# EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON THE GROWTH AND YIELD OF BRRI DHAN 29

**BY**


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## CERTIFICATE

This is to certify that the thesis entitled "Effect of integrated nutrient management on the growth and yield of BRRI DHAN 29 " submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Soil Science, embodies the result of a piece of *bonafide* research work carried out by **Mohammad Kabirul Islam** Registration number: **11-04686** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

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Dedicated

to

My Beloved Parents

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# ABSTRACT


## EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON THE GROWTH AND YIELD OF BRRI DHAN 29

A field experiment was conducted to assess the effect of integrated nutrient management on the growth and yield of BRRIdhan29 at the research farm of Sher-e-Bangla Agricultural University, Dhaka-1207 during Boro season 2011-12. $T_5$ treatment produce the maximum grain yield of BRRIdhan29 due to the application of 100 kg N from urea along with 40 kg N/ha from cowdung. But the effect of cowdung along with nitrogenous fertilizer was the most pronounced than that of vermicompost or nitrogenous fertilizer alone. Similar effects were also observed on N, P, K content and their uptake by BRRI dhan29. The effect of 100 kg N from urea along with 40 kg N/ha from cowdung was statistically identical to treatments 140 kg N/ha from urea, 100 kg N from urea along with 20 kg N from cowdung and 20 kg N/ha as the source of vermicompost, 80 kg N from urea with the combiantion of 60 kg N/ha from cowdung, 80 kg N from urea with the combinaion of 60 kg N/ha as the source of vermicompost and 80 kg N from urea with the association of 30 kg N from cowdung along with 30 kg N/ha from vermicompost. In post harvest soils, the contents of organic matter, total nitrogen, available phosphorus and exchangeable potassium increased due to application of cowdung and vermicompost compared to initial soil. In the contrary, soil pH value decreased slightly as compared to that of initial soil. Application of urea-nitrogen alone slightly decreased the organic matter. The overall results indicate that 100 kg N from urea along with 40 kg N/ha as the source of cowdung was the best treatment in producing higher rice yield with sustenance of soil fertility.

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# CHAPTER 1

# INTRODUCTION

# CHAPTER I

## INTRODUCTION

Rice is the staple food of Bangladesh belongs to Gramineae family cultivated throughout all areas of Bangladesh covering about 80% of the total cropped area and it constitutes about 97% of the total cereal production of the country (Bari *et al.,* 1997). About 6.03 million hectares of land are used for rice cultivation, the total production was 26.53 million metric tons during 2005-2006 (BBS- 2006). Out of total rice production in this county about 45% comes from Aman and the rest 8% and 47% come from Aus and Boro crops, respectively (BBS, 2006). The total production of rice in Bangladesh is not sufficient to feed for the peoples of the country.

Integrated nutrient management is essential for carbohydrate use within plants and stimulates root growth and development as well as the uptake of other nutrients (Brady, 1990). Consistent and indiscriminate use of chemical fertilizers has caused serious damage to the soil health and ecology. There has been a gradual declining or stagnation trend in the yield almost all over the country which might be due to imbalance use of inorganic fertilizer, less use of organic manure such as cowdung, poultry manure, mustard oilcake and vermicompost. To get maximum yield through the application of organic and inorganic fertilizer is best option.

The organic manures viz. cowdung and vermicompost may be used as an alternative source of N which increases efficiency of applied N (Saravana *et al.*, 1987). Integrated use of organic manures with the combination of inorganic fertilizers can contribute to increase N content of rice soil as well as to increase long term productivity and enhancement of ecological sustainability (Gill and Meelu, 1982)

Combined application of cowdung and vermicompost along with chemical nitrogen fertilizer improves soil health and soil productivity but only use of nitrogenous fertilizer for a long period causes deterioration of physical condition and organic matter status and reduces crop yield. When cowdung and vermicompost are applied along with chemical fertilizers for efficient growth of crop, decline in organic carbon is arrested and the gap between potential yield and actual yield is bridged to large extent. (Rabindra *et al.*, 1985). Now a days, it is the demand of time to develop an integrated nutrient management program for higher crop yield and improved soil health ultimately increase the crop sustainability. Keeping these facts in mind the following objectives are undertaken:

1. To assess the effects of cowdung and vermicompost along with nitrogen as the source of urea on growth and yield of BRRIdhan29.
2. To evaluate the combined effect of cowdung and vemicompost with the combination of chemical nitrogen fertilizer on the nutrient uptake by BRRIdhan29.
3. To examine the effect of cowdung and vermicompost along with nitrogenous fertilizer on soil properties.

# CHAPTER 2
# REVIEW OF LITERATURE

# CHAPTER II

## REVIEW OF LITERATURE

A better understanding of the effects of organic and inorganic fertilizers on BRRIdhan29 in our soils will facilitate the development of suitable soil management practices for better production of the crops. This chapter includes the available information regarding the effect of cowdung and vermicompost along with chemical nitrogenous fertilizers on BRRIdhan29.

**Effect of Nitrogen on the Growth and Yield of Crop**

A field experiment was conducted in a typical lowland situation in farmer's field during the wet season of 1986. The results showed that the addition of N increased the number of ear-bearing tillers and number of grains/panicle. They also found that addition of N increased grain yield significantly (Ghosh, *et al.*, 1991).

An experiment with rice cv. Basmati 370 was conducted in sandy clay loam soil with 0, 30. 60, 90 and 150 hg N/ha and found that number of tillers/hill increased up to 16.4 and straw yield increased up to 9.1 t/ha with increasing N rate (Hussain *et al.*, 1989).

Reddy *et al.* (1986) reported that the higher yield was obtained through the application 90 kg N/ha to rice.

BRR1 (1987) observed that the highest yield of rice grain (5.7 t/ha) was obtained by the application of 120 kg N/ha.

BRRI (1986) found that the yield increased with the increasing rate of applied N and these were fairly related with the increasing number of panicles/unit area.

Carreres *et al.* (1996) observed that grain yield increased with increasing amount of N fertilizer upto 70 kg N/ha.

Effective tillers per $m^2$ was increase upto 60 kg N/ha in both the year of 1993 and 1994 through the application of 120 kgN/ha (Chander and Pandey, 1996).

Idris (1981) reported that the grain yield of all cultivars increased remarkably due to the application of chemical fertilizers; the yields were maximum with the maximum dose of N (120 kg N/ha) but with variable dose of $P_2O_5$.

Islam and Bhuiya (1997) reported the effect of nitrogen and phosphorus on the growth, yield and nutrient uptake of deep water rice. They observed that nitrogen and phosphorus fertilization significantly increased the number of fertile tiller/$m^2$ and also that of grains/panicle which in turn resulted in significant increase grain yield. The application of 60kg N/ha alone gave 22% yield benefit over control.

Phongpan *et al.* (1988) reported that the grain and straw yield of rice increased significantly with increasing rates of urea application.

Senanayake *et al.* (1996) concluded that 10 kg/ha of N fertilizer had the positive effect on number of spikelet number when applied at growth stage but was too low to sustain the survival of the differentiated spikelets. Applications after panicle initiation did not lead to an increased survival of spikelets. Foliar N application at GS increased spikelet survival.

Thakur (1991) reported that the yield attributes like panicles/$m^2$ and panicle weight increased with increasing levels of N.

The application of nitrogen increased grains/panicle, 1000 –grain weight and straw yield. They also observed that N application increased N uptake (Sudhakara *et al.*, 1987).

The yield of paddy increased due to application of N up to 100 kg/ha (Maskina *at al.*, 1987).

Wells *et al.* (1990) conducted a field experiment and found that the rice yield increased from 3236kg/ha without N to 7710kg/ha with 202 kg N/ha.

**Effect of manures on the growth and yield of crop.**

A pot experiment was conducted in 1997-98 to study the effects of organic and inorganic sources of nutrients on rice. They cited a significant increase in the available NPK uptake and rice grain yield by organic sources of nutrient (Ritamoni *et al.*,1999).

A significant increased in N, P and K uptake and also the nutritional status of soil with 5t/ha of FYM in rice based cropping system (Sharma and Mitra, 1991).

Al-Moshileh *et al.* (2005) conducted an experiment and found that vegetable and reproductive responses of potato to bio fertilization with chicken and pigeon manures at the rate of 0,4.0, 8.0, and 12.0 t/ha. The results obtained indicated that leaf area, number of tubers and marketable yield per plant were promoted by the rate of chicken manure. The point of profitable and marketable yield corresponded to the chicken manorial rate of 8.0 t/ha. The lowest yield was obtained when adding 12.0 t/ha of pigeon manure.

