significantly higher from urea than manure. P and K up take by rice increased in response to N application from urea and cattle manures.

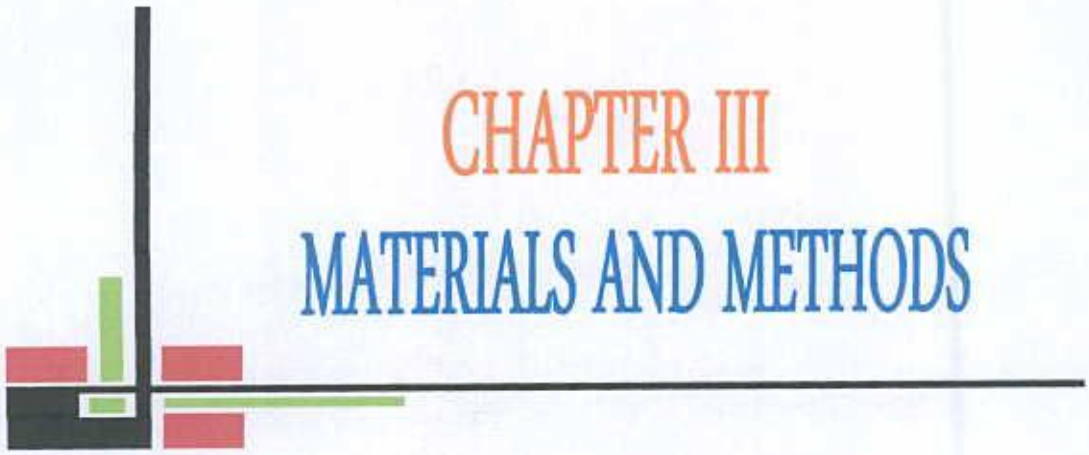
Ahmed and Rahman (1991) reported that the application of organic matter and chemical fertilizers increased tiller number, panicle length, grain and straw yields of rice.

Islam *et al* (2007) a field experiment was conducted to find out the influence of mustard oil cake on the performance of fine rice Chinigura. The MoC was applied @ 0,40, 80 and 120 kg ha^{-1} in three splits. Level of mustard oil cake significantly influenced the number of effective tillers $hill^{-1}$, grains $panicle^{-1}$, and grain and straw yields. The highest grain yield of 2.69 t ha^{-1} was obtained when 80 kg MoC ha^{-1} was applied, which was identical with the treatment of 120 kg MoC ha^{-1}. This could be due to the cumulative effect of higher number of effective tillers $hill^{-1}$, and number of grains $panicle^{-1}$. The lowest one (1.92 t ha^{-1}) was recorded when no MOC was applied.

Sultana *et al* (2008) was conducted an experiment during *aman* season (July to December) of 2007 where mustard oil cake was tried at different levels (0, 25, 50, 75 and 100 kg ha^{-1}) and times (basal, 10 days after transplanting and 20 days after transplanting) with a high yielding fine rice variety BRRI dhan38. It was found that level of mustard oil cake and time of its application and their interaction exerted significant influence on all the characters of crop except panicle length and 1000-grain weight. Grain yields registered an increasing trend upto 75 kg ha^{-1} MOC. The highest grain yield (2.33 t ha^{-1}) was recorded from the MOC @ 75kg ha^{-1} applied at 10 DAT. Economic analysis showed that the highest net profit (Tk. 25421.7 ha^{-1}) and the highest benefit cost ratio (1.56) were recorded when MOC was applied @ 75 kg ha^{-1}. Therefore, application of MOC @ 75 kg ha^{-1} at 10 DAT appears to be the best package for BRRI dhan38 from both yield and economic viewpoints.

Alim (2012) was conducted an experiment to study the effect of different sources and doses of nitrogen application on the yield formation of *boro* rice. Two *indica* modern *boro* rice varieties (BRRI dhan28 and BRRI dhan36) and 21 nitrogen fertilizer combinations were used in the experiment. Yield and yield contributing characters were measured. Among the two varieties BRRI dhan28 produced higher grain and straw yield. Grain and straw yields were increased with the increase of nitrogen rate up to 120 kg ha^{-1} at all the sources. In general, organic manures alone could not produce higher grain yield but the combination of organic and inorganic fertilizers produced higher yield. 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 nitrogen application. The results suggest that replacement of 50% urea N by MOC was the best source of nitrogen considering higher yield of *boro* rice. Therefore, fertilization of BRRI dhan28 and BRRI dhan36 varieties of rice with 60 kg N ha^{-1} as urea and 60 kg N ha^{-1} as MOC or 50 kg N ha^{-1} as urea with 50 kg N ha^{-1} as MOC was found to be the best nitrogen rate among all the treatment combinations in respect of grain and straw yields.

From the literature cited above, it is evident that fertilizers and manure application have definite significant influence on growth parameters, yield components and yield of rice.



CHAPTER III

MATERIALS AND METHODS

CHAPTER 3

MATERIALS AND METHODS

The experiment was conducted at the farm of Sher-e-Bangla Agricultural University, during the period from July to December 2013. This chapter deals with a detail description of the site, soil, land preparation, intercultural operations, data recording and procedure of statistical analysis etc.

3.1 Description of experimental site

3.1.1 Location and site

The experimental field is located at the Sher-e-Bangla Agricultural University (SAU), Dhaka-1207. The experimental area belongs to Madhupur Tract (Agro-Ecological Zone 28). The land area was situated at 23°41' N latitude and 90°22' E longitude at an altitude of 8.6 meter above the sea level.

3.1.2 Soil

The soil of the experimental field belongs to the general soil type, shallow red brown terrace soil under Tejgaon series. Top soils were clay loam in texture, olive gray with common fine medium distinct dark yellowish brown mottles. The experimental area was flat having available irrigation and drainage system. The land was above flood level and sufficient sunshine was available during the experimental period.

3.1.3 Climate

The experimental area was under the sub-tropical climate that is characterized by high temperature, high humidity and heavy rainfall with occasional gusty winds in kharif season (April-September) and less rainfall associated with moderately low temperature during the Rabi season (November-March).

3.2 Planting materials

Rice variety Binasail and BRRI dhan46 were taken as test crop for this experiment. The variety "Binasail" is transplanted late aman in type. The plant grows up to 125 cm height. Seed to seed

duration is 135-140 days. The appropriate time for seed sowing is late June to late July and transplanting should be done with in August to early September. The variety is harvested from Mid November to Mid December and approximate yield is 4.2-5 t/ha (BINA, 1987).

The variety "BRRI dhan46" is also a transplanted late aman type. The plant grows up to 105-115 cm height. Seed to seed duration is 150 days. The appropriate time for seed sowing is mid July to mid August and transplanting should be done within August to early September. The variety is harvested from Mid November to Mid December and approximate yield is 5 t/ha. (BRRI, 2010).

3.3 Experimental treatments

The treatments included in the experiment were two factorials.

Design: RCBD with two factorials

Factor A: Number of variety: 2

V_1 = Binasail

V_2= BRRI dhan46

Factor B: Different nitrogen fertilizer's doses: 8

T_0 = Control (No nitrogen applied)

T_1 = Poultry Manure$(PM)_{25\%}$ + Inorganic Fertilizer$(IF)_{75\%}$ (25% N as poultry manure and 75% N as urea of the Recommended Doses(RD) was applied)

T_2 = $PM_{50\%}$ + $IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied)

T_3 = $PM_{75\%}$ + $IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied)

T_4 = Mustard Oil Cake$(MOC)_{25\%}$ + $IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied)

T_5 = $MOC_{50\%}$ + $IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied)

T_6 = $MOC_{75\%}$ + $IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied)

T_7 = $IF_{100\%}$ (100% N from urea of the RD was applied)

P, K and S was applied as per recommended dose.

Treatment combination = 2 x 8 = 16 , Replication: 3

3.4 Experimental design and layout

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Each replication was divided into 16 plots. The total numbers of unit plots were 48.

The plot size was 3.0 m x 2.0 m. The distances between plot to plot and block to block were 0.5 m and 0.5 m, respectively. The layout of the experimental plot has been shown in Appendix IV.

3.5 Raising of seedlings

Seeds of Binasail were collected from BINA (Bangladesh Institute of Nuclear Agriculture), Mymensingh and Seeds of BRRI dhan46 were collected from BRRI (Bangladesh Rice Research Institute), Gazipur. The seedlings were raised at the wet seed bed in SAU farm. The seeds were sprouted by soaking for 72 hours. The sprouted seeds were sown uniformly in the well-prepared seed bed in 16 July, 2013.

3.6 Land preparation

The experimental field was opened with a power tiller and later on, the land was ploughed and cross-ploughed three times by country plough followed by laddering to obtain the desirable tilth. The corners of the land were spaded. All kinds of weeds and stubbles were removed from the field and the land was made ready. Whole experimental land was divided into sub plots. Finally basal doses of phosphorus, potassium and sulphur fertilizers were applied in sub plots and the plots were made ready by thorough spading and leveling before transplantation. Doses of nitrogen were applied as per treatments.

3.7 Fertilizer application

At the time of first ploughing cow dung at the rate of 1 t/ha was applied. The recommended dose of fertilizers for very low soil are 175 kg ha^{-1}, 7 t ha^{-1}, 3.5 t ha^{-1}, 97 kg ha^{-1}, 67 kg ha^{-1} and 67 kg ha^{-1} urea, poultry manure, mustard oil cake, triple super phosphate (TSP), muriate of potash (MOP) and gypsum respectively for Binasail and BRRI dhan46 (Source: Fertilizer recommendation guide, 2012). All the fertilizers except urea, poultry manure and mustard oil cake were incorporated with the soil one day before transplanting. Nitrogen was applied as urea, poultry manure and mustard oil cake as per the treatments.

N content of Urea – 46.6%

N content of Poultry manure -11.5 kg/ton

N content of Mustard oilcake – 25.5 kg/ton

3.8 Transplanting of seedlings on the main field

Thirty days old seedlings of Binasail and BRRI dhan46 were carefully uprooted from the seedling nursery and transplanted in well puddled plots. Two seedlings per hill were used following a spacing of 15 cm × 25 cm. After one week of transplanting all plots were checked for any missing hill, which was filled up with extra seedlings whenever required.

3.9 Intercultural operations

The following intercultural operations were done for ensuring the normal growth of the crop.

3.9.1 Weed control

During plant growth stage hand weedings were done according to needs.

3.9.2 Irrigation and drainage

Irrigation water was applied keeping a standing water of about 2-3 cm during the whole growing period.

3.9.3 Plant protection measure

During the growing period some plants were infested by rice stem borer (*Scirpophaga incertulus*) which was successfully controlled by applying Diazinon 60 EC @ 20 mL per 10 Liter of water for spraying. No prominent infestation of insect-pests and diseases were observed in the field.

3.10 Harvest and post-harvest operation

The crop was harvested after the grains attained maturity. The grains were threshed, cleaned and sun dried to record grain yield/plot.

3.11 Sampling and data collection

Data collections from the experiment on different growth stages were done under the following heads as per experimental requirements.

3.11.1 Plant height

Then heights of the pre-selected 10 hills were taken by measuring the distance from base of the plant to the tip of the flag leaf after 30, 60 and 90 DAT. The collected data were finally averaged.

3.11.2 Number of tillers

Number of tillers was counted from 10 preselected hills at 30, 60 and 90 DAT and finally averaged.

3.11.3 Number of leaves

Number of leaves per plant was counted three times at 30 days interval such as 30, 60 and 90 DAT of rice plants. Mean value of data were calculated and recorded.

3.11.4 Number of effective and non-effective tillers

Number of effective and non-effective tillers was counted from 10 preselected hills after harvesting and finally averaged.

3.11.5 Panicle length

The panicle length was measured with a meter scale from 10 selected plants and the average value was recorded as per plant.

3.11.6 Number of filled grains and unfilled grains

Number of filled grains and unfilled grains were counted from 10 panicles from each plot. Lack of any food materials inside the spikelets were denoted as unfilled grains.

3.11.7 1000 grain weight

One hundred grains were randomly collected from each plot and were sun dried and weighed by an electronic balance and then multiplied by 10.

3.11.8 Straw yield

Straw obtained from each unit plot were sun-dried and weighed carefully. The dry weight of straw of the respective unit plot yield was converted to t ha^{-1}.

3.11.9 Grain yield

Six square meter (m^2) area (each plot) were harvested. The grains were threshed, cleaned, dried and then weighed in kg. Thereafter it was converted as ton per hectare (t/ha).

3.11.10 Determination of total Nitrogen

The macro Kjeldahl method was used to determine the total nitrogen in grain of plant samples. Three steps were involved in this method. These are as follows:

1. Digestion: In this step the organic nitrogen was converted to ammonium sulphate by sulphuric acid and digestion accelerators (Catalyst Mixture) at a temperature of 360-440^{0}C.

$$N + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$

2. Distillation: In this step, the solution was made alkaline for the distillation of ammonia. The distillated ammonia was received in boric acid solution.

$$(NH_4)_2SO_4 + NaOH \longrightarrow Na_2SO_4 + NH_3 + H_2O$$

$$NH_3 + H_3BO_3 \longrightarrow (NH_4)_2BO_3 + H_2O$$

3. Titration: To determine the amount of NH_3, ammonium borate was titrated with standard sulfuric acid.

$$(NH_4)_2BO_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + H_3BO_3$$

Reagents : 4 % Boric Acid solution, Mixed Indicator (Bromocresol Green And Methyl Red), 4 % Sodium Hydroxide solution, standard Sulfuric Acid solution and 0.05 N Na_2CO_3 solution.

Procedure:

About 0.25 g of oven-dried grain sample was weighed and then transferred into a 250 mL Pyrex Kjeldahl flask. Then 5.0 g catalysts mixer (K_2SO_4: $CuSO_4.5H_2O$: Se =100: 10: 1) was added in to the flask. About 25 mL H_2SO_4 was also added in to the flask. The flask was heated until the solution become clear and then allowed to cool. After digestion, 40% NaOH was added in to the conical flask and attached quickly to the distillation set. Then the flask was heated continuously. In the meantime, 25mL of 4% boric acid solution and 2-4 drops of mixed indicator was taken in 5% receiver conical flask. After distillation, the distillate was collected into receiver conical flask. The distillate was titrated with standard H_2SO_4 taken from a burette until the green color completely turns to pink. The same procedure was followed for a blank sample.

The result was calculated using the following formula –

% N = (T-B) × N × 1.4/S

T = Titration value for sample (ml.), B -= Titration value for blank (ml)

N = Normality of H_2SO_4, S = Weight of the sample (g),

1.4 = Conversion factor

3.11.11 Determination of Phosphorus

Principle:

By ascorbic acid blue color method the phosphorus content in rice grain was determined. This method is based on the principle that in an acid molybdate solution containing orthophosphate ($H_2PO_4^-$) ions, a phosphomolybdate complex forms that can be reduced by ascorbic acid and other reducing agents to a molybdenum blue color.

$(NH_4)_6Mo_7O_{24}.4\ H_2O + H_2SO_4 = (NH_4)_2MoS_4$

$(NH_4)_2MoS_4 + H_2PO_4^- = (NH_4)_3PMo_{12}O_{40}$ [Ammonium phosphorus molybdate, oxidized, colorless]

$(NH_4)_3PMo_{12}O_{40} + C_6H_8O_6$ = Ammonium phosphorus molybdate (Reduced, Blue color)

Reagents:

1. Mixed reagent:

Solution A: About 12.0g ammonium molybdate [$(NH_4)_6Mo_7O_{24}.4\ H_2O$] was dissolved in 250 ml distilled water.

Solution B: At first 0.2908g antimony potassium tartarate [$K(SbO)C_4H_4O_6.1/2H_2O$] was dissolved in 1000 ml of 5N H_2SO_4 (148 ml cone. H_2SO_4/Liter) the two solutions were mixed together thoroughly. Then the volume was made to 2000 ml distilled water.

2. Color developing reagent:

About 0.53g (or.1.06g or 2.65g) of ascorbic acid was added to 100 ml (or 200 ml or 500 ml) of the mixed reagent.

Preparation of plant extract:

0.25 g of dry rice straw/grain were weighed, and then transferred into 250 ml Pyrex conical flasks. Then 10 ml 2:1 nitric-perchloric acid mixture was added into each flask and allowed to stand overnight or until the vigorous reaction phase is over. After the preliminary digestion, the conical flasks were placed on a hot plate in digestion chamber and then temperature was raised to 150°C for 1 hour. The temperature was increased slowly up to 300^0C After the digestion the conical flasks were lifted out of the digester and allowed to cool at room temperature. The solution was taken in 100 ml volumetric flask through funnel and volume with distilled water upto the mark (Jackson, 1973).