An experiment was conducted to investigate the response of wetland rice to N application in a loamy sand soil amended with cattle manure (60 kg N/ha) and poultry manure (80 kg N/ha). In the absence of urea N, poultry manure increased the yield of rice grain which was 2.6 times higher than cattle manure (37%). Rice yield increased linearly with N rate whether or not the soil was amended with organic manure. Apparent recovery in the crop of N from poultry manure ranged from 38 to 82% compared with 51-69% from urea and 20-25% from cattle manure (Maskina *et al.*, 1988).

An experiment was conducted with farmyard manure (FYM) and urea alone or in different combinations equivalent to l00kg N/ha and found that the most noticeable effect of FYM was increased in water-soluble phosphorus. During the four seasons of investigation in the field and one season in pots, grain yield responses reduced as the proportion of N from FYM increased.

Bhadoria *et al.* (2003) carried out an experiment to evaluate the relative efficacy of organic fertilizer, processed city waste (PCW), vermicompost (VC) and oil cake pellets (OCP). They showed that use of organic fertilizers improved tolerance of rice plants to attack by pathogens and pests. They also reported that grain yield increased due to use of organic fertilizer.

BR-3 rice responded well to both nitrogen and phosphorus fertilizers without manure (Ahmed and Nuruzzaman, 1986). When applied with cowdung, only nitrogen fertilizer was necessary for a reasonably higher grain yield of 6t/ha.

Brancher *et. al.* (1998) reported that dry matter (DM) production and grain yields were highest in soil from the A horizon. NPK increased DM yields of above ground parts and grain yields in A and C horizons, while cattle manure increased values only in A horizon.

Budhar *et al.* (1991) reported that the plant height and grain yield of IR 60 was highest with application of poultry manure (6.63t/ha) and lowest with no manure application (5.17t):

Chitdeshwari and Savithri (2000) carried out a pot experiment to determine the effect of eight organic and inorganic fertilizers for growth and yield of rice. It was observed that the highest yield was found by green manure (6.25 t/ha) application.

Dao and Cavigelli (2003) reported that animal manure had long been used as an organic source of plant nutrients and organic matter to improve the physical and fertility condition of agricultural lands.

Dwivedi and Thakur (2000) observed that the highest grain yields of4.77 and 4.84 t/ha with green manure (Sesbania cannabina) treated plots whereas fertilizer treated plots (100; 60; 40 kg NPK/ha) gave 4.32 and 4.44 t/ha, respectively. The results revealed that green manure and biogas slurry saved 50 and 25% NPK fertilizers, respectively.

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

Gupta (1995) conducted a field experiment with different organic manures in India and reported that the application of pig manure (10 t/ha) produced the highest grain yield (4.5 t1ha) followed by poultry manure and FYM which produced yield of 4.1 and 3.9 t/ha of rice grain, respectively. The increase in rice yield with organic manure was 34 to 55% higher over the control and 5-22% higher over NPK fertilizer.

Gypsum and FYM improved significantly the grain yield of rice and substantially decreased pH and ESP (Exchangeable sodium percentage) of soil profile compared with the control (Swamp and Singh, 1994).

Iwaishai (2000) reported that organic fertilizer increased kernel enlargement after the panicle formation stage, increased ear number and panicle length.

Jeong *et al.* (1996) reported that the effects of organic matter on rice growth and grain quality. They reported that 5 t fermented chicken manure/ha in rice field increased N content in plants.

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

Katyal and Gangwar (2000) found that the application of 25-50% of fertilizers in organic form gave the best yield stability.

Kaushik *et al.* (1984) conducted an experiment and found that the application of nitrogen, FYM and especially both increased the yield of rice.

Kim *et al.* (1985) conducted an experiment and found that the application of 10,20 and 30t/ha increased rice yield by 9, 20 and 25%, respectively.

Kwun *et al.* (1984) found that continuous application of P increased P concentration and FYM application increased organic matter, available P, exchangeable K and CEC in soil.

Lu *et al.* (1991) reported that N utilization by the rice plants was 22-24% from chicken manure and 35-53% from urea but the residual N in soils was 30-42% of chicken manure and 23-33% of urea.

McAndrews *et al.* (2006) conducted an experiment to investigate the residual effect of fresh or composted hoop house swine manure on the growth and yield of soybean. During both years, soybean plants from manure-amended plots were significantly taller and had a thicker stem diameter than plants from the other plots. The manure-treated plots produced 39% greater soybean leaf area than the control in 2001 and 11% greater leaf area than the urea-amended plots in 2002. There was a 21 to 34% greater K concentration in soybean plants grown in the manure-amended sites than in the other plots. Soybean grain yield was 0.2 to 0.5 Mg $ha^{-1}$ greater in the manure-treated plots than the control or urea-fertilizer plots.

Mendoza (2002) found that the organic inputs were productive to increase yield in rice production.

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

Mubaric *et al.* (1999) conducted a long-term experiment and farm survey to evaluate the effects of green manures on yield, stability, and profit in rice- based cropping systems. Green manure (GM) was not superior to organic fertilizer in terms of agronomic efficiency. Use of GM destabilized rice yield, and had higher unit production cost than N fertilizers.

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

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

Ranjha *et al.* (2001) reported that the response of rice to Zn, P and FYM was studied in green house by using sandy clay loam soil. Different combinations of N,P,K and Zn were applied at the rate of 120-80-60 and 20 kg $ha^{-1}$ along with FYM at the rate of 12 Mg $ha^{-1}$. All the growth parameters of rice increased with P application over control. Paddy and straw yields produced maximum by the application of FYM along with NPK+Zn. Nitrogen, P and K contents increased with the application of NPK fertilizer along with FYM and Zn but there was significant decrease in P contents by the application of Zn. Zinc contents were found maximum in those treatments where Zn and Zn+P were applied with NPK. The post harvest soil analysis showed that NPK contents were higher in pots with FYM incorporation but Zn was high in pots treated with $ZnSo_4$.

Rochayati *et al.* (1988) observed that the application of 5 t/ha stubble manure produced a similar yield of rice as 20 kg P/ha from TSP without stubble manure. This indicated that 5 t/ha of stubble substituted 20 kg $P_20_5$/ ha.

Sing *et al.* (1987) conducted a field trial on a loamy sand soil where poultry manure was applied as N source for wet land rice cv. PR 106. Nitrogen at the rate of 0, 60, 120 or 180 kg N/ha as urea in equal split was applied at 7,12 and 42 days after transplanting and as poultry manure incorporated into the soil at the last puddling. Nitrogen from poultry manure the rate of 60, 120 and 180 kg N/ha produced rice grain yields equivalent to those with 168 kg N/ha as urea, respectively. On the basis of N uptake, poultry manure N was 80% as efficient as urea N at all rates of application.

Tahir *et al.* (1991) conducted an experiment with rice cv. Basmati 385 grown on a sandy clay loam at Faisalabad in 1980 with various combinations of

NPK, $ZnSO_4$ and FYM. Yield was 1.71 t/ha without fertilizers and 4.32 t/ha with 60 kg N, 40 kg $P_2O_5$, 30 kg $K_2O$ but 5t FYM /ha without inorganic fertilizers produced 3.54t grain/ha and gave the highest value.

The application of dairy cow slurry to rice at the rate of 100 t/ha increased N uptake between ear formation and heading (Kawabata and Miyamatsu, 1984).

The applied organic fertilizer increased rice yield, improve crop growth. They also recommended it for sustenance of soil fertility (Zahid *et al.*, 2001).

Tiwari *et al.* (1980) found that efficiency of FYM was 23% for the first crop but when the residual effect was considered it ranged upto 50%.

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

Verma and Dixit (1989) observed that application of straw mulch and FYM increased the uptake of N, P and K with and without applied nitrogen at tillering as well as harvest stages.

**Effects of urban wastes on the growth and yield of crop.**

The effect of compost made from urban waste on corn plant growth was investigated. Two types of compost were used: the selected compost (SC), produced from organic waste selectively collected; and the non-selected compost (NSC), taken from a 15-years old cell from the canabrava land-fill Brazil. Plants cultivated with SC presented a superior grain, being of 52.5% in stem diameter, 71.1 and 81.2% root and stem biomasses respectively. Chlorophy II content alterations were observed in plants from treatments using 30 ton compost $ha^{-1}$ does onwards (Lima J.S *et al.*, 2004).

Marjovvi *et al.* (2002) conducted a study to obtain information about municipal compost on the soil properties, quality and quantity of sugar beet. A field study was conducted at Baraan Research station with sugar beet- wheat rotation in permanent plots.

Dav Arinejad *et al.* (2002) conducted an experiment in Khorasan agricultural research center in order to investigate the effect of municipal compost and its fortification with chemical fertilizers on growth and yield of sugar beet. Applicant of compost, animal manure and chemical fertilizer increased root and sugar yield compared with control. Using 40 $Mgh^{-1}$ compost along with 50% chemical fertilizer had a higher yield than chemical fertilizer alone.

Bhattacharyya P *et al.* (2005) reported the suitability of municipal solid waste compost (MSWC) application to submerged rice paddies in the perspective of metal pollution hazards associated with such materials. The experiment was conducted at west Bengal, India. The treatment consisted of control, no input, MSWC at 60 kg N $ha^{-1}$, Well decomposed cow manure (DCM), at 60 kg $Nha^{-1}$, MSWC (30 kg $Nha^{-1}$)+ urea (30 kg N $ha^{-1}$), DCM (30kg $Nha^{-1}$) + urea (30kg $Nha^{-1}$) and Fertilizer, (at 60:30:30 NPK kg $ha^{-1}$) through urea, single super phosphate and muriate of potash respectively). Soil microbial biomass-C (MBC), MBC as percentage of organic-C, urease and acid phosphatase activities were higher in DCM than MSWC treated soils, due to higher amount of biogenic organic materials like water soluble organic carbon, carbohydrate and mineralizable nitrogen in the former. The studied parameters were higher when urea was integrated with DCM or MSWC compared to their single applications.

Bai bourdi A *et al.* (2007) reported that organic fertilizer such as municipal solid waste compost are quite rich in plant nutrients. Municipal compost were applied at three levels (5,10 & 15 t/ ha) in rice filed. The highest yield was obtained at the rate of 15t/ha.

An experiment was conducted to evaluate the effect of municipal waste compost leachate (MWCL) on *capsicum annum* plant and chemical properties of a clay loam soil with five ratios of MWCL to irrigate water (0,20,40,60 and 100 percent) treatments. The treatment with 20 percent MWCL increased plant fresh and dry weight, fresh and dry weight of green chili. Plant content of N, P and K increased with increasing concentration of MWCL. The use of 20 percent MWCL seems to cause increasing green chili yield. An application of high concentration due to increase of EC of soil solution (Astrael *et al.*, 2006).

**Integrated effect of organic and inorganic fertilizers on the growth and yield of crop.**

A field trail on Boro production through integration of organic, bio and chemical fertilizers showed that a combination of inorganic (80-60-40-30-5) kg N-P-K-S-Zn/ ha) and organic fertilizer give the significant yield and growth (Kader *et al.*, 1998).

A pot experiment was carried out with rice cv. Sakoli-6 and observed that grain yield and P percentage were highest with the NPK + FYM rates; N percentage in grain was highest with the highest NPK rate without FYM (Kadu *et al.*, 1991).

Ahmed and Rahman (1991) observed that the application of organic matter and chemical fertilizer increased tiller number and panicle length of rice and also increased straw and grain y1elds.

Ahmed and Reddy (2002) conducted a field experiment to optimize fertilizer recommendation of N,P and K through chemical fertilizers, FYM and GM using soil test values. They recommended 3 doses, viz, inorganic fertilizers alone, inorganic + FYM, and inorganic + GM for attaining 35 and 45 q/ha of rice in alluvial soils.

Ali (1994) carried out several experiments on integrated nutrient management at different places of Bangladesh and reported that when boro rice receiving total chemical fertilizers were followed by T. aman rice, receiving the same, the yield increase over the control was 86% for straw, but this figure was102% when boro was fertilized with 100% chemical fertilizer + 5 t FYM /ha followed by T. aman rice with only 100% chemical fertilizer.

An experiment was conducted on rice grown with annual applications of either 10 or 20t FYM /ha or 10 t FYM with 80 kg each of N, $P_2O_5$ and $K_20$ and found that the average unpolished rice yields over the 5 years were 3.66 t/ha with 10t FYM /ha, 3.53 t with 20t FYM/ha and 5.92t with FYM+NPK fertilizer. Plant height, number of stems/$m^2$ and panicle number all showed similar difference to those shown on yields but the number of grains/panicle was highest with 10t FYM/ha (Kobayashi *et al.*, 1989).

An experiment was conducted with organic and inorganic sources of N in rice found 4.17 t/ha of grain yield with 66% N from FYM and the rest urea against 4.03 t/ha with 100% from prilled urea (Pandey and Tripathi, 1993).

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

Bhuiya and Akhand (1982) found that the number of tillers per plant at maximum tillering stage was 16 to 24 due to application of organic material in combination with (e.g. mustard oil cake, cowdung, water hyacinth, rice straw) chemical fertilizers (NPK).

Bhuiyan and Zaman (1984) carried out a pot culture experiment reported that the decomposed cowdung at the rate of 1.5% dry weight basis produced similar grain yield to that of the recommended fertilizer but significantly higher than that of compost.

Calendacion *et at.* (1990) observed that the highest total rice yield was produced by 220-70-70 kg NPK + 12 t chicken manure/ha. They concluded that rice and potatoes could profitably be grown in rotation, when chicken manure applied to potatoes which result residual effects for a following rice crop.

Chettri *et al.* (2002) conducted an experiment on rice cultivation under chemical fertilizer with or without FYM. They found that the highest number of effective tillers, grains per panicle, percentage of filled grains, 1000-grain weight and grain yield (44.05 q/ha) where obtained from the application of 60,3 and 10 kg N, $P_2O_5$,$K_2O$ with FYM/ha.

Ghosh (1994) conducted an experiment during 1988-90. They studied the influence of organic and inorganic fertilizers on the performance of rice and fish in a dual culture system. They reported that the grain and dry matter yield of rice were increased when inorganic N fertilizer (560 kg/ha) or combination of organic and inorganic N fertilizer was applied.

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

Gill and Meelu (1983) observed that paddy yields of rice/wheat sequence on loamy sand significantly increased with 12t FYM + 80 kg N/ha.

Gupta *et al.* (1995) reported that the highest yield of rice was obtained with the combined application of poultry manure and P. In addition, the concentration of phosphorus in rice tissue at different stages and P uptake at maturity, increased with the application of P and/or manure. They also stated that the highest uptake P was recorded with combined application of poultry manure and P.

Islam (1995) carried out an experiment with different doses of fertilizer-N, cowdung and fertilizer *sesbania*, and reported a significant yield increase with fertilizer-N, cowdung compared to fertilizer-N alone in T. aman rice.

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

Labios *et al.* (1994) reported the advantage of using GM, AM (animal manures) and composted agricultural wastes together with chemical fertilizers. It was observed that agricultural wastes had significant effect on rice yield.

Liao (1989) conducted an experiment with application of "King" ( a new organic inorganic fertilizer) containing about 30% humus and about 16% N,P and K. He reported that it gave higher yields usually > 15% and costs were lower especially on cropland, which contained low organic matter.

Maskina and Meelu (1984) observed that mean rice grain yield obtained with 80 kg N + 12t FYM/ha (5.8 t/ha) was comparable to that with 120 kg N/ha (5.6 t/ha).

Maskina *et al.* (1986) carried out an experiment with poultry manure and FYM on rice cv. PR 106 to supply 75kg N/ha and supplemented with 80 or 120 kg N/ ha applied as urea. Rice yield ranged from. 3.3 t with no manure to 7 t/ha with poultry manure + 120kg N/ha.

Mathew and Nair (1997) carried out a trial with applied organic fertilizer alone or in combination with NPK fertilizers. They revealed a significant improvement of soil productivity and yield properties.

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

Mobbayad (1981) conducted an experiment and showed that use of organic and inorganic fertilizer in 50:50 ratio gave yield similar to pure chemical fertilizer.

Mondal *et al.* (1990) observed with a field trial in 1984-85 with rice grown in sandy clay loam soil that the application of 0 and 10t FYM/ha gave average paddy yields of 1.90 and 2.69 t/ha, respectively. Application of 40 kg N/ha or N + $P_2O_5$ + $K_2O$ at the rate of 40 + 20 + 20, 60+ 40 + 40 or 80 + 60 + 60 kg/ha gave yields of 3.17, 3.40, 3.59 and 4.0 t/ha without FYM, respectively. The number of panicles/$m^2$ and spikelets/panicle, percentage of filled grains and 1000-grain weight were increased with increasing NPK rates and FYM application.

More (1994) found from a 3- years study, that the application of 25 t/ha FYM plus 20 t/ha press mud was the best for increasing y1eld of rice and wheat.