Procedure:

20 ml of the extract was pipette out in a 100 ml volumetric flask. Then 20 ml color developing reagent was added slowly and carefully to prevent loss of sample due to excessive foaming. After the evolution of CO; has ceased the flask was shake gently to mix the contents. Distilled water was added to make the volume up to the mark of the flask. By spectrophotometer, the color intensity (% absorbance) was measured at 660 nm.

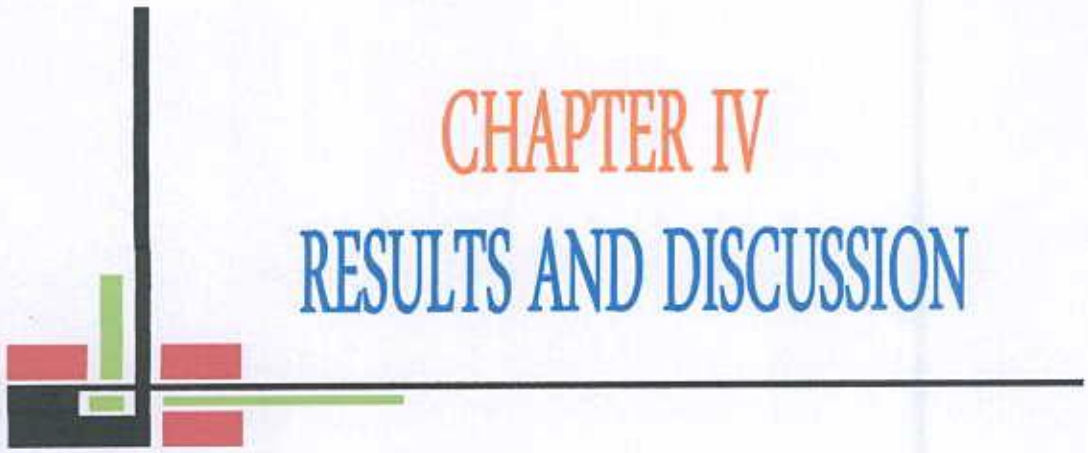
3.11.12 Determination of Potassium

Procedure:

Plant samples (for grain) were prepared by digestion as for phosphorus. Then the amount of potassium was estimated from prepared sample with the help of a flame photometer at 589 nm.

3.12 Statistical Analysis

The data were compiled and tabulated in proper form and were subjected to statistical analysis. Analysis of variance (ANOVA) was done following the computer package MSTAT-C program developed by Russel, 1986. The mean differences among the treatments were adjusted by least significant difference test (LSD) at 5% level of significance (Gomez and Gomez, 1984).



CHAPTER IV

RESULTS AND DISCUSSION

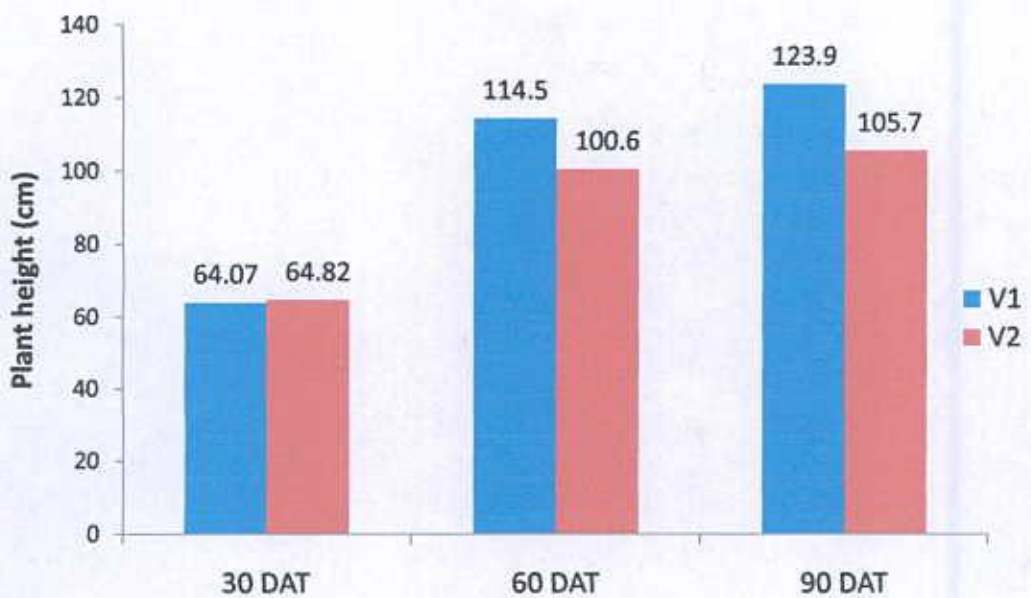
CHAPTER 4

RESULTS AND DISCUSSION

The results of different growth parameters, yield attributes, yield and nutrient concentrations in the grains and straw of rice are presented this chapter.

4.1 Plant Height

At different growth stages plant height varied significantly among two rice cultivars except 30 DAT (Figure 1 and Appendix VIII). At 30DAT BRRI dhan46 showed 64.82cm plant while Binasail showed 64.07cm of plant height. But at 60 and 90 DAT Binasail produced the taller plant among the two (114.5cm and 123.9cm respectively) while BRRI dhan46 produced comparatively shorter plant (100.6cm and 105.7cm respectively). Probably the genetic makeup of varieties was responsible for the variation in plant height. This confirms the reports of Shamsuddin *et al.* (1988) that plant height differed due to varietal variation.



V_1 – Binasail, V_2 - BRRI dhan46

Figure 01. Effect of variety on plant height (cm) at different days after transplanting (mean of eight treatments)

Table 1. Effect of different combinations of organic and inorganic fertilizer on plant height (cm) at different days after transplanting (mean of two varieties)

Treatments	Plant height (cm)		
	30 DAT	60 DAT	90 DAT
T_0	59.37 d	106.0 c	110.2 d
T_1	64.83 b	114.3 a	117.4 a
T_2	68.77 a	115.4 a	118.0 a
T_3	64.97 b	113.0 a	116.2 ab
T_4	64.57 b	114.2 a	112.9 c
T_5	60.70 cd	108.5 bc	116.7 ab
T_6	63.93 bc	111.4 ab	112.3 cd
T_7	68.43 a	113.1 a	114.6 bc
LSD $_{(0.05)}$	3.345	4.100	2.365
Significant level	*	*	*
CV (%)	8.37	3.92	4.82

* - Significant at 5% level

T_0 = Control (No nitrogen applied), **T_1**= $PM_{25\%}+IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), **T_2** = $PM_{50\%}+IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), **T_3** = $PM_{75\%}+IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), **T_4**= $MOC_{25\%}+IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), **T_5** = $MOC_{50\%}+IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), **T_6** = $MOC_{75\%}+IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), **T_7**= $IF_{100\%}$ (100% N from urea of the RD was applied)

At 30, 60 and 90 DAT plant height differs significantly due to various combinations of organic and inorganic fertilizers (Table 1). At 30 DAT T_2 showed the highest plant height (68.77cm) which was statistically similar to T_7 (68.43cm). At 60 DAT T_2 showed the highest plant height (115.4cm) which was statistically similar to rest of the treatments except T_0 and T_5. At 90 DAT T_2 showed the highest plant height (118.0cm) which was statistically similar to T_1(117.4cm), T_5(116.7cm), T_3(116.2cm). T_0 showed the lowest plant height at 30, 60 and 90 DAT(59.37, 106.0 and 110.2cm respectively). It seems from the results that combination of organic and

Table 2. Interaction effect of variety and different organic and inorganic fertilizers combination on plant height (cm) at different days after transplanting

Treatments		Plant Height (cm)		
Variety	Combination of organic and inorganic fertilizer	30DAT	60DAT	90DAT
V_1	T_0	58.93 g	106.8 fg	104.2 fg
	T_1	65.93 cde	113.3 abcde	128.0 a
	T_2	64.73 de	116.3 a	128.9 a
	T_3	64.73 de	114.6 abc	123.4 b
	T_4	67.93 bc	112.4 bcde	120.0 c
	T_5	63.33 ef	110.1 ef	128.3 a
	T_6	64.53 de	112.3 cde	119.7 c
	T_7	67.40 bcd	114.3 abcd	124.9 b
V_2	T_0	58.33 g	105.2 g	102.6 g
	T_1	63.73 ef	115.3 abc	106.9 de
	T_2	72.13 a	113.6 abcde	105.7 ef
	T_3	65.20 cde	116.1 ab	108.9 d
	T_4	61.20 fg	112.1 cde	107.1 de
	T_5	63.07 ef	106.9 fg	105.1 ef
	T_6	59.80 g	110.6 de	104.9 efg
	T_7	70.13 ab	111.9 cde	117.8 c
$LSD_{(0.05)}$		2.796	3.523	2.261
Significant level		*	*	*
CV (%)		8.37	3.92	4.82

* - Significant at 5% level

V_1 – Binasail, V_2 - BRRI dhan46

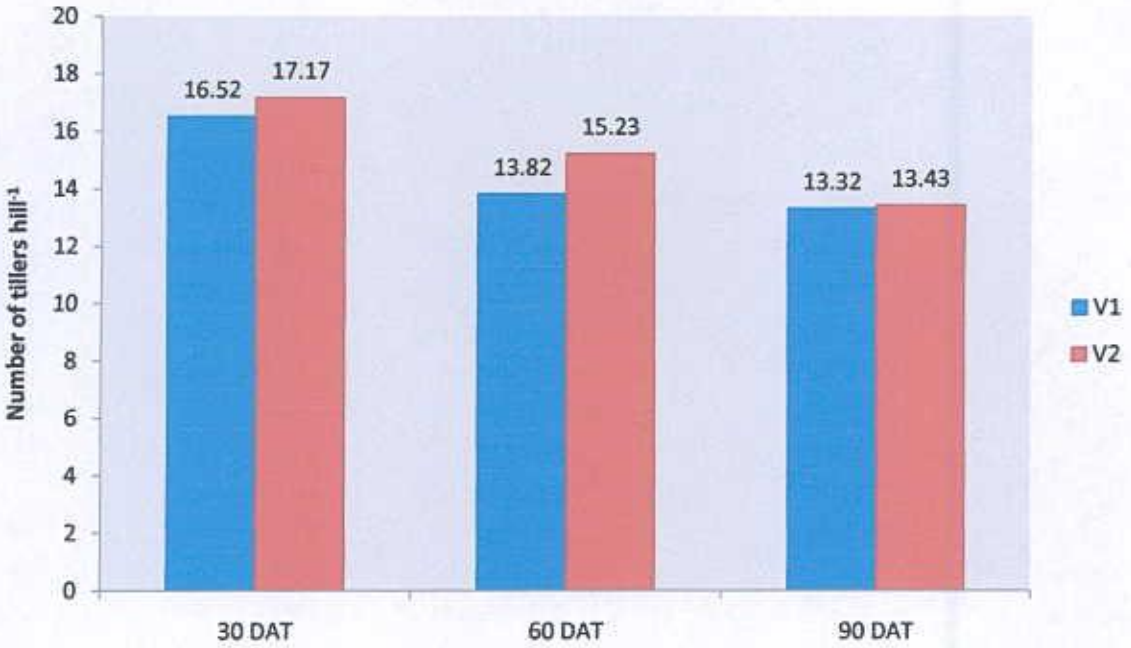
T_0 = Control (No nitrogen applied), **T_1**= $PM_{25\%}+IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), **T_2** = $PM_{50\%}+IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), **T_3** = $PM_{75\%}+IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), **T_4**= $MOC_{25\%}+IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), **T_5** = $MOC_{50\%}+IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), **T_6** = $MOC_{75\%}+IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), **T_7**= $IF_{100\%}$ (100% N from urea of the RD was applied)

inorganic fertilizers significantly increased the plant height than sole use of inorganic fertilizer and then that of organic manure. Actually organic fertilizers help to increase the organic matter content of soil, thus reducing the bulk density and decreasing compaction. Thus plants get a suitable growing environment which promotes better growth and development. Similar sort of findings were found by many scientists while experimenting with various crops.

Due to the interaction of variety and different organic and inorganic fertilizers combination on plant height significantly varied at 30, 60 and 90 DAT (Table 2). At 30 DAT highest plant height was found in V_2T_2 (72.13cm) which was statistically similar to V_2T_7 (70.13cm). At 60 DAT, the highest plant height was recorded in V_1T_2(116.3cm) which was closely followed by and statistically similar with V_2T_3(116.1cm), V_2T_1(115.3cm) and V_1T_3(114.6cm). At 90 DAT the highest plant height was showed by V_1T_2(128.9cm) which was statistically similar to V_1T_5(128.3cm) and V_1T_1(128.0cm). At all growth stages V_2T_0 showed the lowest plant height. Reddy and Kumar (2007) was observed that the combination of 50 percent N through urea and 50 percent N through different organic sources (farmyard manure, poultry manure and neem cake) produced significantly taller plants.

4.2 Number of Tillers

The production of total number of tillers hill^{-1} of aman rice was statistically insignificant and hence was not influenced by different varieties (Figure 02 and Appendix VIII). Numerically maximum number of tillers hill^{-1} at 30, 60 and 90 DAT was observed in the V_2 (BRRI dhan46) and the minimum number of tillers hill^{-1} was obtained from the variety V_1 (Binasail). These results are similar with the findings of Sultana (2008) observed that number total of tillers hill^{-1} was not significantly affected by variety. Idris and Matin (1990) also reported that number of total tillers hill^{-1} was identical among the varieties studied. But the results are in contrary with Alam *et al.* (2012) who found that highest number of total tillers hill^{-1} (12.23) was produced by BR11 and the lowest number of total tillers hill^{-1} (10.17) was produced by BRRI dhan32 among three varieties.



V_1 – Binasail, V_2 - BRRI dhan46

Figure 02. Effect of variety on number of tillers hill^{-1} at different days after transplanting (mean of eight treatments)

At 30, 60 and 90 DAT number of tillers hill^{-1}differ significantly due to various combinations of organic and inorganic fertilizers (Table 3). At 30 DAT T_2 showed the highest number of tillers hill^{-1}(17.63) which was statistically similar to all except T_0 (14.90). At 60 DAT T_2 showed the highest number of tillers hill^{-1}(15.57) which was statistically similar to rest of the treatments except T_0. T_0 showed the lowest number of tillers hill^{-1}at 30 and 60 DAT(59.37) and 110.2 respectively). At 90 DAT the production of total number of tillers hill^{-1} of aman rice was statistically insignificant. Numerically maximum number of tillers hill^{-1} at 90 DAT was observed in the T_2(14.20) and the minimum number of tillers hill^{-1} was obtained from the T_0 (12.70) treatment. Umanah *et al.* (2003) find out the effect of different rates of poultry manure on the growth, yield component and yield of upland rice and showed that significant differences in tillers number per hill.

Table 3. Effect of different combinations of organic and inorganic fertilizer on number of tillers hill^{-1} at different days after transplanting (mean of two varieties)

Treatments	Number of tillers hill $^{-1}$		
	30 DAT	60 DAT	90 DAT
T_0	14.90 b	13.50 b	12.70
T_1	17.10 ab	14.40 ab	13.60
T_2	17.63 a	15.57 a	14.20
T_3	17.30 ab	14.40 ab	13.57
T_4	17.53 a	15.17 ab	13.47
T_5	16.70 ab	14.53 ab	13.37
T_6	16.60 ab	14.17 ab	13.07
T_7	16.97 ab	14.50 ab	13.07
LSD $_{(0.05)}$	2.243	1.672	1.906
Significant level	*	*	NS
CV (%)	10.63	16.62	14.59

* - Significant at 5% level
NS – Non Significant

T_0 = Control (No nitrogen applied), **T_1**= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), **T_2** = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), **T_3** = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), **T_4**= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), **T_5** = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), **T_6** = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), **T_7**= $IF_{100\%}$ (100% N from urea of the RD was applied)

Due to the interaction of variety and different organic and inorganic fertilizers combination number of tillers hill^{-1} significantly varied at 30, 60 and 90 DAT (Table 4). At 30 DAT highest number of tillers hill^{-1} was found in V_2T_2 (19.13) which was statistically similar to V_1T_2 (18.87), V_1T_7(18.53) and V_2T_1 (18.33). At 60 DAT, the highest number of tillers hill^{-1} was recorded in V_2T_2(16.67) which was closely followed by and statistically similar with V_1T_1(14.60), V_1T_2 (14.60), V_1T_4 (16.13),V_1T_5 (15.53), V_1T_7 (15.53) and V_2T_7 (15.60). At 90 DAT the highest number of tillers hill^{-1} was showed by V_2T_2(14.73) which was statistically similar to all treatment except V_1T_0 (12.33).

Table 4. Interaction effect of variety and different organic and inorganic fertilizers combination on number of tillers hill^{-1} at different days after transplanting

Treatments		Number of tillers hill^{-1}		
Variety	Combination of organic and inorganic fertilizer	30DAT	60DAT	90DAT
V_1	T_0	13.73 g	12.13 e	12.33 b
	T_1	15.87 efg	14.60 abc	12.80 ab
	T_2	18.87 ab	14.60 abc	13.80 ab
	T_3	16.20 def	14.40 bcd	14.33 ab
	T_4	17.47 abcdef	16.13 ab	12.33 b
	T_5	17.53 abcdef	15.53 abc	13.60 ab
	T_6	16.07 def	14.60 abc	13.00 ab
	T_7	18.53 abc	15.53 abc	13.80 ab
V_2	T_0	16.67 bcdef	14.13 bcde	13.53 ab
	T_1	18.33 abcd	14.20 bcde	14.60 a
	T_2	19.13 a	16.67 a	14.73 a
	T_3	15.47 fg	14.20 bcde	12.47 b
	T_4	17.80 abcde	14.20 bcde	13.07 ab
	T_5	15.87 efg	13.53 cde	13.13 ab
	T_6	16.53 cdef	12.40 de	13.13 ab
	T_7	15.40 fg	15.60 abc	13.40 ab
$LSD_{(0.05)}$		2.116	1.942	1.951
Significant level		*	*	*
CV (%)		10.63	16.62	14.59

* - Significant at 5% level

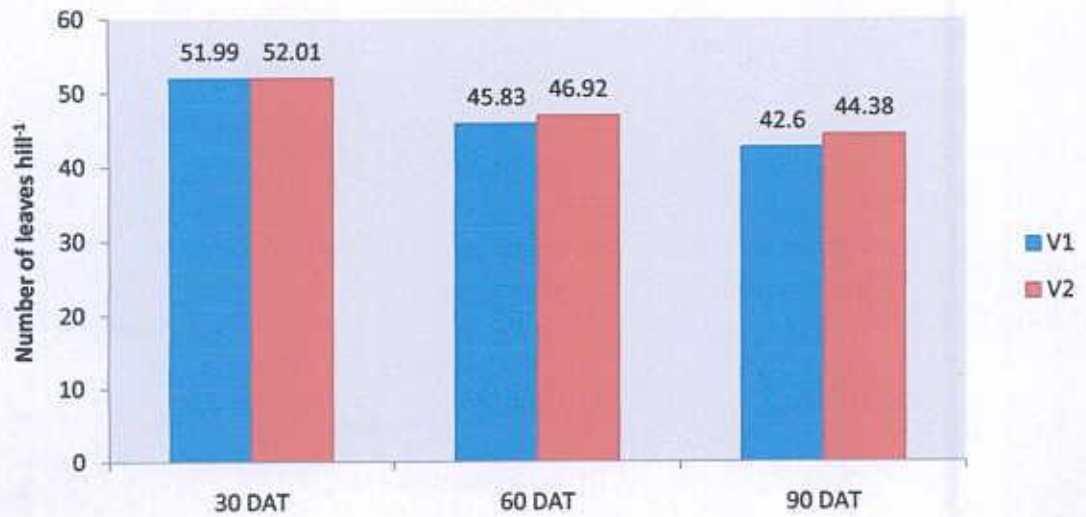
V_1 – Binasail, V_2 - BRRI dhan46

T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied)

At all growth stages V_1T_0 showed the lowest number of tillers hill^{-1}.Chauhan *et al.* (2010), Sangeetha *et al.* (2010) reported that number of tillers hill^{-1} increased with the application of chemical fertilizers. Reddy and Kumar (2007) was observed that the combination of 50 percent N through urea and 50 percent N through different organic sources (farmyard manure, poultry manure and neem cake) produced significantly more number of tillers.

4.3 Number of Leaves

The production of total number of leaves hill^{-1} of *aman* rice was statistically insignificant and hence was not influenced by different varieties (Figure 03 and Appendix VIII). Numerically maximum number of number of leaves hill^{-1} was at 30, 60 and 90 DAT was observed in the V_2 (BRRI dhan46) and the minimum number of tillers hill^{-1} was obtained from the variety V_1(Binasail).



V_1 – Binasail, V_2 - BRRI dhan46

Figure 03. Effect of variety on number of leaves hill^{-1} at different days after transplanting (mean of eight treatments)

At 30, 60 and 90 DAT number of leaves hill^{-1} differ significantly due to various combinations of organic and inorganic fertilizers (Table 5). At 30 DAT T_2 showed the highest number of leaves hill^{-1}(54.63) which was statistically similar to all except T_0 (45.80), T_5 (49.93) and T_6 (51.87) . At 60 DAT T_2 showed the highest number of leaves hill^{-1}(49.37) which was statistically similar to the treatments T_4 (47.73). At 90 DAT T_2 showed the highest number of leaves hill^{-1}(46.93) which was statistically similar to T_1(45.13). T_0 showed the lowest number of leaves hill^{-1} at 30, 60 and 90 DAT(45.80, 44.40 and 40.10 respectively).

Table 5. Effect of different combinations of organic and inorganic fertilizer on number of leaves hill^{-1} at different days after transplanting (mean of two varieties)

Treatments	Number of leaves hill^{-1}		
	30 DAT	60 DAT	90 DAT
T_0	45.80 d	44.40 d	40.10 d
T_1	53.33 ab	46.10 bcd	45.13 ab
T_2	54.63 a	49.37 a	46.93 a
T_3	53.60 ab	46.23 bcd	43.57 b
T_4	54.03 ab	47.73 ab	41.37 cd
T_5	49.93 c	45.47 cd	43.73 b
T_6	51.87 bc	44.83 cd	43.20 bc
T_7	52.80 ab	46.87 bc	43.90 b
LSD $_{(0.05)}$	2.306	2.049	1.968
Significant level	*	*	*
CV (%)	10.74	12.08	16.12

* - Significant at 5% level

T_0 = Control (No nitrogen applied), **T_1**= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), **T_2** = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), **T_3** = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), **T_4**= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), **T_5** = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), **T_6** = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), **T_7**= $IF_{100\%}$ (100% N from urea of the RD was applied)

Table 6. Interaction effect of variety and different organic and inorganic fertilizers combination on number of leaves hill^{-1} at different days after transplanting

Treatments		Number of leaves hill^{-1}		
Variety	Combination of organic and inorganic fertilizer	30DAT	60DAT	90DAT
V_1	T_0	44.07 g	41.87 f	40.80 ef
	T_1	48.60 ef	44.73 de	42.13 de
	T_2	51.33 cd	48.13 b	42.20 de
	T_3	57.93 a	50.60 a	46.87 ab
	T_4	52.60 c	47.87 b	43.80 cd
	T_5	50.07 de	44.33 de	44.87 bc
	T_6	47.53 f	46.93 bc	39.40 f
	T_7	56.47ab	45.93 cd	43.80 cd
V_2	T_0	52.20 c	40.87 f	38.93 f
	T_1	58.07 a	47.47 bc	44.93 bc
	T_2	57.93 a	51.60 a	48.13 a
	T_3	51.53 cd	43.80 e	47.00 a
	T_4	55.47 b	47.60 bc	43.80 cd
	T_5	49.80 de	46.60 bc	42.60 de
	T_6	49.27 ef	45.87 cd	42.60 de
	T_7	49.13 ef	47.80 b	44.00 cd
$LSD_{(0.05)}$		1.910	1.719	1.951
Significant level		*	*	*
CV (%)		10.74	12.08	16.12

* - Significant at 5% level

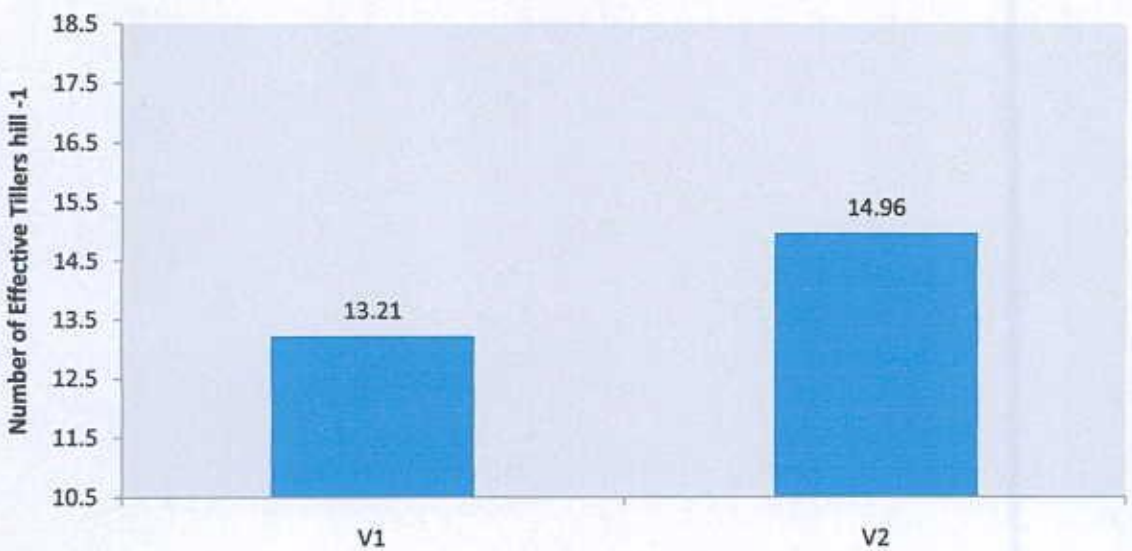
V_1 – Binasail, V_2 - BRRI dhan46

T_0 = Control (No nitrogen applied), **T_1**= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), **T_2** = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), **T_3** = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), **T_4**= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), **T_5** = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), **T_6** = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), **T_7**= $IF_{100\%}$ (100% N from urea of the RD was applied)

Due to the interaction of variety and different organic and inorganic fertilizers combination number of leaves hill^{-1} significantly varied at 30, 60 and 90 DAT (Table 6). At 30 DAT highest number of leaves hill^{-1} was found in V_2T_2 (57.93) which was statistically similar to V_1T_3 (57.93), V_1T_7 (56.47) and V_2T_1 (58.07). At 60 DAT, the highest number of leaves hill^{-1} was recorded in V_2T_2(51.60) which was closely followed by and statistically similar with V_1T_3(50.60). At 90 DAT the highest number of leaves hill^{-1} was showed by V_2T_2(48.13) which was statistically similar to V_1T_3 (46.87) and V_2T_3(47.00). At all growth stages V_1T_0 showed the lowest number of leaves hill^{-1}.

4.4 Number of Effective Tillers

At different growth stages number of effective tillers hill^{-1} varied significantly among two rice cultivars (Figure 04 and Appendix VIII). BRRI dhan46 produced the highest number of effective tillers hill^{-1} among the two varieties (14.96) while Binasail produced comparatively lowest number of effective tillers hill^{-1} (13.21).These results match with the findings of Roy *et al.* (2014) who reported that effective tillers hill^{-1} differed among the varieties.



V_1 – Binasail, V_2 - BRRI dhan46

Figure 04. Effect of variety on number of effective tillers hill^{-1}(mean of eight treatments)

Number of effective tillers hill^{-1} differs significantly due to various combinations of organic and inorganic fertilizers (Table 7). T_2 showed the highest number of effective tillers hill^{-1} (15.63) which was statistically similar to T_4 (14.33) and T_5 (14.40) whereas T_0 (13.30) showed the lowest number of effective tillers hill^{-1}. Combination of organic and inorganic fertilizers was found better for number of effective by Umanah *et al.* (2003) in upland rice and Channabasavanna (2003) in wetland rice than only inorganic fertilizers.

Table 7. Effect of different combinations of organic and inorganic fertilizer on number of effective and non-effective tillers hill^{-1} (mean of two varieties)

Treatments	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}
T_0	13.30 b	2.200 a
T_1	13.83 b	1.533 f
T_2	15.63 a	1.300 g
T_3	13.70 b	1.800 c
T_4	14.33 ab	2.033 b
T_5	14.40 ab	1.667 e
T_6	13.47 b	2.033 b
T_7	14.00 b	1.733 d
LSD $_{(0.05)}$	1.295	0.04664
Significant level	*	*
CV (%)	16.58	31.67

* - Significant at 5% level

T_0 = Control (No nitrogen applied), **T_1**= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), **T_2** = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), **T_3** = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), **T_4**= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), **T_5** = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), **T_6** = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), **T_7**= $IF_{100\%}$ (100% N from urea of the RD was applied)

Table 8. Interaction effect of variety and different organic and inorganic fertilizers combination on number of effective tillers hill-1, number of non-effective tillers hill^{-1} and panicle length (cm)

Treatments		Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle Length (cm)
Variety	Combination of organic and inorganic fertilizer			
V_1	T_0	12.80 h	3.000 a	22.03 d
	T_1	13.00 gh	0.9333 l	24.19 abc
	T_2	14.80 cd	0.9333 l	23.08 bcd
	T_3	13.13 gh	1.267 k	23.83 abc
	T_4	14.27 de	1.800 g	23.79 abc
	T_5	13.60 fg	1.400 j	22.65 cd
	T_6	14.13 ef	1.467 i	22.90 bcd
	T_7	14.13 ef	1.267 k	23.15 abcd
V_2	T_0	12.80 h	2.600 b	22.76 cd
	T_1	13.07 gh	1.667 h	23.31 abcd
	T_2	18.13 a	0.6667 m	24.74 a
	T_3	13.13 gh	2.333 d	23.24 abcd
	T_4	13.87 ef	2.267 e	24.40 ab
	T_5	15.73 b	2.400 c	23.73 abc
	T_6	14.87 c	2.400 c	23.50 abcd
	T_7	13.87 ef	2.200 f	23.81 abc
$LSD_{(0.05)}$		0.5629	0.05629	1.492
Significant level		*	*	*
CV (%)		16.58	31.67	4.76

* - Significant at 5% level

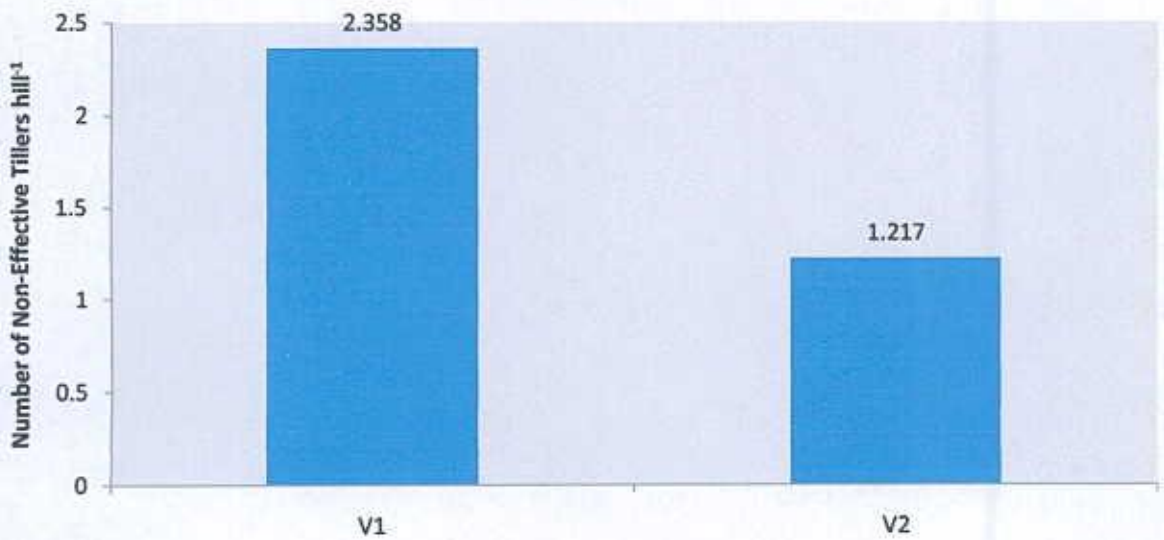
V_1 – Binasail, V_2 - BRRI dhan46

T_0 = Control (No nitrogen applied), **T_1**= $PM_{25\%}+IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), **T_2** = $PM_{50\%}+IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), **T_3** = $PM_{75\%}+IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), **T_4**= $MOC_{25\%}+IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), **T_5** = $MOC_{50\%}+IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), **T_6** = $MOC_{75\%}+IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), **T_7**= $IF_{100\%}$ (100% N from urea of the RD was applied)

Due to the interaction of variety and different organic and inorganic fertilizers combination number of effective tillers hill^{-1}significantly varied (Table 8). The highest number of effective tillers hill^{-1}was found in V_2T_2 (18.13) whereas the lowest number of effective tillers hill^{-1} was found in V_1T_0 (12.80) which is statistically similar with V_1T_1 (13.00), V_1T_3 (13.13), V_2T_0 (12.80), V_2T_1 (13.07) and V_2T_3 (13.13).Islam *et al* (2007) was observed that level of mustard oil cake significantly influenced the number of effective tillers hill^{-1}.