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

Rajput and Warsi (1992) conducted a field trial with different levels of inorganic and organic sources of N in rice nutrition and residual effect of organic sources in the following crop (wheat) and reported that an addition of 10t FYM/ha saved 50kg N/ha in grain production.

Raman *et al.* (1996) carried out a field trial during 1984-94 with inorganic and organic inorganic nutrient supply system on rice-wheat cropping system. They observed that in the first year yield was highest with organic fertilizers only. After 2-3 years, the combination of organic and inorganic fertilizers gave similar yields to the inorganic treated plots, while after 3-4 years the combined fertilizer started giving higher yield than the inorganic source.

Ranjha *et al.* (2001) carried out an experiment about rice response to applied nutrients. The combination N,P,K and Zn+FYM resulted in the greatest plant height (99.29 cm), grains per panicle (111,33), thousand –grain weight (19.47 g), grain yield per pot (53.67 g) and straw yield per pot (57.73g).

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

Rao and Sitaramyya (1997) carried out a pot experiment to test the changes in soil nitrogen forms, uptake and grain yield due to integrated nutrient management of rice through conjunctive use of fertilizer urea with FYM, bio-gas slurry, poultry manure and the green manures *gliricidia and Azolla.* Nitrogen uptake by rice was in the order *Azolla*>*Gliricidia*>poultry manure>bio gas slurry. None of the organic sources had any specific positive influence on total or available N contents of soil at any stage. The contents had increased at 45 and 60 days after treatment due to soil nitrogen transformation and later decreased at harvest due to plant utilization.

Saleque *et al.* (2004) stated that Poultry manure may be a good source of organic matter and nutrients for rice production.

Salik (1999) observed a field investigation during the season of 1995 and 1996, rice was grown with difference combinations of poultry manure, farmyard manure and green manuring with Sesbania rotstrata and chemical nitrogen fertilizer (Urea) in 50:50 ratios. The grain yield, straw yield, gross return, net return and net return per rupee investment were higher when different types of organic amendments were applied than where nitrogen was applied as urea alone.

Satyanarayana *et al.* (2002) carried out an experiment on integrated use of organic and inorganic fertilizers. It was obtained that the application of FYM at 10 t/ha and inorganic fertilizer at 120:60:45 kg N: P2O5: $K_2O$/ha increased grain and straw yields, tiller number, filled grains per paincle, and 1000- grain weight.

Sharma *et al.* (1987) found better crop growth and improved soil productivity due to application of FYM and N fertilization, which resulted in significant improvement in yield and yield attributes of rice and wheat consequently higher grain yields as compared with unfertilized plots.

Singh *et al.* (1996) conduct a field experiment in Ludhiana, Punjab, India, where irrigated rice was given 60,120 or 180 kg N/ha/yr as poultry manure, urea or poultry manure + urea. In the first year, poultry manure did not perform better than urea but in the third year, 120 and 150 kg N as poultry manure produced significantly higher grain yields than the same rates as urea. Poultry manure sustained the grain yield of rice during the three years while the yield decreased with urea.

Singhania and Singh (1991) carried out an experiment with various combinations of 0-40 kg N/ha as manure and 0-120 kg N/ha as inorganic fertilizer. They observed higher yield and P uptake when N was applied in a combination of organic and inorganic forms.

The application of 30 kg N/ha in the form of FYM at pudding and 30 kg N/ha as urea at planting gave grain yield comparable to that of 60 kg N/ha as urea applied in 3 splits. Application of lime with FYM, 2 weeks before planting showed beneficial effect during initial growth stages on dry matter production through stimulated mineralization of N from FYM and the combined application of urea and FYM also showed residual effect (Khan *et al.*, 1986).

The application of FYM provided considerable direct and residual effect on crop yields and improved soil fertility (Meelu and Moris, 1987).

The application of organic and inorganic fertilizers at 50:50 ratio gave the best yield of rice. Gunasena and Ahmed (1977) observed that combined application of organic and inorganic fertilizer was found to increase grain and straw yields of rice over organic or inorganic fertilizers applied alone (Haga and Dayag, 1989).

Vanaja and Raju (2002) conducted a field experiment during 1996-97 on integrated nutrient management practice in rice crop. It was obtained from different combination of chemical fertilizer with poultry manure (PM) 2 t/ha given highest grain and straw yield.

XuQ *et al.* (1989) reported that the proper use of fertilizer contributed both to the yield and to the quality of the product. In trials with late rice, application on NPK fertilizer increased yields by 49.2% and organic manure applied in addition to the NPK increased yields by 54.7% . The organic manure alone increased yield by 22.1%.

**Effect of fertilizers and manures on the properties of the post-harvest soil**

Singh. *et al.* (1985) reported that organic manures increased the organic carbon and available N content in soil and available phosphorus was increased with FYM.

Shivaramu *et al.* (1994) found that bulk density was reduced by organic residues incorporation.

Sharma and Sharma (1994) observed that application of organic fertilizer decreased soil bulk density and increased infiltration rate. They also observed that increased soil organic carbon content and the application of organic fertilizer availability of soil N, P and K.

Nahar *et al.* (1996) carried out a field experiment in Bangladesh in 1992 with rice cv. BR-14 which received a combination of 0.75 or 100 kg N/ha as urea and 10 t/ha of rice straw, fresh ipil-ipil *(Leucaena leucocephala )* leaves as green manure, fresh cattle manure or composted rice straw + cattle manure. They observed that organic matter and urea-N improved the organic carbon content of soil significantly. Available nitrogen content was improved significantly only due to addition of urea-N. Grain yield of rice was increased markedly due to application of manure.

More (1994) concluded from 3-years study that application of 25 t/ha FYM plus 20 t/ha pressmud deceased the soil pH and increased organic matter content and availability of N, and K in soil.

Mian, *et al.* (1983) observed that some beneficial effect of N, P and FYM on organic carbon but their effects on exchangeable K was very negligible.

Mian and Eaqub (1980) observed that N,P and K alone and in combination had no effect on soil pH but the application of farmyard manure and green manure slightly decreased the pH value. Organic carbon content was increased with chemical fertilizer in combination with FYM and green manure but decreased due to chemical fertilizer only.

Hoque and Mannan (1980) reported the effect of individual or combined application of phosphate fertilizers and farmyard manure on some soil properties. They found that a considerable increase in soil organic matter content and available P in soil due to separate or combined use of TSP, MP and FYM. The single application of FYM recorded the highest value of soil organic matter.

Gani and Singh (1988) observed that available P was significantly higher when FYM was applied to rice where as the trend was reverse in case of available K.

Cassman (1995) reported that K availability and uptake were increased with increasing organic matter.

Brancher *et al.* (1996) carried out pot trial in greenhouse, with rice cv. BRIRGA 409 sown in A or Cg horizons of a low humic clay soil mixed with cattle manure, rice straw, NPK or lime alone or in all possible combinations of 2, 3 or 4 components. They found that addition of NPK and/or lime with or without manure reduced Fe concentration in above ground parts of plants grown on the Cg horizons, whilst manure alone increased Fe concentration.

Bahman *et al.* (2004) conducted an experiment to observe the residual effects of N-and P-based manure and compost applications on corn grain yield and N uptake lasted for at least one growing season while the effects on soil properties were longer lasting. Soil P can contribute to crop P uptake for> 4 yr after N-based manure of compost application had ceased. Effects of manure and compost applications significantly increased soil electrical conductivity and pH levels and plant-available P and $NO_3$-N concentrations.

# CHAPTER 3

# MATERIALS AND METHODS

# CHAPTER III

## MATERIALS AND METHODS

A brief description of the types of soil, nature of crops, design of experiment, treatment, cultural operations, collection of soil and plant samples and analytical methods followed in this experiment. The chapter has been described as below:

**Soil**

The experiment was carried out at research farm of Sher-e-Bangla Agricultural University, Dhaka-1207 during Boro season of 2011-2012. The morphological, physical and chemical characteristics of soil are shown in Tables 3.1 and 3.2, respectively.

**Crop**

BRRIdhan29 a high yielding variety was used as the test crop in the Boro Season. The variety was released by Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur for Boro season. Life cycle of these variety ranges from 150-160 days in Boro Season (BRRI, 1995).

**Seedling raising**

A well puddled land was selected for seedling raising. The sprouted seeds were sown uniformly as possible and covered with thin layer of fine earth. Proper care of the seedlings in the nursery was taken.

**Table 3.1 Physical and chemical properties of the initial soils sample**

| Physical properties | Value |
|---|---|
| Sand (%) | 17.60 |
| Silt (%) | 47.40 |
| Clay (%) | 35.00 |
| Porosity (%) | 44.5 |
| Texture | Silty loam |
| Bulk density (g/cc) | 1.45 |
| Particle density (g/cc) | 2.52 |
| **Chemical properties** | **Value** |
| Soil pH | 5.70 |
| Organic Carbon (%) | 0.74 |
| Total N (%) | 0.043 |
| Available P (mg /kg soil) | 16.90 |
| Exchangeable K (meq/100 g soil) | 0.12 |
| Available S (mg/kg) | 12.0 |

**Table: 3.2 Nutrient content of cowdung and vermicompost**

| Sample | Nutrient content (air dry basis) | | |
|---|---|---|---|
| | N (%) | P (%) | K (%) |
| Cowdung | 1.20 | 1.00 | 0.70 |
| Vermicompost | 2.00 | 1.90 | 0.80 |

## Land Preparation

Land was prepared for the cultivation of BRRIdhan29. First it was ploughed with a power tiller. The soil was saturated with adequate supply of irrigation water and finally prepared by successive ploughing and cross ploughing followed by laddering. The unexpected residues were removed from the experimental plot.

## Lay out of the experiment

The experiment was carried out in the Randomized Complete Block Design (RCBD). The entire experimental area was divided into 3 blocks representing the replications to reduce soil heterogeneity and each block was subdivided into 12 unit plots with raised band as per treatments. Thus, the total number of unit plots was 36, treatments were twelve. The unit plot size was 3.5 m × 2.0 m and the plots were separated through raising soil band upto 25 cm from the soil level. The blocks were separated by 1.0 m drains. The treatments were randomly distributed within each block.

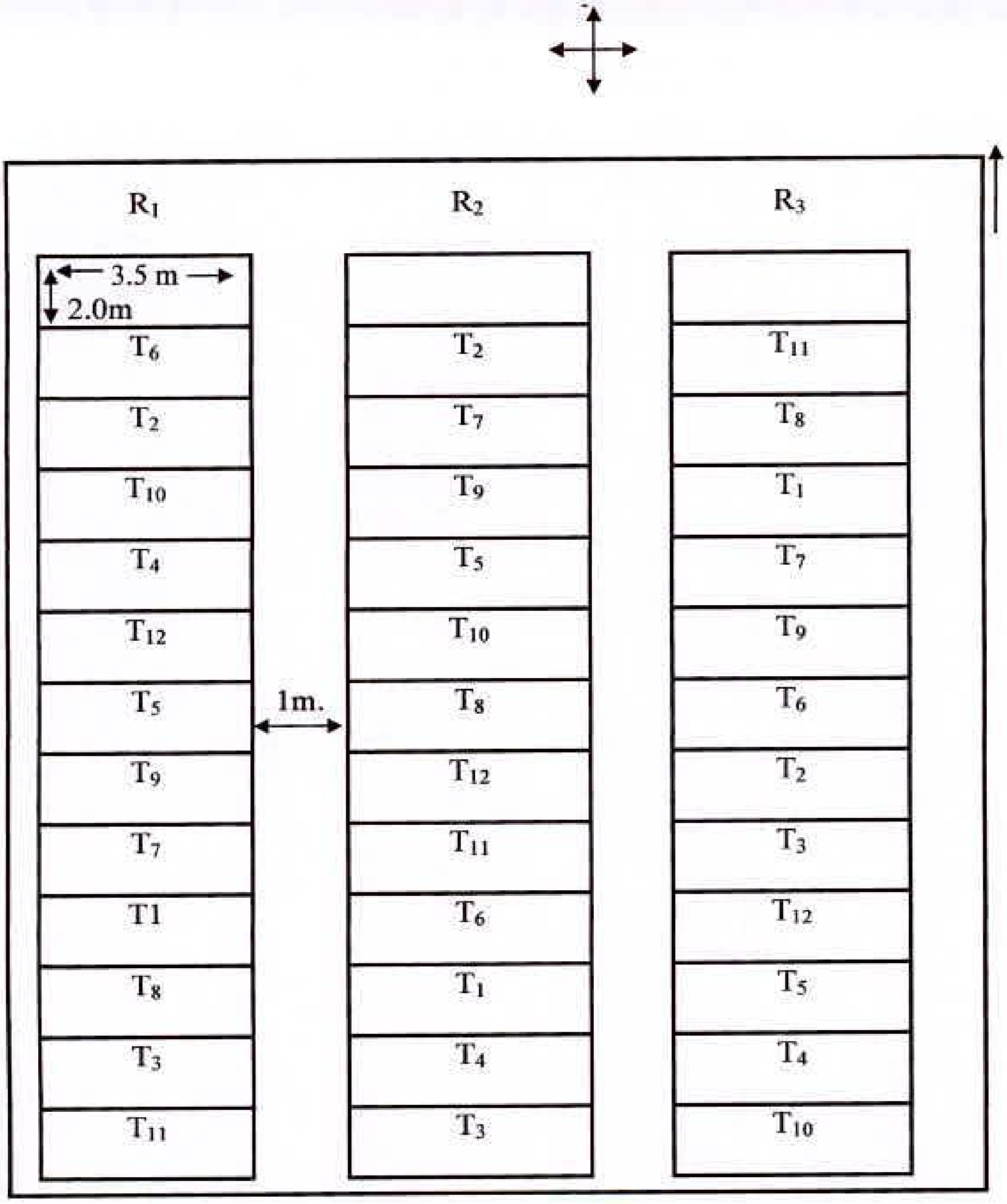


**Fig: 3.1 Lay out of the experiment**

## Treatments:

**$T_1$** : 140 kg N/ha from Urea + P K S & Zn as per recommendation

(35, 120, 20, 2.5 kg/ha, respectively) from Chemicals.

**$T_2$:** 120 kg N/ha from Urea+ 20 kg N/ha from Cow dung (CD)

**$T_3$:** 120 kg N/ha from Urea+ 20 kg N/ha from Vermicompost (VC).

**$T_4$**: 120 kg N/ha from Urea+ 10 kg N/ha from (CD)+10 kg N/ha from vermicompost (VC)

**$T_5$:** 100 kg N/ha from Urea+ 40 kg N/ha from Cow dung (CD)

**$T_6$:** 100 kg N/ha from Urea+ 40 kg N/ha from Vermicompost (VC).

**$T_7$**: 100 kg N/ha from Urea+ 20 kg N/ha from(CD)+20 kg N/ha from Vermicompost (VC)

**$T_8$:** 80 kg N/ha from Urea+ 60 kg N/ha from Cow dung (CD)

**$T_9$:** 80 kg N/ha from Urea+60 kg N/ha from Vermicompost (VC)

**$T_{10}$**: 80 kg N/ha from Urea+ 30 kg N/ha from cowdung (CD)+30 kg N/ha from Vermicompost (VC)

**$T_{11}$**: 70 kg N/ha from cowdung (CD)+70 kg N/ha from Vermicompost (VC)

**$T_{12}$**: No Chemicals and no Manures (Control)

**Fertilizer, cowdung and vemicompost application**

BARC manual (BARC, 2007) was followed for application of fertilizers and for selecting the manurial dose, the findings of previous works were kept in mind. Well decomposed cowdung and vermicompost were applied as per treatments during final land preparation.

The sources of nitrogen, phosphorus, potassium, sulpher and zinc used in the experiment were urea, TSP, MoP, gypsum and zinc oxide respectively. The rest except urea was applied during final land preparation. Urea was top dressed in three equal installments (splits) at 15, 35 and 60 days after transplanting.

**Transplantation**

Thirty five days old seedlings were transplanted in the experimental plots on 10 January, 2012. Distances of 20 cm from row to row and 15 cm from plant to plant were maintained.

**Intercultural operations**

The crops were infested by pests which were controlled through the application of ripcord. Necessary intercultural operations like weeding and irrigations were done as and when necessary.

**Harvesting**

The crops were harvested plot wise at maturity after 155 days in Boro season on 11 may 2011.

**Sample Collection**

From each plot five hills were randomly selected to keep records on yield and yield contributing characters. The selected hills were collected before the crop was harvested and necessary information was recorded accordingly. The grain and straw samples were also kept for chemical analyses.

**Soil**

The initial soil sample was collected from the experimental field before manuring and fertilization. Five samples of 0-15 cm depth were collected, mixed, air-dried, ground and sieved through a 2 mm (10 mesh) sieve. The composite sample was stored in clean polyethylene bag for physical and chemical analyses. Post-harvest soil samples of 0-15 cm depth were also collected from each plot.

**Data collection**

**Plant height :** Plant height was measured from the ground level to the top of the panicle. From each plot, five hills were recorded.

**Number of tillers:** Five hills were taken at random from each plot and total number of tillers (effective and non-effective tillers) was counted, the average of which was considered as total number of tillers per hill.