4.5 Number of Non-Effective Tillers

At different growth stages number of non-effective tillers hill^{-1} varied significantly among two rice cultivars (Figure 05 and Appendix VIII). Binasail produced the highest number of non-effective tillers hill^{-1} among the two varieties (2.358) while BRRI dhan46 produced comparatively lowest number of non-effective tillers hill^{-1} (1.217). Debnath (2010) and Ashrafuzzman (2006) also observed that varieties differed insignificantly in respect of number of non-effective tillers m^{-2} though Ahmed (2006) found significant effect between inbred and hybrid varieties in respect of number of non-effective tillers m^{-2}.



V_1 – Binasail, V_2 - BRRI dhan46

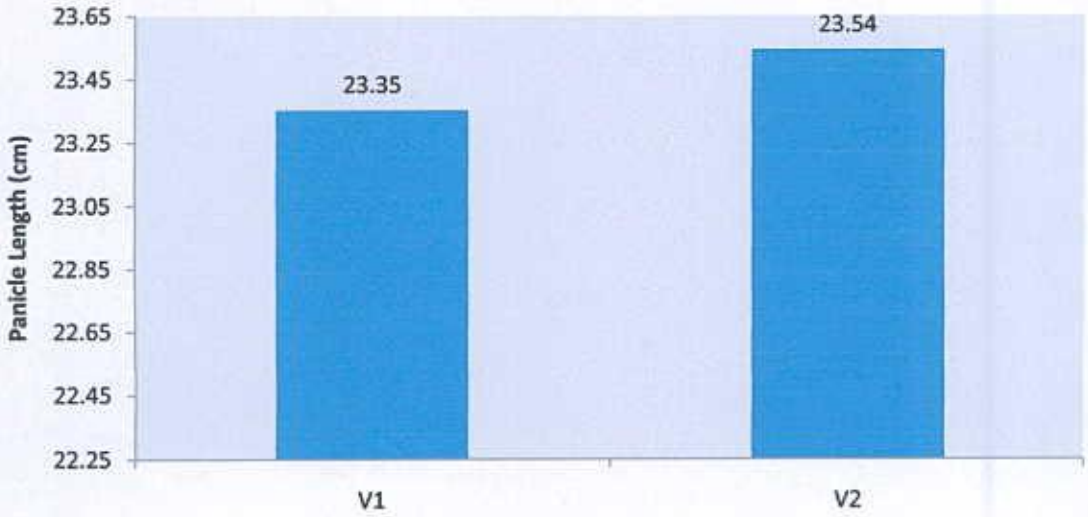
Figure 05. Effect of variety on number of non-effective tillers hill^{-1}(mean of eight treatments)

Number of non-effective tillers hill^{-1}differ significantly due to various combinations of organic and inorganic fertilizers (Table 7). T_0 showed the highest number of non-effective tillers hill^{-1} (2.200) whereas T_2 (1.300) showed the lowest number of non-effective tillers hill^{-1}.

Due to the interaction of variety and different organic and inorganic fertilizers combination number of non-effective tillers hill^{-1}significantly varied (Table 8). The highest number of non-effective tillers hill^{-1}was found in V_1T_0 (3.000) whereas the lowest number of non-effective tillers hill^{-1} was found in V_2T_2 (0.6667).

4.6 Panicle Length

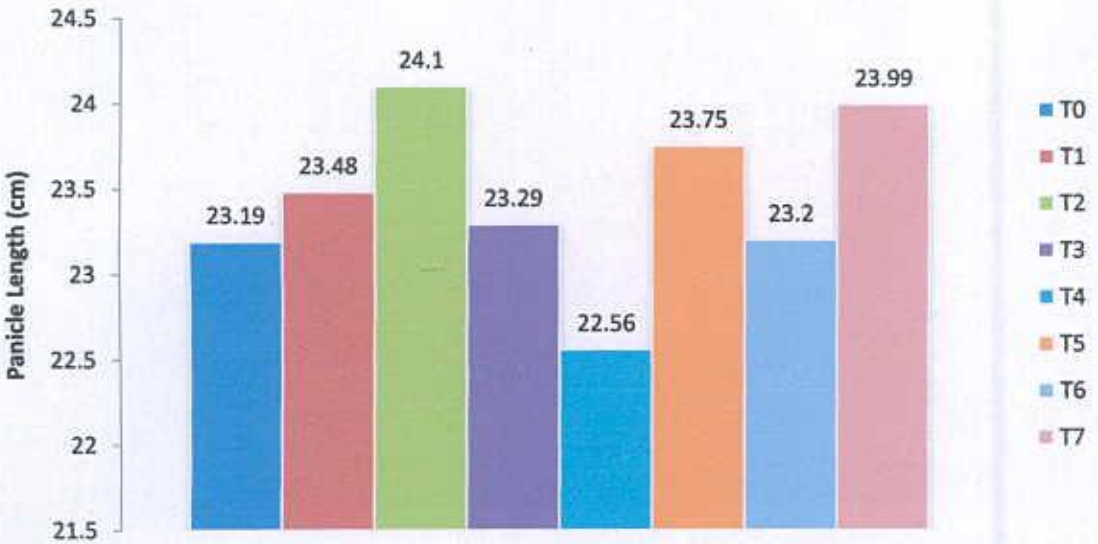
At different growth stages panicle length (cm) varied significantly among two rice cultivars (Figure 06 and Appendix IX). The panicle length (cm) of aman rice was statistically insignificant and hence was not influenced by different varieties. Numerically maximum panicle length was observed in the V_2 (BRRI dhan46) and the minimum panicle length was obtained from the variety V_1 (Binasail). Alam *et al.* (2012) found that BR11 have higher panicle length than BRRI dhan32 and BRRI dhan33.



V_1 – Binasail, V_2 - BRRI dhan46

Figure 06. Effect of variety on panicle length (cm) (mean of eight treatments)

Panicle length (cm) differs significantly due to various combinations of organic and inorganic fertilizers (Figure 07 and Appendix X). T_2 showed the highest Panicle length (24.10 cm) which was statistically similar to T_7 (23.99 cm) whereas T_0 (23.19 cm) showed the lowest Panicle length which was statistically similar to T_3 (23.29 cm) and T_6 (23.20 cm). Dwivedi *et al.* (2006) observed that the increase panicle length due to application of increased rates of organic and inorganic fertilizers.



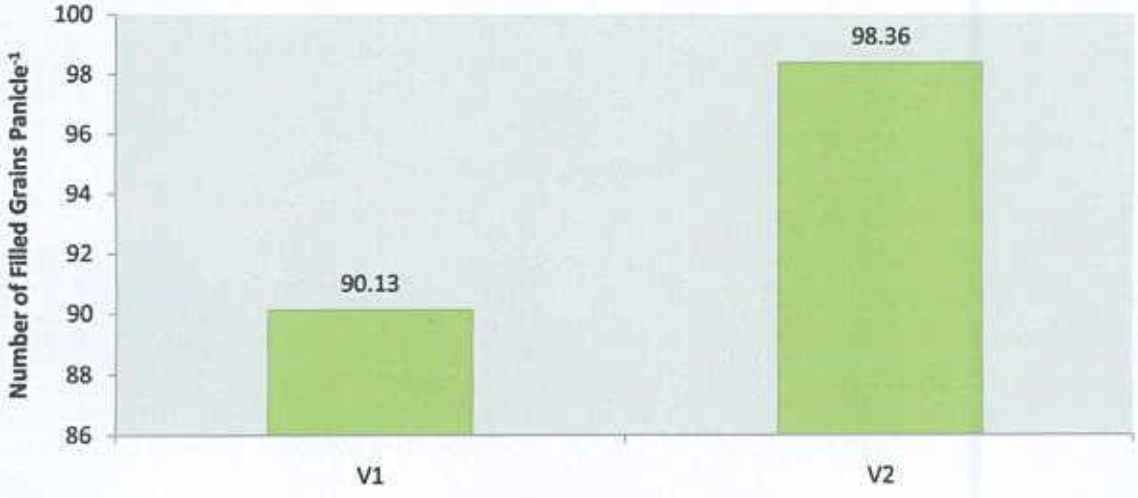
T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied)

Figure 07. Effect of different combinations of organic and inorganic fertilizer on panicle length (cm) (mean of two varieties)

Due to the interaction of variety and different organic and inorganic fertilizers combination panicle length significantly varied (Table 8). The highest panicle length was found in V_2T_2 (24.74 cm) which is statistically similar with all except V_1T_0 (22.03 cm), V_1T_2 (23.08 cm), V_1T_5 (22.65 cm), V_1T_6 (22.90 cm) and V_2T_0 (22.76 cm) whereas the lowest panicle length was found in V_1T_0 (22.03 cm). Ahmed and Rahman (1991) reported that application of organic manure and chemical fertilizers increased the panicle length of rice. Reddy and Kumar (2007) was observed that the combination of 50 percent N through urea and 50 percent N through different organic sources (farmyard manure, poultry manure and neem cake) produced significantly longer panicles.

4.7 Number of Filled Grains

At different growth stages number of filled grains panicle^{-1} varied significantly among two rice cultivars (Figure 08 and Appendix IX). BRRI dhan46 produced the highest number of filled grains panicle^{-1} among the two varieties (98.36) while Binasail produced comparatively lowest number of filled grains panicle^{-1} (90.13). BRRI (2006) studied the performance of BR14, Pajam, BR5 and Tulsimala and reported that Tulsimala produced the highest number of filled grains panicle^{-1} and BR14 produced the lowest number of filled grains panicle^{-1}.

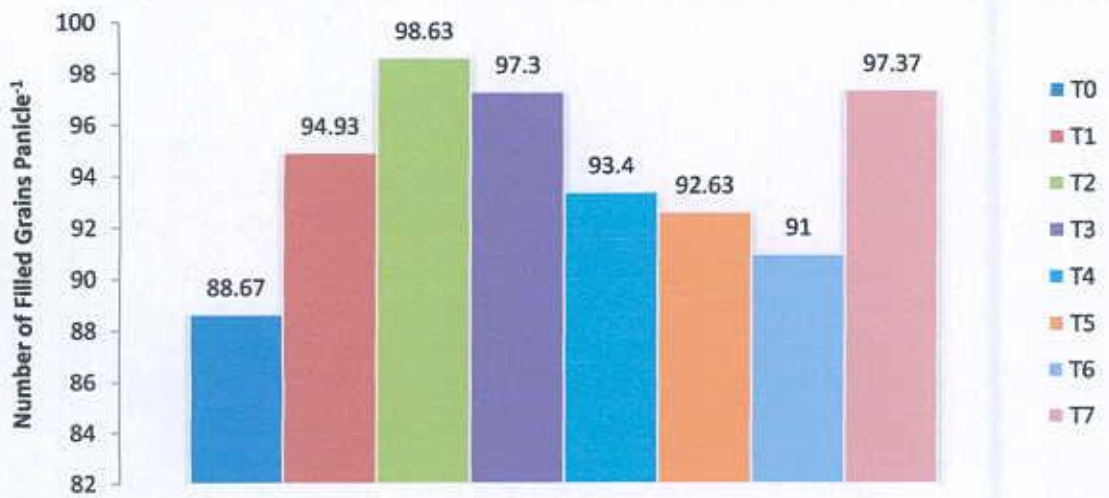


V_1 – Binasail, V_2 - BRRI dhan46

Figure 08. Effect of variety on number of filled grains panicle^{-1} (mean of eight treatments)

Number of filled grains panicle^{-1}differs significantly due to various combinations of organic and inorganic fertilizers (Figure 09 and Appendix X). T_2 showed the highest number of filled grains panicle^{-1}(98.63) which was statistically similar to T_3 (97.30) and T_7 (97.37) whereas T_0 (88.67) showed the lowest number of filled grains panicle^{-1}. Reddy and Kumar (2007) was observed that the combination of 50 percent N through urea and 50 percent N through different organic sources (farmyard manure, poultry manure and neem cake) produced significantly greater number of grains panicle^{-1}.

Due to the interaction of variety and different organic and inorganic fertilizers combination number of filled grains panicle^{-1}significantly varied (Table 9). The highest number of filled grains panicle^{-1}was found in V_2T_2 (113.1) which is statistically similar with V_1T_3 (111.5) whereas the lowest number of filled grains panicle^{-1}was found in V_2T_0 (84.40). Umanah *et al.* (2003) find out the effect of different rates of poultry manure on the growth, yield component and yield of upland rice and observed that significant differences in grain number/panicle.



T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied)

Figure 09. Effect of different combinations of organic and inorganic fertilizer on number of filled grains panicle^{-1} (mean of two varieties)

Table 9. Interaction effect of variety and different organic and inorganic fertilizers combination on number of filled grains panicle^{-1}, number unfilled grains panicle^{-1} and 1000 grain weight (g)

Treatments		Number of Filled Grains Panicle^{-1}	Number of Unfilled Grains Panicle^{-1}	1000 Grain Weight (g)
Variety	Combination of organic and inorganic fertilizer			
V_1	T_0	85.73 g	39.20 b	15.93 d
	T_1	81.67 gh	38.33 bc	16.70 d
	T_2	101.1 bc	15.93 h	25.80 ab
	T_3	111.5 a	21.80 f	25.50 ab
	T_4	81.80 gh	37.27 bcd	17.57 d
	T_5	104.1 b	36.00 d	16.87 d
	T_6	99.47 bcd	21.93 f	16.20 d
	T_7	91.47 f	16.20 h	15.70 d
V_2	T_0	84.40 g	41.33 a	16.00 d
	T_1	93.53 ef	37.00 cd	25.17 ab
	T_2	113.1 a	12.13 i	26.43 a
	T_3	85.80 g	18.47 g	24.10 b
	T_4	93.80 def	24.27 e	25.17 ab
	T_5	97.60 cde	18.47 g	26.27 a
	T_6	77.87 h	22.20 f	16.47 d
	T_7	105.0 b	15.67 h	19.70 c
$LSD_{(0.05)}$		5.498	1.911	1.936
Significant level		*	*	*
CV (%)		23.70	50.56	7.74

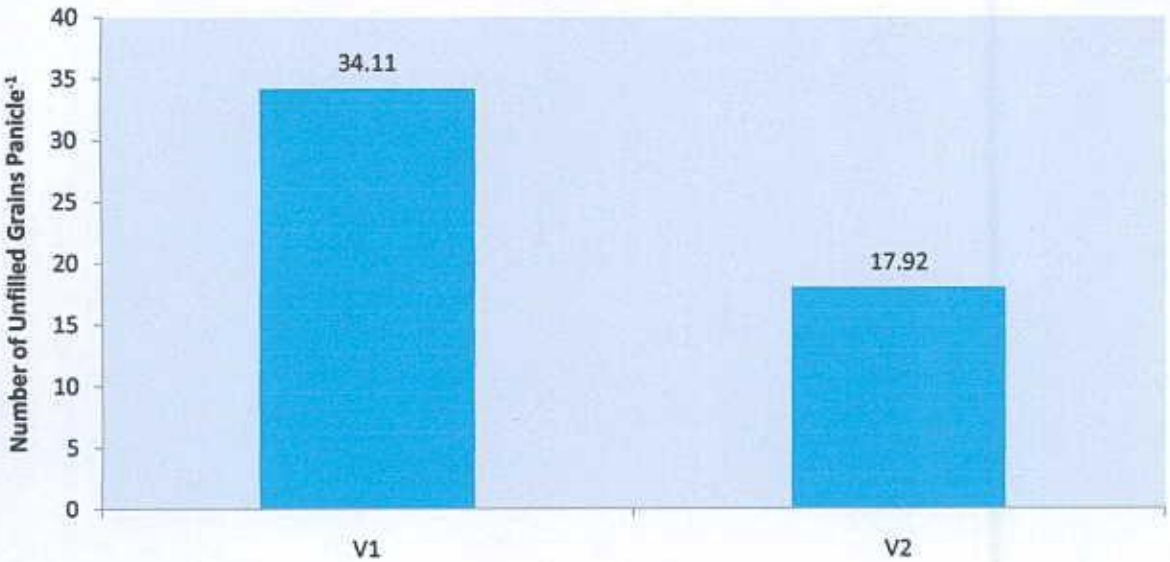
* - Significant at 5% level

V_1 – Binasail, V_2 - BRRI dhan46

T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied)

4.8 Number of Unfilled Grains

At different growth stages number of unfilled grains panicle^{-1} varied significantly among two rice cultivars (Figure 10 and Appendix IX). Binasail produced the highest number of unfilled grains panicle^{-1} among the two varieties (34.11) while BRRI dhan46 produced comparatively lowest number of unfilled grains panicle^{-1} (17.92).Shimizu and Kumo (1967) reported a wide range of abnormal spikelets, all of which were induced under the low temperature treatments at the young panicle primordial differentiation stage. As the temperature in Bangladesh is lower in December it induced in increased sterile grain.



V_1 – Binasail, V_2 - BRRI dhan46

Figure 10. Effect of variety on number of unfilled grains panicle^{-1} (mean of eight treatments)

Number of unfilled grains panicle^{-1} differs significantly due to various combinations of organic and inorganic fertilizers (Figure 11 and Appendix X). T_0 showed the highest number of unfilled grains panicle^{-1}(32.80) whereas T_2 (20.13) showed the lowest number of unfilled grains panicle^{-1}.

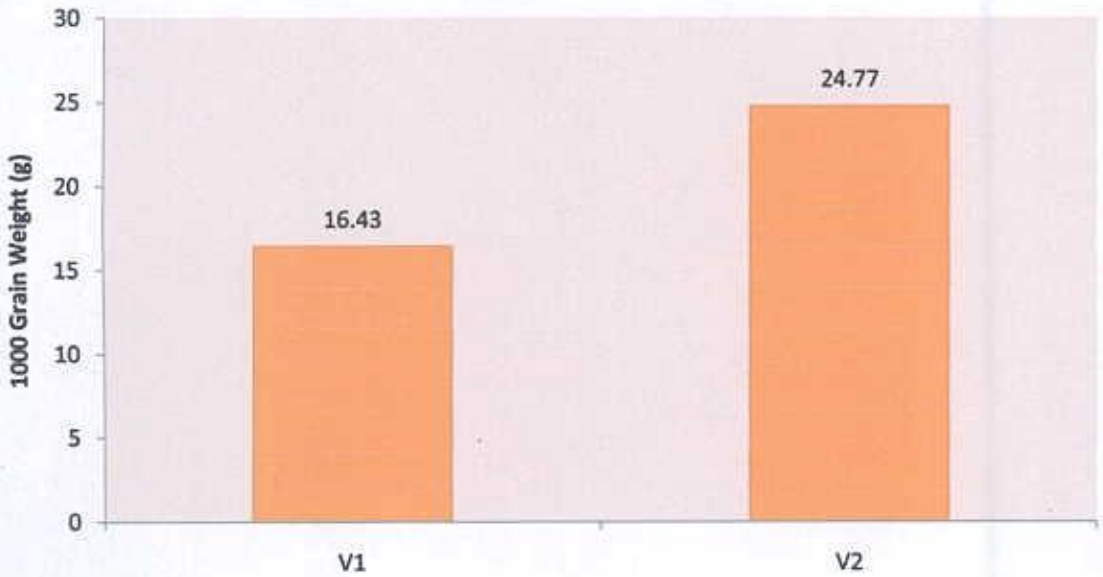
Due to the interaction of variety and different organic and inorganic fertilizers combination number of unfilled grains panicle^{-1} significantly varied (Table 9). The highest number of unfilled grains panicle^{-1} was found in V_2T_0 (41.33) whereas the lowest number of unfilled grains panicle^{-1} was found in V_2T_2 (12.13).

T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied)

Figure 11. Effect of different combinations of organic and inorganic fertilizer on number of unfilled grains panicle^{-1} (mean of two varieties)

4.9 Weight of 1000 Grain

At different growth stages 1000 grain weight (g) varied significantly among the two rice cultivars (Figure 12 and Appendix IX). BRRI dhan46 produced the highest 1000 grain weight (g) among the two varieties (24.77 g) while Binasail produced comparatively lowest 1000 grain weight (g) (16.43 g). Alam *et al.* (2012) found that BR11 have higher 1000 grain weight than BRRI dhan32 and BRRI dhan33.

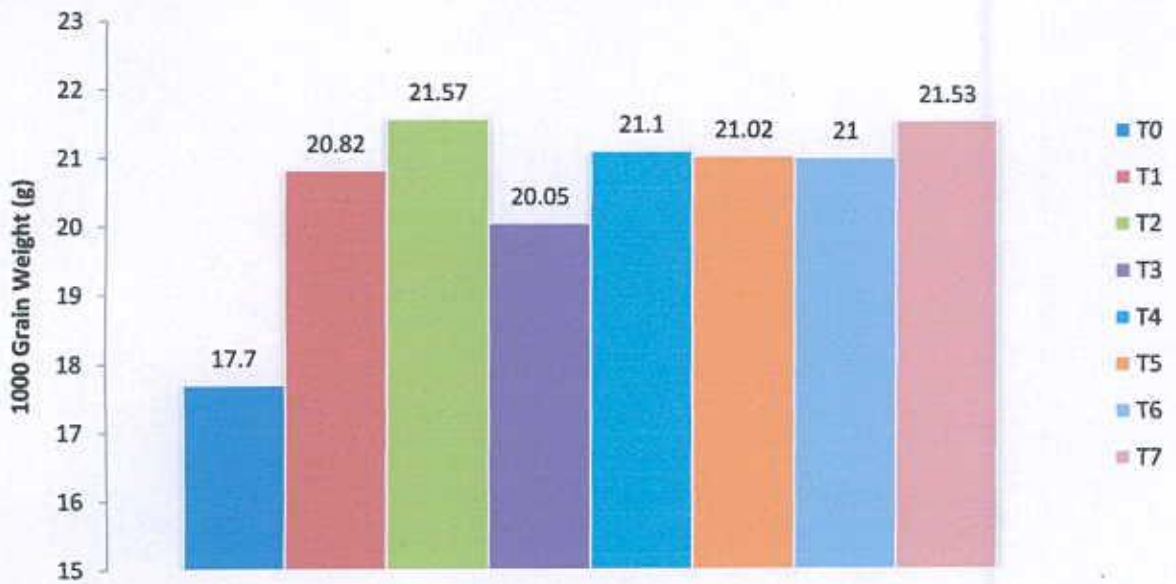


V_1 – Binasail, V_2 - BRRI dhan46

Figure 12. Effect of variety on number of 1000 grain weight (g) (mean of eight treatments)

1000 grain weight (g) differ significantly due to various combinations of organic and inorganic fertilizers (Figure 13 and Appendix X). T_2 showed the highest 1000 grain weight (g) (21.57 g) which was statistically similar to T_7 (21.53 g) whereas T_0 (17.70) showed the lowest 1000 grain weight (g). Umanah *et al.* (2003) find out the effect of different rates of poultry manure on the growth, yield component and yield of upland rice and showed that there was no significant difference among the treatments for 1000 grain weight.

Due to the interaction of variety and different organic and inorganic fertilizers combination 1000 grain weight (g) significantly varied (Table 9). The highest 1000 grain weight (g) was found in V_2T_2 (26.43 g) which is statistically similar with V_1T_2 (25.80 g), V_1T_3 (25.50 g),V_2T_1 (25.17 g) and V_2T_4 (25.17 g) whereas the lowest 1000 grain weight (g) was found in V_1T_0 (15.93 g).

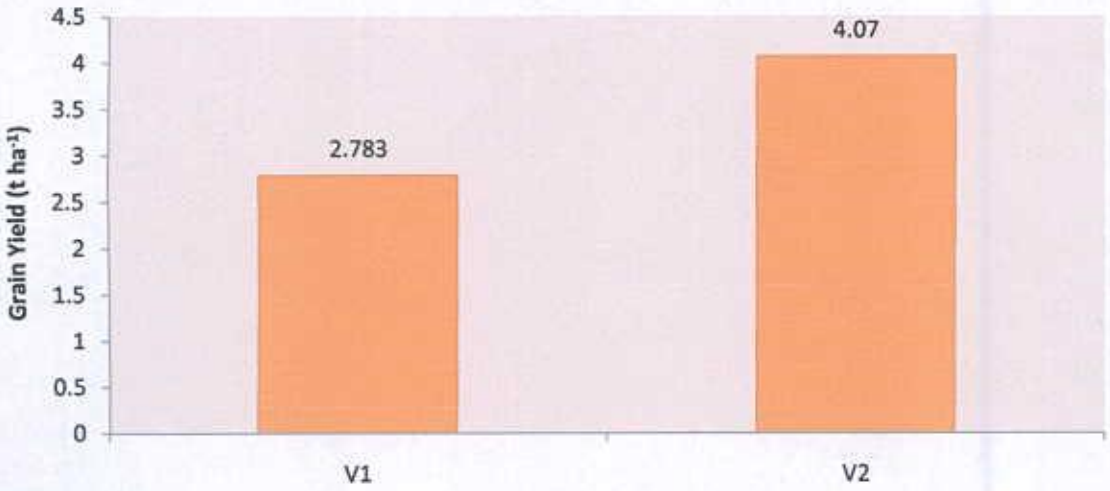


T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied)

Figure 13. Effect of different combinations of organic and inorganic fertilizer on 1000 grain weight (g) (mean of two varieties)

4.10 Grain Yield

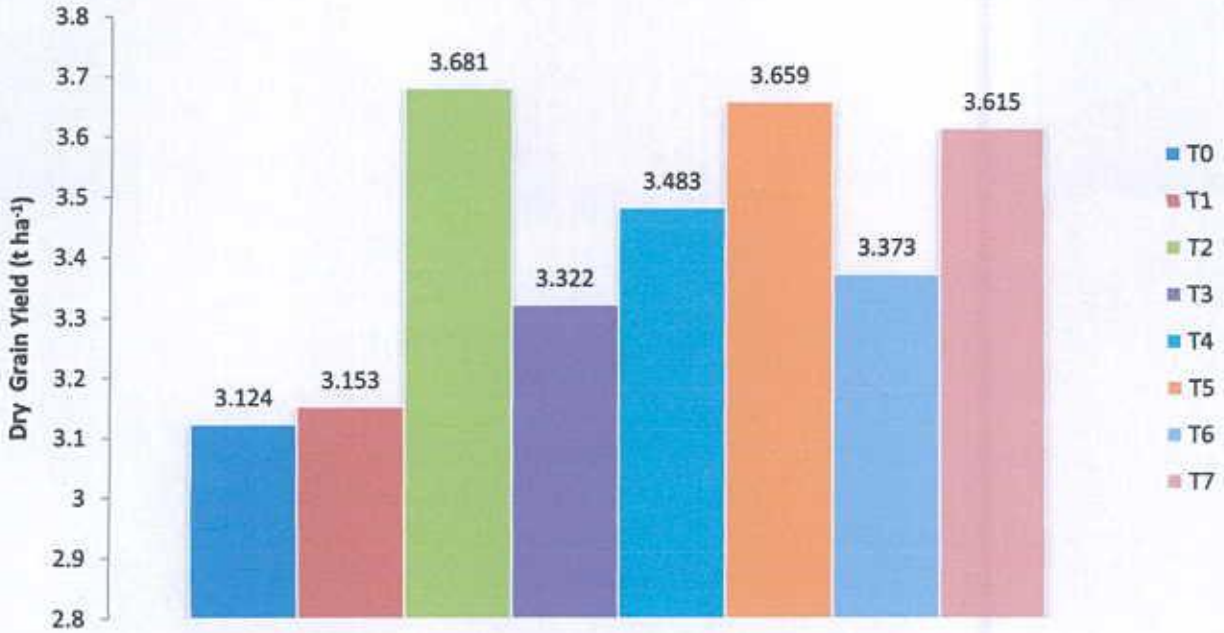
At different growth stages grain yield (t ha^{-1}) varied significantly among the two rice cultivars (Figure 14 and Appendix IX). BRRI dhan46 produced the highest grain yield (t ha^{-1}) among the two varieties (4.070 t ha^{-1}) while Binasail produced comparatively lowest grain yield (2.783 t ha^{-1}). Alam *et al.* (2012) found that the yield components (tillers $hill^{-1}$, effective tillers $hill^{-1}$, panicle *length*, weight of 1000 grain and grain yield) except number of fertile spikelets $panicle^{-1}$ were highest in case of variety BR11 and hence it produced the highest grain yield (5.92 t ha^{-1}) than BRRI dhan32 and BRRI dhan33.



V_1 – Binasail, V_2 - BRRI dhan46

Figure 14. Effect of variety on grain yield (t ha^{-1}) (mean of eight treatments)

Grain yield (t ha^{-1}) differs significantly due to various combinations of organic and inorganic fertilizers (Figure 15 and Appendix X). T_2 showed the highest grain yield (3.681 t ha^{-1}) which was statistically similar to T_4 (3.483 t ha^{-1}), T_5 (3.659 t ha^{-1}) and T_7 (3.615 t ha^{-1}) whereas T_0 (3.124 t ha^{-1}) showed the lowest grain yield. Vanaja and Raju (2002) conducted a field experiment on integrated nutrient management practice in rice crop and observed that different combinations of chemical fertilizer with poultry manure (PM) 2 t ha^{-1} gave highest grain yield. Umanah *et al.* (2003) find out the effect of different rates of poultry manure on the growth, yield component and yield of upland rice and showed that there was a significant difference in dry grain yield.



T_0 = Control (No nitrogen applied), T_1= PM25%+IF75% (25% N as poultry manure and 75% N as urea of the RD* was applied), T_2 = PM50%+IF50% (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = PM75%+IF25% (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= MOC25%+IF75% (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = MOC50%+IF50% (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = MOC75%+IF25% (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= IF100% (100% N from urea of the RD was applied)
*RD – Recommended Dose

Figure 15. Effect of different combinations of organic and inorganic fertilizer on grain yield (t ha^{-1}) (mean of two varieties)

Table 10. Interaction effect of variety and different organic and inorganic fertilizers combination on grain yield (t ha^{-1}) and straw yield (t ha^{-1})

Treatments		Grain Yield (t ha^{-1})	Straw Yield (t ha^{-1})
Variety	Combination of organic and inorganic fertilizer		
V_1	T_0	2.141 e	3.843 d
	T_1	3.051 bcde	3.725 d
	T_2	3.520 abcde	4.033 d
	T_3	2.816 cde	3.975 d
	T_4	2.405 cde	3.271 d
	T_5	3.520 abcde	3.828 d
	T_6	2.523 cde	3.535 d
	T_7	3.799 abcd	3.447 d
V_2	T_0	2.288 de	7.304 c
	T_1	3.256 bcde	9.651 ab
	T_2	4.943 a	11.19 a
	T_3	3.841 abcd	10.71 ab
	T_4	4.561 ab	10.27 ab
	T_5	3.931 abc	10.93 ab
	T_6	3.725 abcde	7.553 c
	T_7	4.503 ab	9.372 b
$LSD_{(0.05)}$		1.496	1.615
Significant level		*	*
CV (%)		28.08	29.71

* - Significant at 5% level

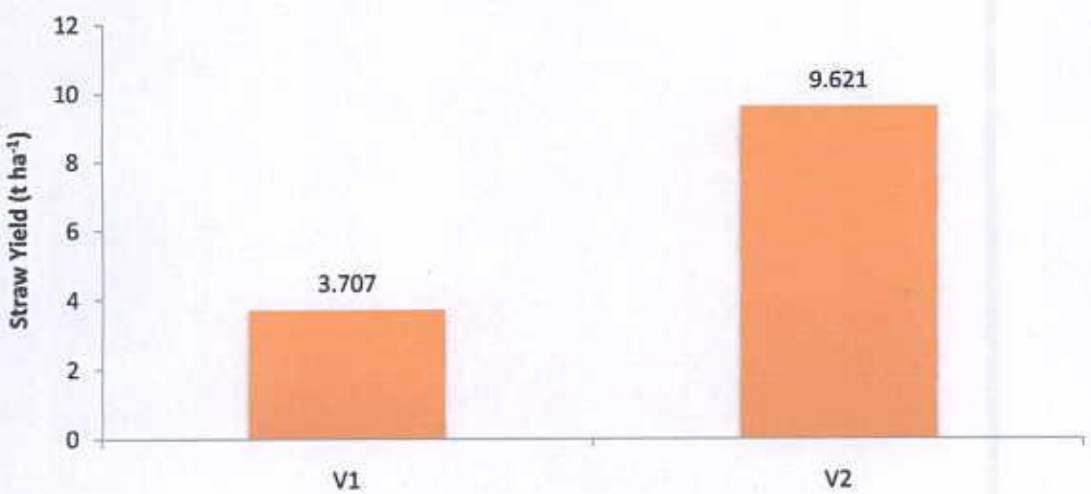
V_1 – Binasail, V_2 - BRRI dhan46

T_0 = Control (No nitrogen applied), **T_1**= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), **T_2** = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), **T_3** = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), **T_4**= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), **T_5** = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), **T_6** = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), **T_7**= $IF_{100\%}$ (100% N from urea of the RD was applied)

Due to the interaction of variety and different organic and inorganic fertilizers combination grain yield (t ha^{-1}) significantly varied (Table 10). The highest grain yield (t ha^{-1}) was found in V_2T_2 (4.943 t ha^{-1}) which is statistically similar to all except V_1T_1(3.051 t ha^{-1}), V_1T_3 (2.816 t ha^{-1}), V_1T_4 (2.405 t ha^{-1}),V_1T_6 (2.523 t ha^{-1}), V_2T_0 (2.288 t ha^{-1}) and V_2T_1 (3.256 t ha^{-1}) whereas the lowest grain yield (t ha^{-1}) was found in V_1T_0 (2.141 t ha^{-1}). Mahavishnan *et al.* (2004) conducted a field study on the effect of nutrient management through organic and inorganic sources on the yield of rice. They found that the yield and yield contributing components were higher with the application of 125% recommended doses of fertilizer RDF + poultry manure (PM) compared to other treatments.