**Panicle length :** Panicle length was measured from basal node of the rachis to apex. Each observation was a mean of 5 hills.

**Number of grains and filled grains/ panicle :** The number of grains and filled grains/ panicle were counted and averaged.

**1000-grain weight :** Thousand grains were counted and weighed.

**Grain and straw yields :** The crop was harvested and the grain and straw obtained from each unit plot were dried and weighed carefully. The results were express as t/ha.

**Soil Analysis**

The initial soil sample was analyzed for particle size distribution, particle density, bulk density, pH, organic carbon, total nitrogen, available P and exchangeable K (Table 3.2). Post harvest soil samples were analyzed for pH, organic matter, total nitrogen, available P, exchangeable K, available S and cation exchange capacity.

**Textural class:** Particle size analyses of soil was done by hydrometer method (Black, 1965) and the textural class was determined by plotting the values for %sand, %silt and %clay to the Marshall's triangular coordinate following the USDA system.

**Particle density :** Particle density of soil was determined by volumetric flask method (Black, 1965) following the formula:

$$\text{Particle density (Dp)} = \frac{\text{Weight of soil (solid)}}{\text{Volume of soil (solid)}} \quad \text{g/cc}$$

**Bulk density :** Bulk density of soil was determined by core sampler method following the formula:

$$\text{Bulk density } (D_b) = \frac{\text{Weight of oven dry soil}}{\text{Volume of soil (solid)}} \quad \text{g/cc}$$

**Porosity :** Porosity of soil was calculated from the following formula given by Vomocil (1965).

$$\text{Total porosity (\%)} = 100 - \frac{D_b}{D_b} \times 100$$

Where, $D_b$ = Bulk density (g/cc)

$D_b$ = Particle density (g/cc)

**Soil pH :** Soil pH was measured with the help of a glass electrode pH meter using soil water suspension of 1:2.5 as described by Jackson (1962).

**Organic carbon :**Organic carbon was determined following the wet oxidation method as described by Page *et al.* (1982)

**Total nitrogen :**Total nitrogen of soil was estimated following the micro-kjeldahl method. The soil was digested with $H_2O_2$ and conc. $H_2SO_4$ in presence of the catalyst mixture ($K_2SO_4$:$CuSO_4$ 5 $H_2O$: Se in the ratio 10:1:0.1) and nitrogen in the digest was determined by distillation with 40% NaOH followed by titration of distillate trapped in $H_3B0_3$ with 0.1 N $H_2SO_4$ (Page, *et al.* 1982).

**Available phosphorus :** Available phosphorus was extracted from the soil with 0.5 M $NaHC0_3$ at pH 8.5. The phosphorus in the extract was then determined by developing the blue colour by $SnCl_2$ reduction of phosho-molybdate complex and measuring the colour calorimetrically at 660 nm (Olsen *et al.* 1954).

**Exchangeable potassium :** Exchangeable potassium of soil was determined from 1 N ammonium acetate (pH 7.0) extract of the soil by using flame-photometer.

**Chemical analyses of grain, straw, cowdung and vermicompost.**

**Preparation of samples :** Grain and straw samples were dried in an oven at $65^0$C for 48 hours and then ground by a grinding machine to pass through a 20 mesh sieve and stored in small paper bags into a desiccators. Representative cowdung and vermicompost samples were dried and prepared followings. Then the samples were analyzed for N,P and K.

**Digestion of samples with nitric-perchloric acid :** 0.5 g was transferred into a dry clean 100 ml kjeldahl flask. A 10 ml of diacid ($HNO_3$ : $HClO_4$ in the ratio 2:1) was added. After leaving for a while, the flask was heated at a temperature slowly to raise upto $200^0$C. Heating was momentarily stopped when the dense white fumes of $HClO_4$ occurred and after cooling, 6 ml of 6N HCl was added to it. The contents of the flask were boiled until they became sufficiently clean and colourless. P, K and S contents were determined from this digest.

**Nutrient uptake:** Nutrient uptake by grain and straw was calculated by multiplying the yield (oven dry basis) with the corresponding nutrient content.

**Statistical analysis**

The analysis of variance for the crop characters and also the nutrient content of the plant samples were done following the ANOVA technique and the mean values were adjudged by Least Significant Difference Test (LSD).

# CHAPTER 4
# RESULTS AND DISCUSSION

# CHAPTER IV

# RESULTS AND DISCUSSION

The results of the experiment conducted under field conditions are presented in several Tables and Figures. The experiment was conducted to study the effect of integrated nutrient management on the growth and yield of BRRIdhan29. The results are presented and discussed under the following parameters.

**Plant height**

Plant height was significantly influenced by cowdung and vermicompost and inorganic nitrogenous fertilizer (Table 4.1). Plant height ranged from 95.73 to 78.60 cm. The highest plant height (95.73 cm) was recorded in the treatment $T_1$ receiving 140 kg N/ha as the source of urea. Treatment $T_1$ was statistically identical with $T_2$, $T_3$, $T_5$, $T_6$ and $T_8$. Cowdung and vermicompost along with nitrogenous fertilizer performed better in recording plant height compared to other treatment combination except only use of chemical nitrogenous fertilizer in $T_1$. However, plant height recorded either with single or combined application of nitrogen and manure or vermicompost was higher than that of control treatment. The lowest plant height (78.60 cm) was observed by control treatment having no cowdung or vermicompost even any chemical fertilizer. Treatment $T_1$ receiving 140 kg N/ha from urea fertilizer produced 21.79% higher plant height compared to control treatment (Fig. 4.1). Plant height in BRRIdhan29 increased by the application of farm wastes (Budhar *et al.* 1991). Hoque (1999) found that plant height significantly increased with the application of cowdung along with chemical fertilizer. The increased plant height through the application of FYM along with N, P and K was also reported by many other scientists (Kobayashi *et al.* 1989, Maskina *et al.* 1987). Maximum plant height in BRRIdhan29 due to the application of poultry manure at the rate of 3t/ha along with 50% soil test basis fertilizer in boro season Anonymous (2007).

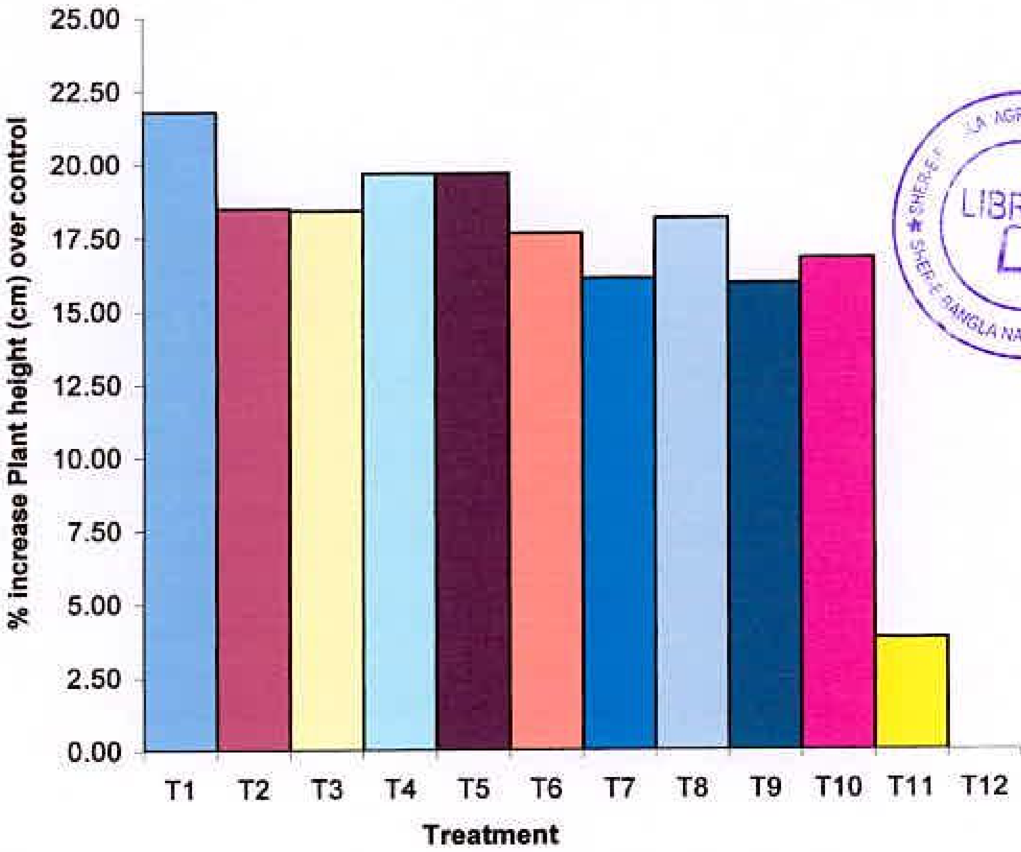




**Fig.4.1. Effect of integrated nutrient management on percent increase plant height over control of BRRIdhan29**

**Number of tillers per hill**

Number of tillers per hill was significantly influenced by cowdung and vermicompost along with chemical nitrogen fertilizer (Table 4.1). Maximum number of tillers per hill (24.87/hill) was recorded in $T_3$ treatment receiving 20 kg N from vermicompost along with 120 kg N/ha as the source of urea. Vermicompost in association with chemical nitrogen fertilizer exerted positive effect on the number of tillers per hill. Cowdung and vermicompost in combination with nitrogenous fertilizers showed better performance than only nitrogen fertilizers. The lowest number of tillers per hill (18.40/hill) was noted by control ($T_{12}$) treatment. Treatment $T_3$ produced

35.16% higher number of effective tiller per hill than control treatment (Fig. 4.2). Ahmed and Rahman (1991) recorded significantly increased tiller number of rice due to cowdung or vermicompost along with chemical nitrogen fertilizers.. Aptosol (1989) also found that combined application of organic and inorganic fertilizers increased the number of tillers per hill.

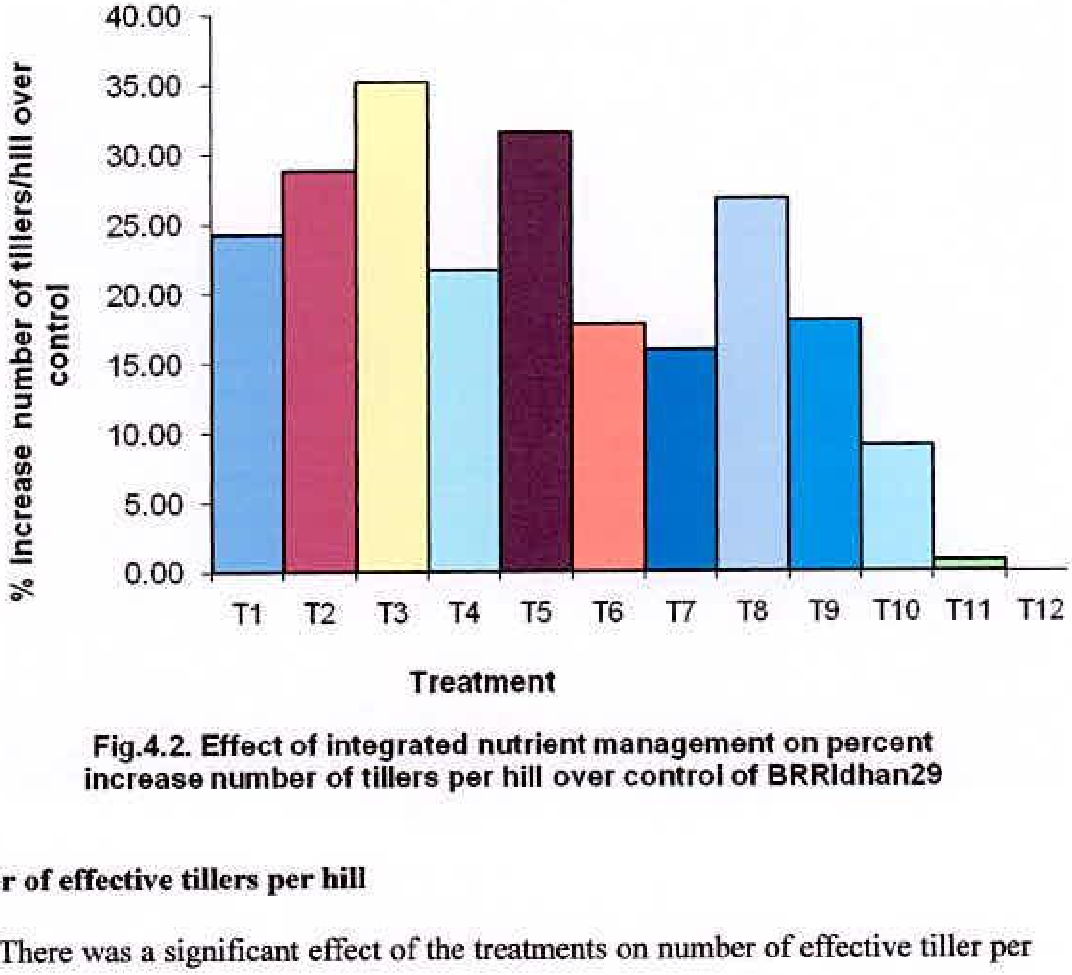


**Fig.4.2. Effect of integrated nutrient management on percent increase number of tillers per hill over control of BRRIdhan29**

**Number of effective tillers per hill**

There was a significant effect of the treatments on number of effective tiller per hill (Table 4.1). All the treatments significantly produced higher number of effective tillers per hill over control treatment. Application of 20kg N /ha from cowdung along 120 kg N/ha as the source of urea produced the highest number of effective tillers (24.00/hill). Treatment $T_5$ produced 34.30% higher number of effective tiller per hill than control treatment (Fig. 4.3). Cowdung with the association with chemical nitrogen fertilizer was found to be more or less similar to vermicompost along with chemical nitrogen in producing number of effective tiller.

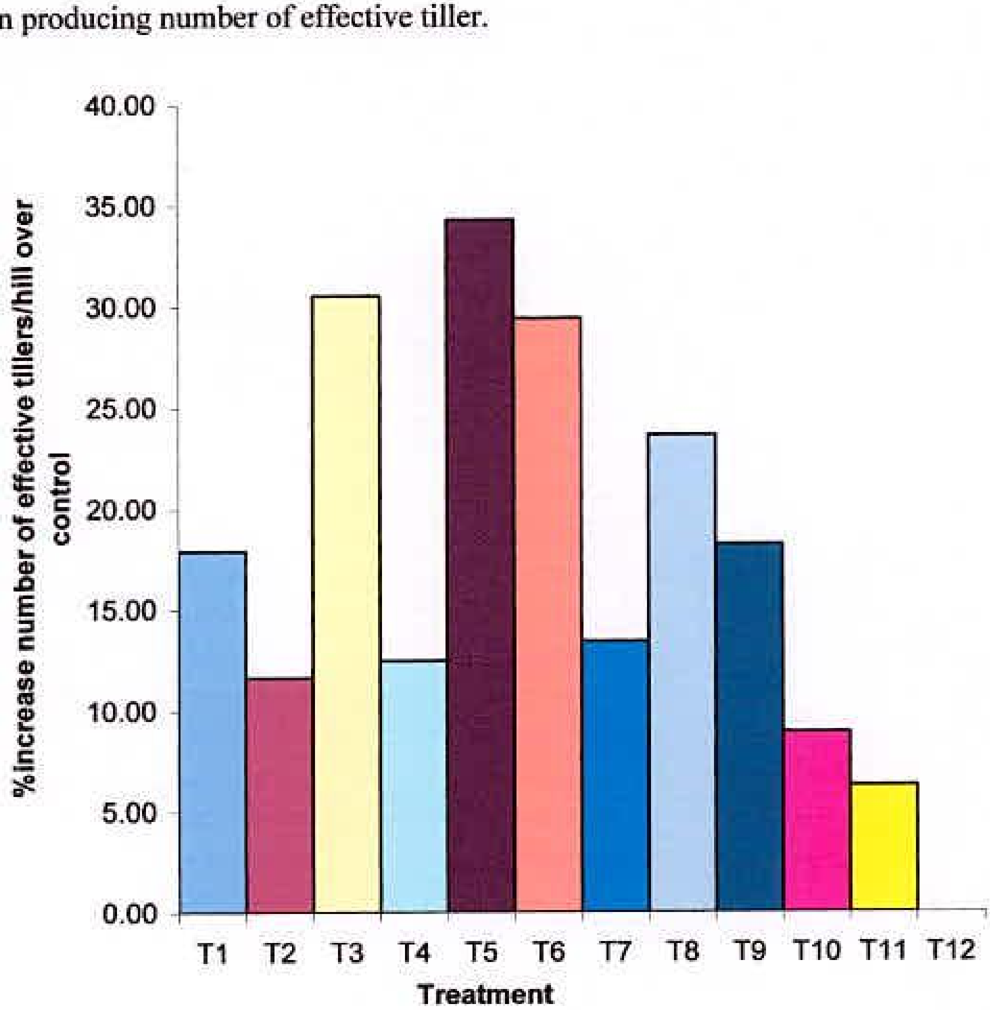


**Fig. 4.3. Effect of integrated nutrient management on percent increase number of effective tillers per hill over control of BRRIdhan29**

**Number of non effective tiller**

The effects of different treatments on non effective tiller per hill are shown in Table 4.1. The maximum number of non effective tillers (1.90/hill) was recorded in treatment $T_2$ receiving 20 kg N /ha from cowdung along with 120 kg chemical nitrogen fertilizer. The effect of the $T_2$ treatment was statistically superior to the rest of the treatments. The minimum number of non effective tillers per hill (0.53/hill) was noted in control ($T_{12}$) treatment.