4.11 Straw Yield

At different growth stages straw yield (t ha^{-1}) varied significantly among the two rice cultivars (Figure 16 and Appendix IX). BRRI dhan46 produced the highest straw yield among the two varieties (9.621 t ha^{-1}) while Binasail produced comparatively lowest straw yield (3.707 t ha^{-1}). M.B. Islam *et al.* (2013) observed that the highest straw yield was found from BR11 and lowest from BRRI dhan33. BRRI dhan46 showed statistically similar result with BR11 for all cases. This result was in agreement with the finding of Patel (2000) who reported that yield performance varied with variety.

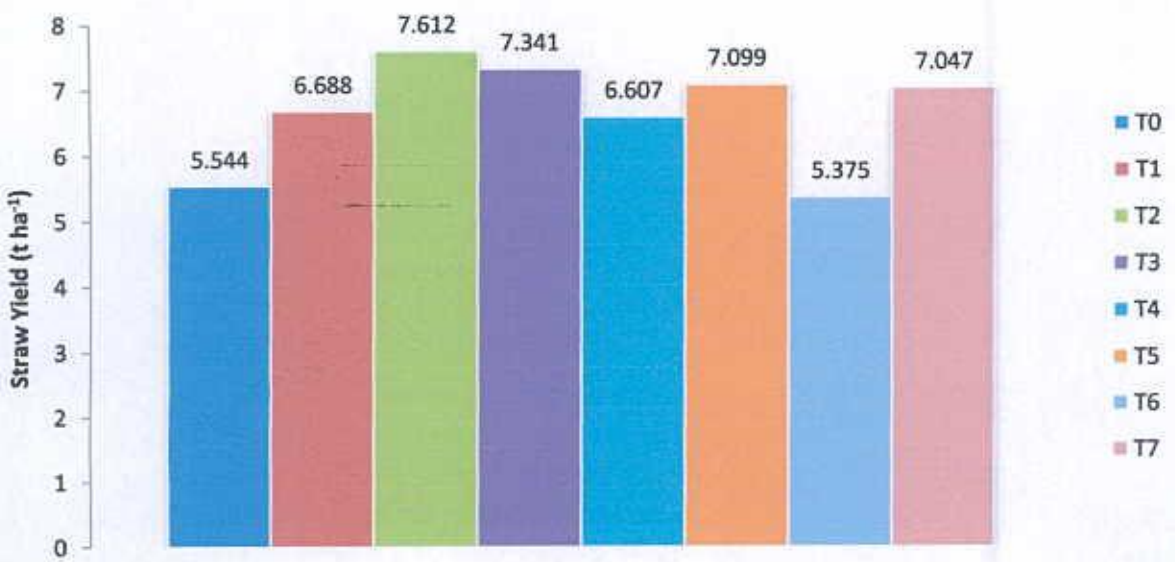


V_1 – Binasail, V_2 - BRRI dhan46

Figure 16. Effect of variety on straw yield (t ha^{-1}) (mean of eight treatments)

Straw yield (t ha^{-1}) differs significantly due to various combinations of organic and inorganic fertilizers (Figure 17 and Appendix X). T_2 showed the highest straw yield (7.612 t ha^{-1}) which was statistically similar to T_3 (7.341 t ha^{-1}), T_5 (7.099 t ha^{-1}) and T_7 (7.047 t ha^{-1}) whereas T_0 (5.544 t ha^{-1}) showed the lowest straw yield. Vanaja and Raju (2002) conducted a field experiment on integrated nutrient management practice in rice crop and observed that different combinations of chemical fertilizer with poultry manure (PM) 2 t ha^{-1} gave highest straw yield.

Due to the interaction of variety and different organic and inorganic fertilizers combination straw yield (t ha^{-1}) significantly varied (Table 10). The highest straw yield was found in V_2T_2 (11.19 t ha^{-1}) which is statistically similar with V_2T_1 (9.651 t ha^{-1}), V_2T_3 (10.71 t ha^{-1}), V_2T_4 (10.27 t ha^{-1}) and V_2T_5 (10.93 t ha^{-1}) whereas the lowest straw yield was found in V_1T_4 (3.271 t ha^{-1}). Ahmed and Rahman (1991) reported that the application of organic matter and chemical fertilizers straw yields of rice



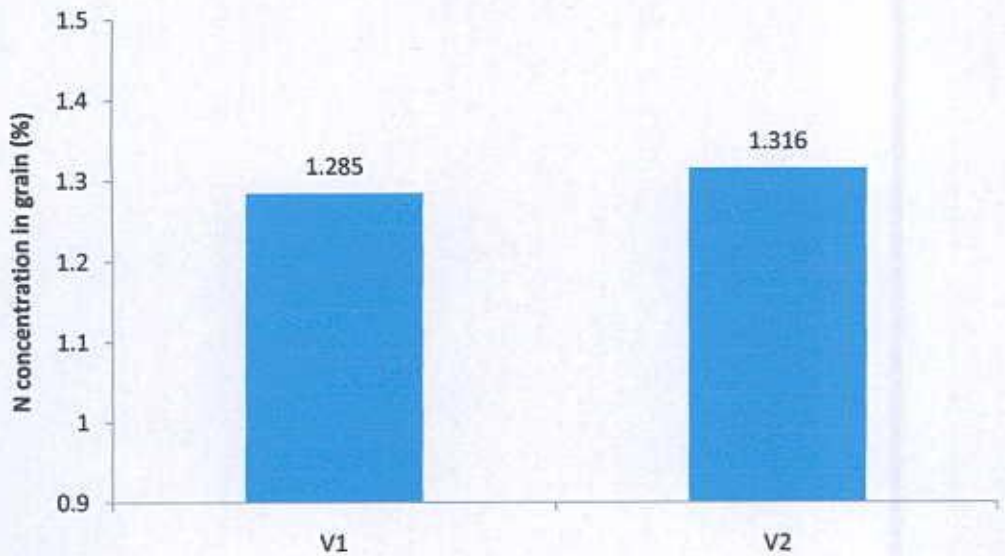
T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied)

Figure 17. Effect of different combinations of organic and inorganic fertilizer on straw yield (t ha^{-1}) (mean of two varieties)

4.12 Chemical Composition

4.12.1 N content in grain

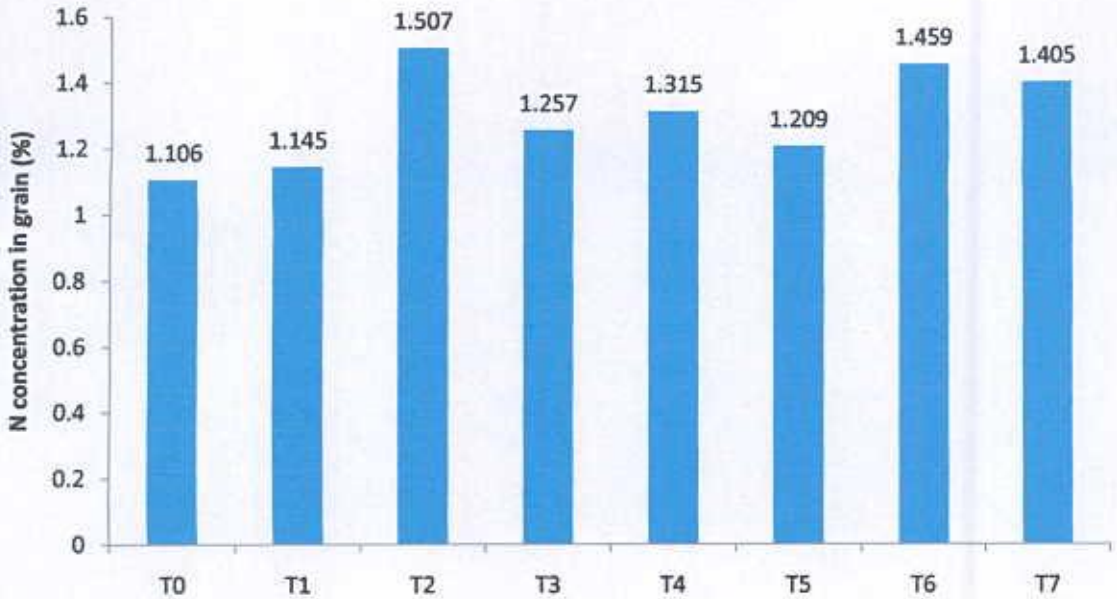
N content in grain showed statistically non-significant difference due to the varieties (Figure 18 and Appendix IX). Numerically the highest N content (1.316 %) was observed in grain from the variety V_2 (BRRI dhan46) and the lowest amount of N (1.285 %) found in grain for the variety V_1(*Binasail*).



V_1 – Binasail, V_2 - BRRI dhan46

Figure 18. Effect of variety on N content in grain (mean of eight treatments)

It was observed from the results presented in Figure 19 and Appendix X that, various combinations of organic and inorganic fertilizers have significant influence on N content in grain. The highest N content (1.507 %) in grain was observed from T_2 treatment while T_0 gave the lowest result (1.106 %).



T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied)

Figure 19. Effect of different combinations of organic and inorganic fertilizer on N content in grain (mean of two varieties)

N content in grain varied significantly due to the interaction effect of variety and different organic and inorganic fertilizers combination (Table 11). The highest N content in grain (1.531 %) was observed from V_2T_2 while the lowest result (1.071 %) was recorded from V_1T_0.

Table 11. Interaction effect of variety and different organic and inorganic fertilizers combination on N, P and K content in grain

Treatments		N concentration in grain (%)	P concentration in grain (%)	K concentration in grain (%)
Variety	Combination of organic and inorganic fertilizer			
V_1	T_0	1.071 i	0.1957 ef	0.2624 h
	T_1	1.149 gh	0.1815 fg	0.2990 fg
	T_2	1.264 f	0.2703 ab	0.5390 a
	T_3	1.337 e	0.2437 bc	0.3123 fg
	T_4	1.355 de	0.2333 cd	0.4090 d
	T_5	1.484 b	0.1807 fg	0.2990 fg
	T_6	1.437 c	0.2483 bc	0.4990 b
	T_7	1.429 c	0.1650 g	0.4523 c
V_2	T_0	1.154 gh	0.1650 g	0.3218 fg
	T_1	1.142 h	0.1711 fg	0.3290 f
	T_2	1.531 a	0.2920 a	0.5490 a
	T_3	1.178 g	0.1627 g	0.2890 gh
	T_4	1.275 f	0.2483 bc	0.4857 b
	T_5	1.142 h	0.1783 fg	0.3690 e
	T_6	1.481 b	0.2620 bc	0.4957 b
	T_7	1.380 d	0.2137 de	0.4090 d
$LSD_{(0.05)}$		0.02928	0.02724	0.03172
Significant level		*	*	*
CV (%)		1.36	2.61	1.59

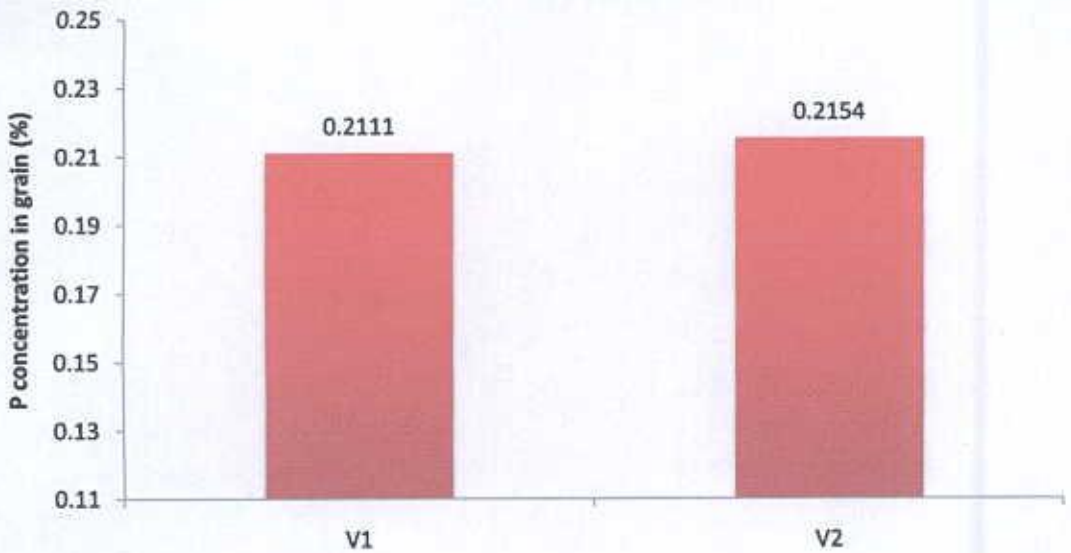
* - Significant at 5% level

V_1 – Binasail, V_2 - BRRI dhan46

T_0 = Control (No nitrogen applied), **T_1**= $PM_{25\%}+IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), **T_2** = $PM_{50\%}+IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), **T_3** = $PM_{75\%}+IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), **T_4**= $MOC_{25\%}+IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), **T_5** = $MOC_{50\%}+IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), **T_6** = $MOC_{75\%}+IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), **T_7**= $IF_{100\%}$ (100% N from urea of the RD was applied)

4.12.2 P content in grain

P content in grain showed statistically non-significant difference due to the varieties (Figure 20 and Appendix IX). Numerically the highest P content (0.2154 %) was observed in grain from the variety V_2 (BRRI dhan46) and the lowest amount of P (0.2111 %) found in grain for the variety V_1 (Binasail).

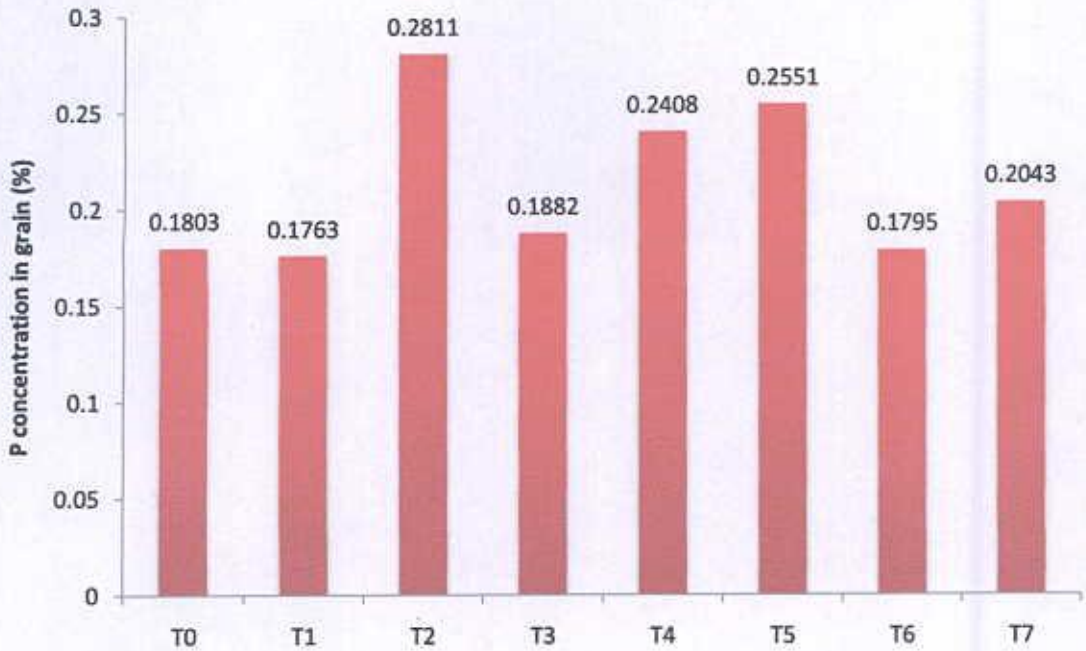


V_1 – Binasail, V_2 - BRRI dhan46

Figure 20. Effect of variety on P content in grain (mean of eight treatments)

It was observed from the results presented in Figure 21 and Appendix X that, various combinations of organic and inorganic fertilizers have significant influence on P content in grain. The highest P content (0.2811 %) in grain was observed from T_2 treatment which is statistically similar with T_5 (0.2551 %) while T_0 gave the lowest result (0.1803 %) which is statistically similar with all except T_2 (0.2811 %) and T_5 (0.2551 %).

P content in grain varied significantly due to the interaction effect of variety and different organic and inorganic fertilizers combination (Table 11). The highest P content in grain (0.2920 %) was observed from V_2T_2 which is statistically similar with V_1T_2 (0.2703 %) while the lowest result (0.1650 %) was recorded from V_2T_0.

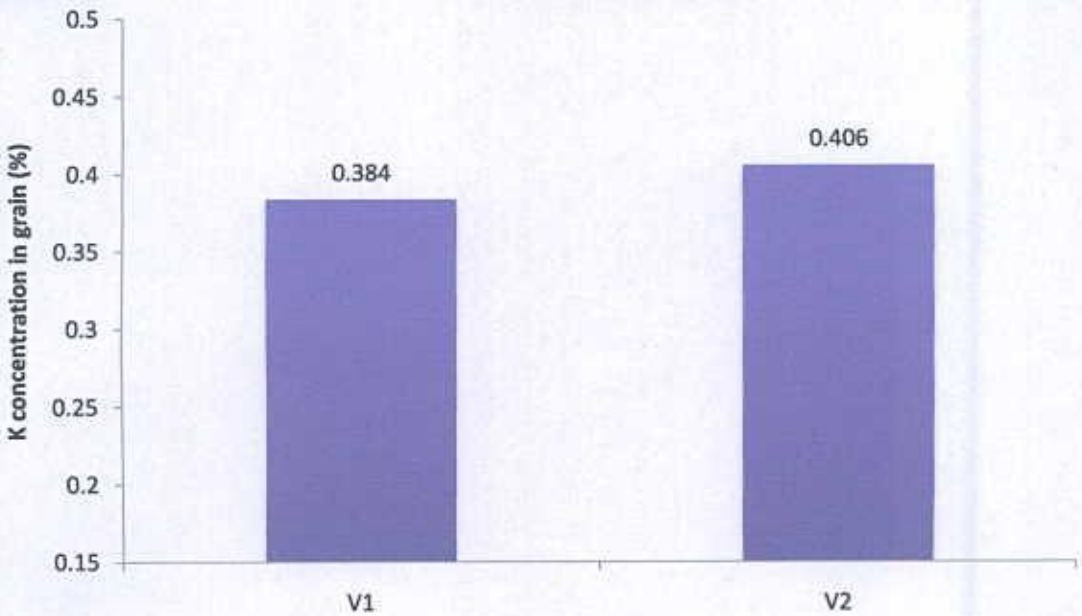


T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied)

Figure 21. Effect of different combinations of organic and inorganic fertilizer on P content in grain (mean of two varieties)

4.12.3 K content in grain

K content in grain showed statistically non-significant difference due to the varieties (Figure 22 and Appendix IX). Numerically the highest K content (0.4060 %) was observed in grain from the variety V_2 (BRRI dhan46) and the lowest amount of K (0.3840 %) found in grain for the variety V_1 (Binasail).

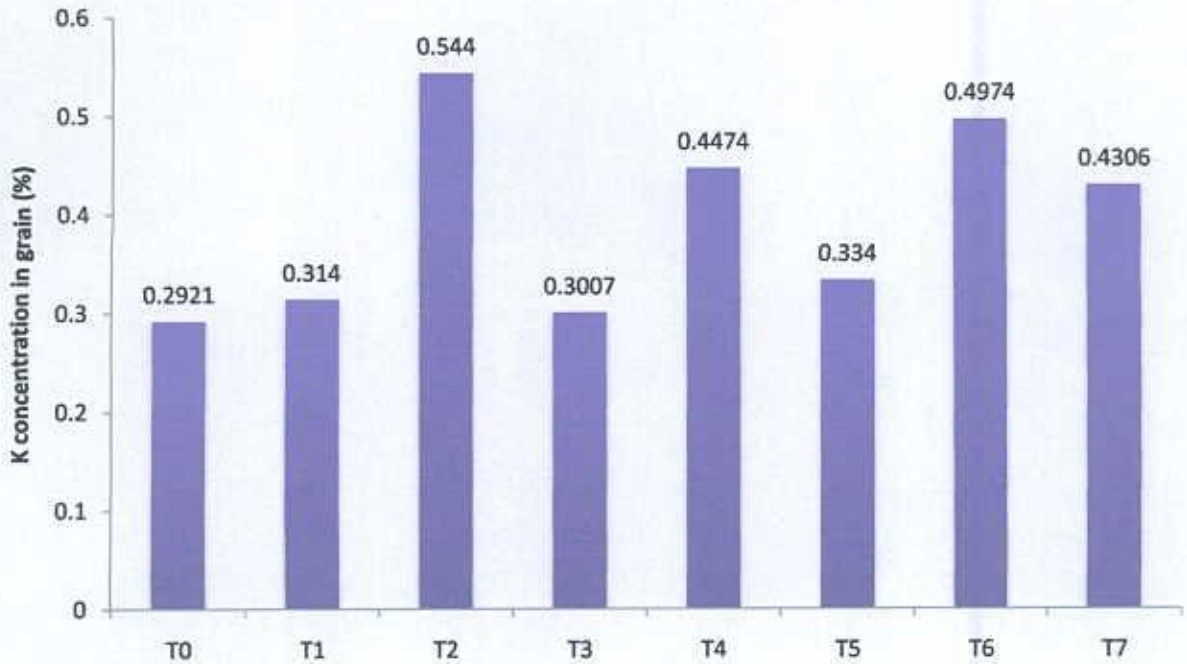


V_1 – Binasail, V_2 - BRRI dhan46

Figure 22. Effect of variety on K conent in grain (mean of eight treatments)

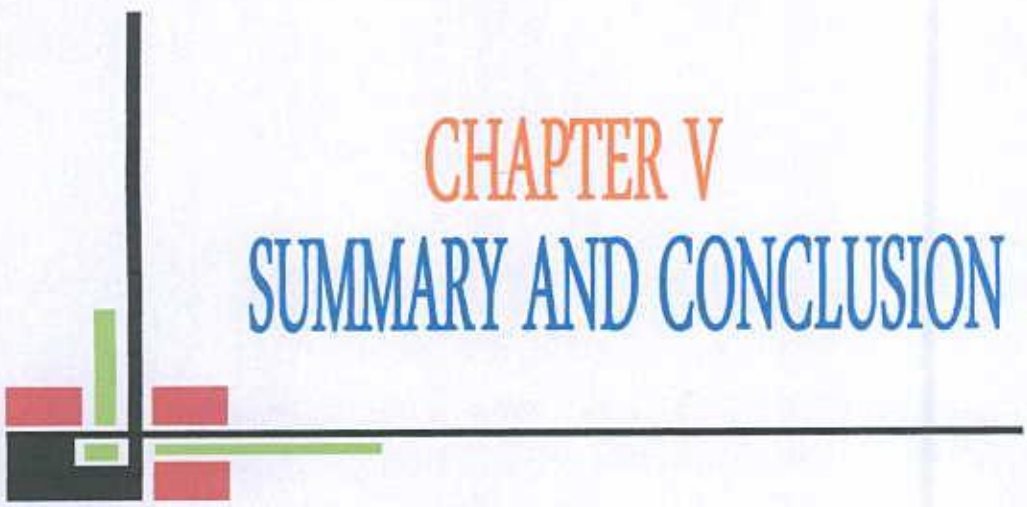
It was observed from the results presented in Figure 23 and Appendix X that, various combinations of organic and inorganic fertilizers have significant influence on K content in grain. The highest K content (0.5440 %) in grain was observed from T_2 treatment while T_0 gave the lowest result (0.2921 %).

K content in grain varied significantly due to the interaction effect of variety and different organic and inorganic fertilizers combination (Table 11). The highest K content in grain (0.5490 %) was observed from V_2T_2 which is statistically similar with V_1T_2 (0.5390 %) while the lowest result (0.2624 %) was recorded from V_1T_0.



T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied)

Figure 23. Effect of different combinations of organic and inorganic fertilizer on K content in grain (mean of two varieties)



CHAPTER V
SUMMARY AND CONCLUSION

Chapter 5

SUMMARY AND CONCLUSIONS

The experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Dhaka-1207 during the period from July to December, 2013 to find out the effect of combined application of different organic and inorganic nitrogenous fertilizers on the growth, yield and nutrient content in two aman rice cultivars. The two factorial experiment was laid out in a RCBD design with three replications. Factor A : two varieties [V_1-Binasail, V_2-BRRI dhan46], and factor B : different combinations of organic and inorganic nitrogenous fertilizer doses [$\mathbf{T_0}$ = Control (No nitrogen), $\mathbf{T_1}$= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea was applied), $\mathbf{T_2}$ = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea was applied), $\mathbf{T_3}$ = $PM_{75\%}$ + $IF_{25\%}$ (75% N as poultry manure and 25% N as urea was applied), $\mathbf{T_4}$= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea was applied), $\mathbf{T_5}$ = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea was applied), $\mathbf{T_6}$ = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea was applied), $\mathbf{T_7}$= $IF_{100\%}$ (100% N from urea was applied)].

Growth and yield parameters varied significantly most of the time due to varietal differences. At 30 DAT BRRI dhan46 showed higher plant than Binasail. But due to varietal variation At 60 and 90 DAT Binasail produced the taller plant among the two. Numerically maximum number of tillers hill^{-1}, number of leaves hill^{-1} at 30, 60 and 90 DAT was observed in BRRI dhan46. BRRI dhan46 produced the highest number of effective tillers hill^{-1} among the two varieties. Binasail produced the highest number of non-effective tillers hill^{-1} among the two varieties (2.358) while BRRI dhan46 produced comparatively lowest number of non-effective tillers hill^{-1} (1.217). The panicle length (cm) of aman rice was statistically insignificant and hence was not influenced by different varieties. Though higher panicle length was observed in the BRRI dhan46. BRRI dhan46 produced the highest number of filled grains panicle^{-1} among the two varieties while Binasail produced the highest number of unfilled grains panicle^{-1}. BRRI dhan46 produced the highest 1000 grain weight, highest grain yield and highest straw yield among the two varieties. N, P and K content in grain did not vary significantly between the varieties. Numerically the highest N, P and K content (1.316 %) was observed in grain from the variety BRRI dhan46.

Different combinations of organic and inorganic nitrogenous fertilizers affected significantly the various growth, yield parameters and nutrient content of rice grain. At 30, 60 and 90 DAT plant height T_2 showed the highest plant height and T_0 showed the lowest plant height. At 30 and 60 DAT, T_2 showed the highest number of tillers hill^{-1}. T_0 showed the lowest number of tillers hill^{-1}at 30 and 60 DAT 14.9and 13.5 respectively). At 90 DAT the production of total number of tillers hill^{-1} of aman rice was statistically insignificant .Numerically maximum number of tillers hill^{-1} at 90 DAT was observed in the T_2 and the minimum number of tillers hill^{-1} was obtained from the T_0 treatment. At 30, 60 and 90 DAT T_2 showed the highest number of leaves hill^{-1}. At 30, 60 and 90 DAT. T_2 showed the highest number of effective tillers hill^{-1} which was statistically similar to $T_4$and $T_5$and T_0 showed the lowest effective tillers hill^{-1}. T_0 showed the highest number of non- effective tillers hill^{-1} whereas T_2 showed the lowest number of non-effective tillers hill^{-1}. T_2 showed the highest Panicle length while T_0 showed the lowest Panicle length. T_2produced the highest number of filled grains panicle^{-1}whereas T_0 showed the lowest number of filled grains panicle^{-1}. T_0produced the highest number of unfilled grains panicle^{-1}(32.80) whereas T_2produced the lowest number of unfilled grains panicle^{-1}. T_2 showed the highest 1000 grain weight, grain yield and straw yield whereas T_0gave the lowest results for these parameters. The highest N, P and K content in grain were observed from T_2 treatment while T_0 gave the lowest results.

Due to the interaction of variety and different organic and inorganic fertilizers combination; on plant height significantly varied at 30, 60 and 90 DAT. At 30 DAT highest plant height was found in V_2T_2. At 60 and 90 DAT, the highest plant height was recorded in V_1T_2. At all growth stages V_1T_0 showed the lowest plant height. At 30, 60and 90 DAT highest number of tillers hill^{-1}, number of leaves hill^{-1} was found in V_2T_2 and V_1T_0 showed the lowest results.The highest number of effective tillers hill^{-1}was found in V_2T_2 whereas the lowest number of effective tillers hill^{-1} was found in V_1T_0. The highest number of non-effective tillers hill^{-1}was found in V_1T_0 whereas the lowest number of non-effective tillers hill^{-1} was found in V_2T_2. The highest panicle length was found in V_2T_2 and lowest panicle length was found in V_1T_0. The highest number of filled grains panicle^{-1}was found in V_2T_2 which is statistically similar with $V_1T_3$and the lowest number of filled grains panicle^{-1}was found in V_2T_0. The highest number of unfilled grains

panicle^{-1}was found in $V_2T_0$and the lowest number of unfilled grains panicle^{-1}was found in V_2T_2. The highest 1000 grain weight, grain yield and straw yield was found in V_2T_2. The highest N content in grain was observed from V_2T_2 while the lowest result was recorded from V_1T_0. The highest P content in grain was observed from V_2T_2 which is statistically similar with V_1T_2 while the lowest result was recorded from V_2T_0.The highest K content in grain was observed from V_2T_2 which is statistically similar with V_1T_2 while the lowest result was recorded from V_1T_0.

From the above results it can be concluded that,

- BRRI dhan46 has better yield potential than Binasail in aman season.
- Combination of organic and inorganic fertilizers performed better than sole inorganic fertilizer. It was observed that 50% N as poultry manure and 50% N as urea produced highest grain and straw yield due to better yield contributing factors.
- In aman season if farmers adopt the variety BRRI dhan46 and apply 50% N as poultry manure and 50% N as urea then it will be helpful to increase the yield as well as to deplete the use of inorganic nitrogen fertilizer.

The following recommendations can be made:

- Such studies are needed to be performed in different AEZ's where aman rice is cultivated.
- Studies are needed to find out the grain protein content and other quality attributes of rice for such combinations of organic and inorganic fertilizers.
- Poultry feed contains heavy metals which is reported by different media and journals. Therefore the Poultry manure should also need to analyze.

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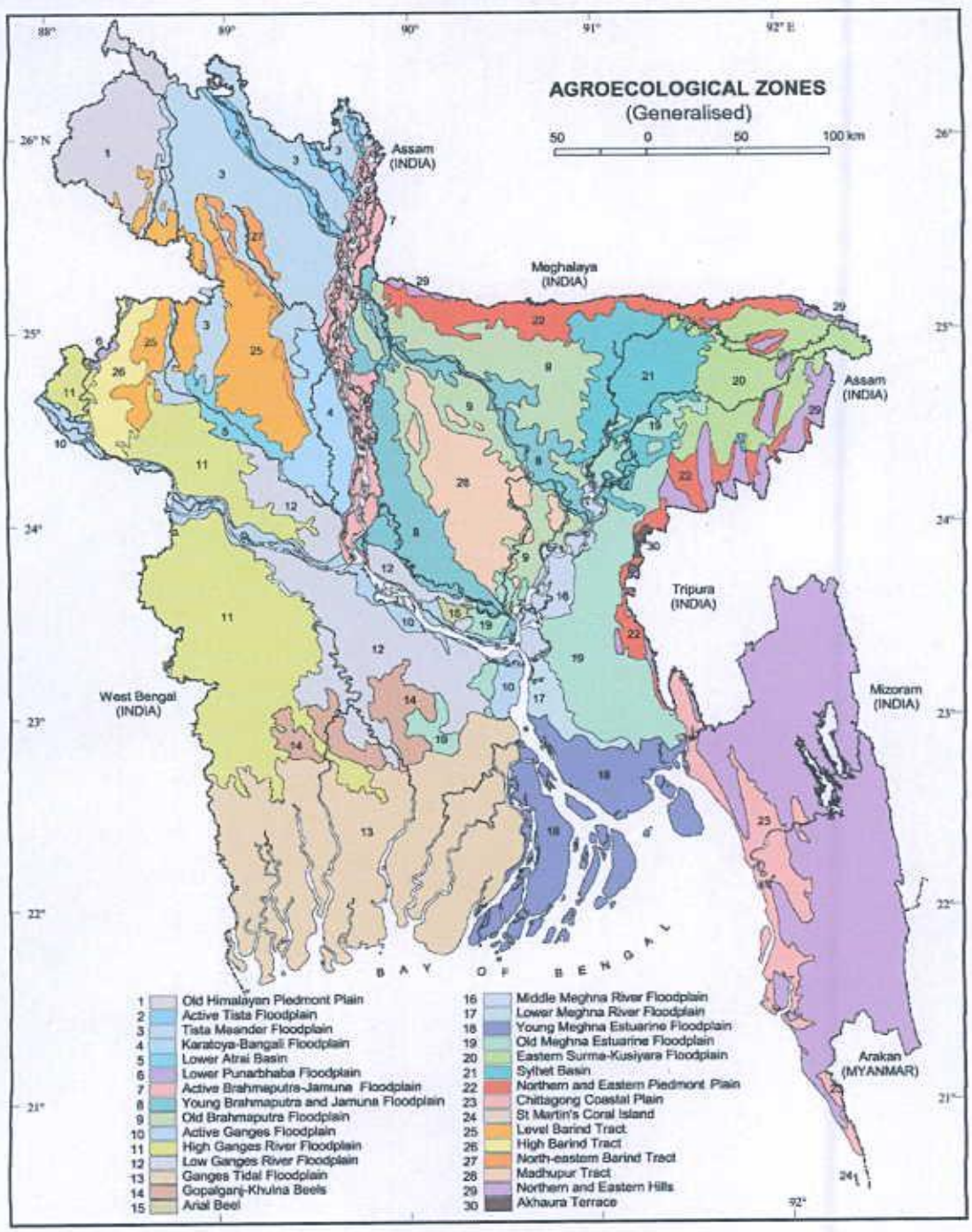
APPENDICES

APPENDICES

Appendix I. Experimental location on the map of Agro-ecological Zones of Bangladesh



Appendix II. Morphological characteristics of the experimental field

Morphology	Characteristics
Location	SAU Farm, Dhaka.
Agro-ecological zone	Madhupur Tract (AEZ- 28)
General Soil Type	Deep Red Brown Terrace Soil
Parent material	Madhupur Terrace.
Topography	Fairly level
Drainage	Well drained
Flood level	Above flood level

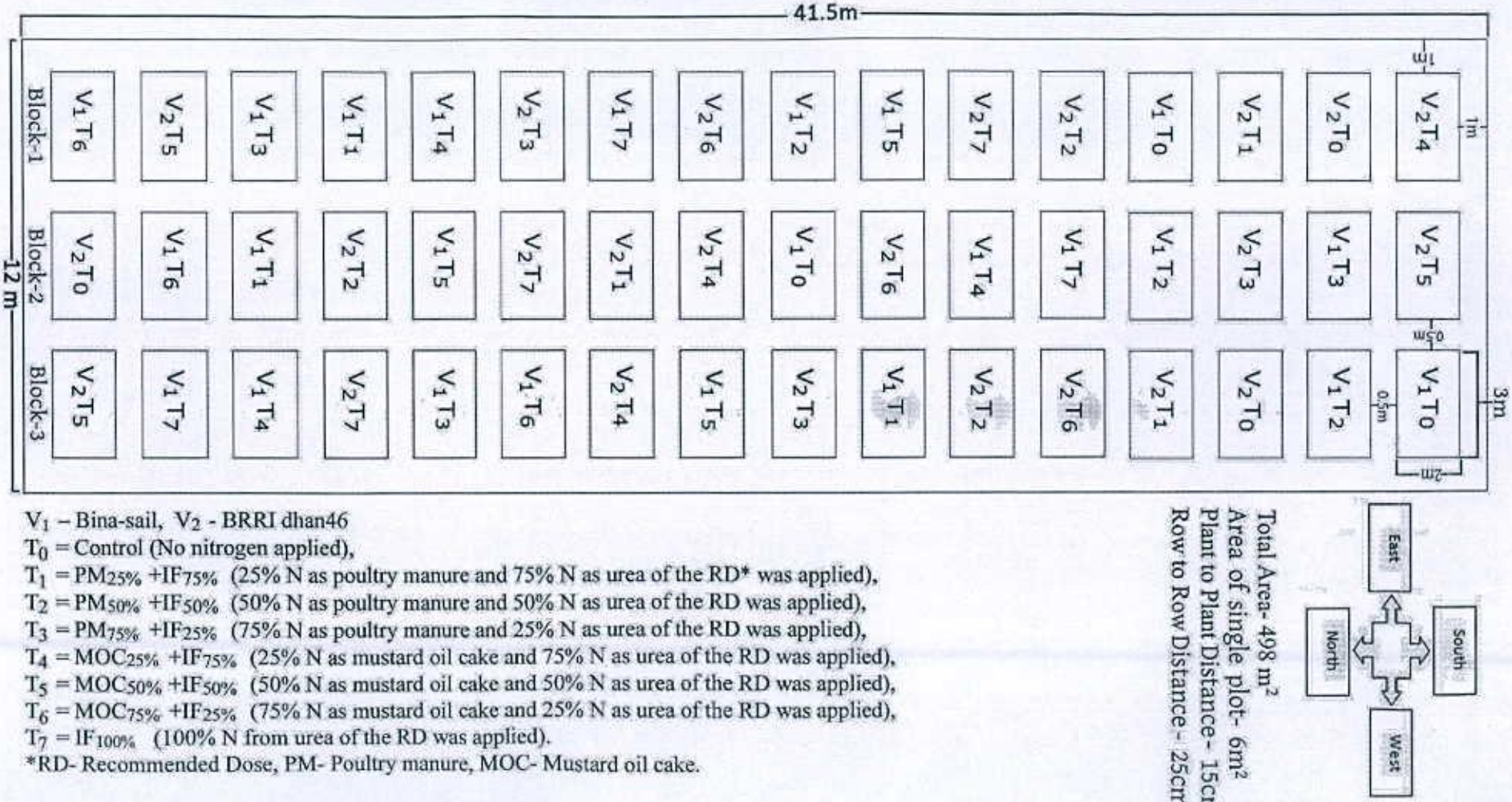
(SAU Farm, Dhaka)

Appendix III. Initial physical and chemical characteristics of the experimental field

Characteristics	Value
Physical properties: % Sand (2-0.02mm) % Silt (0.02-0.002mm) % Clay (>0.002mm)	 22.24 56.74 20.75
Textural class	Silt Loam
pH (Soil: water = 1: 2.5)	5.7
Organic Matter (%)	1.19
Total N (%)	0.08
Exchangeable K (c mol kg^{-1})	0.13
Available P (mg kg^{-1})	18.75
Available S (mg kg^{-1})	14.35

(SAU Farm, Dhaka)

Appendix IV. Layout of the experimental field



Total Area- 498 m^2
Area of single plot- 6m^2
Plant to Plant Distance- 15cm
Row to Row Distance- 25cm

V_1 – Bina-sail, V_2 - BRRI dhan46
T_0 = Control (No nitrogen applied),
T_1 = $PM_{25\%}$ +$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the RD* was applied),
T_2 = $PM_{50\%}$ +$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied),
T_3 = $PM_{75\%}$ +$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied),
T_4 = $MOC_{25\%}$ +$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied),
T_5 = $MOC_{50\%}$ +$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied),
T_6 = $MOC_{75\%}$ +$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied),
T_7 = $IF_{100\%}$ (100% N from urea of the RD was applied).
*RD- Recommended Dose, PM- Poultry manure, MOC- Mustard oil cake.

Appendix V. Analysis of variance of the data on plant height and number of tillers hill^{-1} of aman rice as influenced by varieties and different combinations of organic and inorganic fertilizer

Sources of variation	Degrees of freedom	Mean square			Mean square		
		Plant height (cm)			Number of tillers hill^{-1}		
		30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
Replication	2	588.626	105.986	30.663	15.476	6.256	11.021
Factor A (Variety)	1	6.901^{NS}	12.608*	3978.521*	5.070^{NS}	23.801^{NS}	0.141^{NS}
Factor B (Combination of organic & inorganic fertilizer)	7	64.369*	62.121*	53.823*	4.497*	2.321*	1.219*
A X B	7	28.419*	19.263*	45.866*	8.878*	3.744*	2.352*
Error	30	29.070	8.011	21.965	3.204	5.832	3.809

* Significant at 5% level

NS – Non-Significant.

Appendix VI. Analysis of variance of the data on number of leaves hill^{-1} of aman rice as influenced by varieties and different combinations of organic and inorganic fertilizer

Sources of variation	Degrees of freedom	Mean square		
		Number of leaves hill^{-1}		
		30 DAT	60 DAT	90 DAT
Replication	2	144.742	17.478	155.176
Factor A (Variety)	1	0.003^{NS}	14.520^{NS}	49.154^{NS}
Factor B (Combination of organic & inorganic fertilizer)	7	50.379*	15.630*	10.780*
A X B	7	60.603*	33.796*	26.464*
Error	30	31.177	31.382	38.163

* Significant at 5% level

NS – Non-Significant.

Appendix VII. Analysis of variance of the data for crop growth characters, yield and other crop characters of Binasail and BRRI dhan46 at harvest

Sources of Variation	Degrees of freedom	Mean square values										
		Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of filled grains panicle^{-1}	Number of unfilled grains panicle^{-1}	1000-grains weight (g)	Grain yield (t/ ha)	Straw yield (t/ha)	N (%) in grain	P (%) in grain	K (%) in grain
Replication	2	0.336	0.232	0.326	174.756	18.098	1.258	0.363	2.700	0.002	0.000	0.000
Factor A (Variety)	1	36.750*	15.641*	0.456^{NS}	813.453*	3146.041*	834.167*	19.871*	419.752*	0.026^{NS}	0.002^{NS}	0.004^{NS}
Factor B (Combination of organic & inorganic fertilizer)	7	3.236*	0.524*	1.501*	71.801*	85.451*	9.556*	0.289*	3.953*	0.139*	0.012*	0.055*
A × B	7	3.481*	0.287*	1.561*	574.764*	138.384*	5.720*	1.486*	2.892*	0.008*	0.002*	0.003*
Error	30	5.454	0.321	1.246	498.966	173.005	2.539	0.926	3.921	0.001	0.000	0.000

* Significant at 5% level

NS – Non Significant

Appendix VIII. Effect of variety on various growth and yield parameters of Aman rice cv. Binasail and BRRI dhan46 (mean of 8 treatments)

Treat-ments	Plant height (cm)			Number of tillers hill^{-1}			Number of leaves hill^{-1}			Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT		
V_1	64.07	114.5 a	123.9 a	16.52	13.82	13.32	51.99	45.83	42.60	13.21 b	2.358 a
V_2	64.82	100.6 b	105.7 b	17.17	15.23	13.43	52.01	46.92	44.38	14.96 a	1.217 b
$LSD_{0.05}$	2.518	3.080	2.206	2.206	3.305	2.215	3.763	4.308	3.836	0.8415	0.06454
CV %	8.37	3.92	4.82	10.63	16.62	14.59	10.74	12.08	16.12	16.58	31.67
Significant level	NS	*	*	NS	NS	NS	NS	NS	NS	*	*

V_1= Binasail, V_2= BRRI dhan46

* - Significant at 5 % level

NS- Non-significant

Appendix IX. Effect of variety on various growth, yield and nutrient content parameters of Aman rice cv. Binasail and BRRI dhan46 (mean of 8 treatments)

Treatments	Panicle length (cm)	Number of filled grains panicle^{-1}	Number of unfilled grains panicle^{-1}	1000 grain weight	Grain yield	Straw yield	N Conc. in grain (%)	P Conc. in grain (%)	K Conc. in grain (%)
V_1	23.35	90.13 b	34.11 a	16.43 b	2.783 b	3.707 b	1.285	0.2111	0.3840
V_2	23.54	98.36 a	17.92 b	24.77 a	4.070 a	9.621 a	1.316	0.2154	0.4060
$LSD_{0.05}$	2.161	4.307	4.814	2.395	1.180	3.051	0.1104	0.04478	0.03726
CV %	4.76	23.70	50.56	7.74	28.08	29.71	1.36	2.61	1.59
Significant level	NS	*	*	*	*	*	NS	NS	NS

V_1= Binasail, V_2= BRRI dhan46

* - Significant at 5 % level

NS- Non-significant.

Appendix X . Effect of different combinations of organic and inorganic fertilizer onvarious growth, yield and nutrient content parameters of Aman rice cv. Binasail and BRRI dhan46 (mean of 2 varieties)

Treatments	Panicle length (cm)	Number of filled grains panicle^{-1}	Number of unfilled grains panicle^{-1}	1000 grain weight	Grain yield	Straw yield	N Conc. in grain (%)	P Conc. in grain (%)	K Conc. in grain (%)
T_0	23.19 d	88.67 e	32.80 a	17.70 e	3.124 d	5.544 c	1.106 h	0.1803 c	0.2921 e
T_1	23.48 c	94.93 b	25.67 c	20.82 c	3.153 cd	6.688 b	1.145 g	0.1763 c	0.3140 de
T_2	24.10 a	98.63 a	20.13 e	21.57 a	3.681 a	7.612 a	1.507 a	0.2811 a	0.5440 a
T_3	23.29 d	97.30 a	27.13 b	20.05 d	3.322 bcd	7.341 ab	1.257 e	0.1882 c	0.3007 e
T_4	22.56 e	93.40 c	26.73 b	21.10 b	3.483 ab	6.607 b	1.315 d	0.2408 b	0.4474 c
T_5	23.75 b	92.63 c	22.07 d	21.02 bc	3.659 a	7.099 ab	1.209 f	0.2551 ab	0.3340 d
T_6	23.20 d	91.00 d	27.23 b	21.00 bc	3.373 bc	5.375 c	1.459 b	0.1795 c	0.4974 b
T_7	23.99 a	97.37 a	26.33 bc	21.53 a	3.615 a	7.047 ab	1.405 c	0.2043 c	0.4306 c
$LSD_{0.05}$	0.1189	1.438	1.003	0.2349	0.2243	0.7376	0.03638	0.02696	0.02325
CV %	4.76	23.70	50.56	7.74	28.08	29.71	1.36	2.61	1.59
Significant level	*	*	*	*	*	*	*	*	*

* - Significant at 5 % level

T_0 = Control (No nitrogen applied), T_1= $PM_{25\%}$+$IF_{75\%}$ (25% N as poultry manure and 75% N as urea of the recommended dose (RD) was applied), T_2 = $PM_{50\%}$+$IF_{50\%}$ (50% N as poultry manure and 50% N as urea of the RD was applied), T_3 = $PM_{75\%}$+$IF_{25\%}$ (75% N as poultry manure and 25% N as urea of the RD was applied), T_4= $MOC_{25\%}$+$IF_{75\%}$ (25% N as mustard oil cake and 75% N as urea of the RD was applied), T_5 = $MOC_{50\%}$+$IF_{50\%}$ (50% N as mustard oil cake and 50% N as urea of the RD was applied), T_6 = $MOC_{75\%}$+$IF_{25\%}$ (75% N as mustard oil cake and 25% N as urea of the RD was applied), T_7= $IF_{100\%}$ (100% N from urea of the RD was applied).