**Table 4.1. Effect of integrated nutrient management on plant height, number of tillers, effective tillers and noneffective tillers per hill of BRRIdhan29**

| Treatment | Plant height (cm) | Number of tillers/hill | Number of effective tillers/hill | Number of non effective tillers/hill |
|---|---|---|---|---|
| $T_1$ | 95.73a | 22.87abc | 21.07bcd | 1.80bc |
| $T_2$ | 93.13ab | 23.7abc | 21.80 a | 1.90a |
| $T_3$ | 93.07ab | 24.87a | 23.07ab | 1.80a |
| $T_4$ | 94.07ab | 22.4abcd | 20.10cde | 2.30c |
| $T_5$ | 94.07ab | 24.20ab | 23.13ab | 1.07b |
| $T_6$ | 92.47ab | 21.68bcd | 19.95cde | 1.73a |
| $T_7$ | 91.27 b | 21.33cd | 20.27cde | 1.06b |
| $T_8$ | 92.87ab | 23.33abc | 22.1abc | 1.23c |
| $T_9$ | 91.13b | 21.73bcd | 21.13bcd | 0.6de |
| $T_{10}$ | 91.80b | 20.07de | 19.47 de | 0.6de |
| $T_{11}$ | 81.60c | 18.53e | 19.00de | 0.47d |
| $T_{12}$ | 78.60d | 18.40 e | 17.87e | 0.533e |
| CV (%) | 2.54 | 7.46 | 7.06 | 9.02 |

Means in a column followed by same letter (s) are not significantly different at 5% level of significance by LSD

**Panicle length**

The effects of different treatments on panicle length are shown in Table 4.2. The highest panicle length (27.90 cm) was noted in $T_8$ treatment receiving 80 kg N as the source of urea with combination of 60 kg N from cowdung which was statistically identical to $T_5$ treatment. Treatment $T_2$ produced second highest panicle length among the treatment were selected. The lowest panicle length (25.27 cm) was produced by $T_{12}$ treatment receiving no inorganic and organic fertilizer. Treatment $T_8$ produced 10.41%

higher panicle length than control treatment (Fig. 4.4). This might be due to the balanced supply of nutrients from cowdung along with urea fertilizer, which enhanced panicle length.

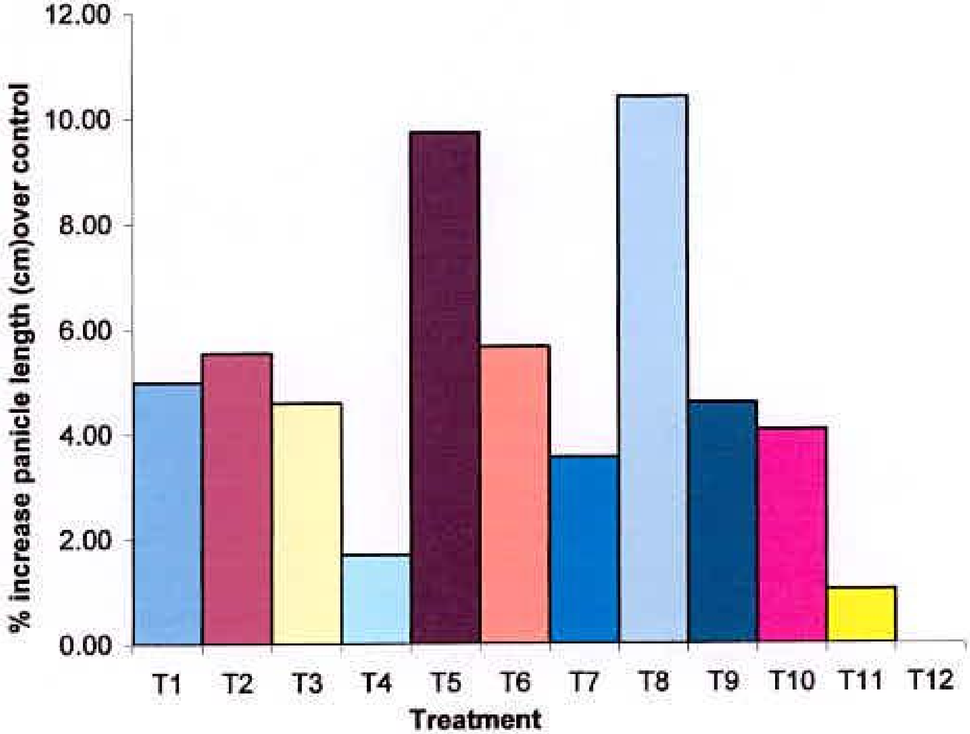


**Fig. 4.4 Effect of integrated nutrient management on percent increase panicle length of BRRIdhan29 over control**

**Number of grains per panicle**

Number of grains per panicle of BRRIdhan29 ranged from 168.10 to 229.70 and the highest and the lowest number of grains per panicle was found in the treatment $T_5$ and $T_{12}$, respectively (Table 4.2). All the treatments significantly produced higher number of grains per panicle over control treatment of BRRIdhan29. Application of 100 kg N as the source of urea along with 40 kg N from cowdung/ha produced the maximum number of grains per panicle (229.70) with an increase of 36.64% over control treatment under study (Fig. 4.5). Inorganic nitrogen with the combination of cowdung was found to be more effective in producing number of grain per panicle compared to other treatments even with only inorganic nitrogenous fertilizer. This is in agreement with the findings of other researchers (Anonymous, 2007).

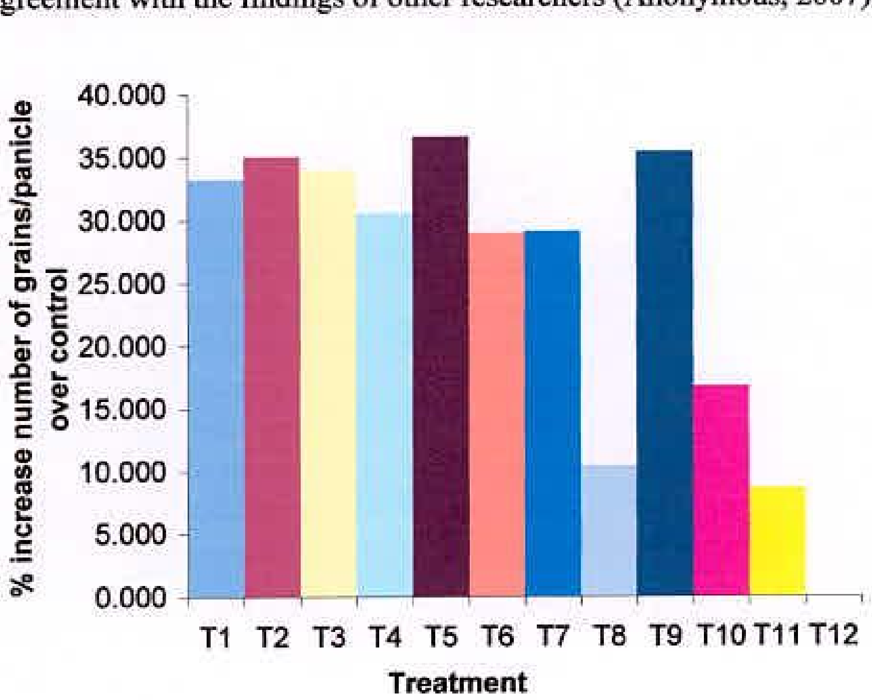


**Fig. 4.5.Effect of integrated nutrient management on percent increase number of grains per panicle over control of BRRIdhan29**

### Number of filled grains per panicle

There was a significant effect of the treatments on number of filled grains per panicle (Table 4.2). The maximum number of filled grains per panicle (216.70/panicle) was noted when 140 kg N/ha ($T_1$) was applied. The effect of this treatment was statistically similar to $T_5$ treatment but superior to the rest of the treatments of the crop. The minimum number of filled grains per panicle (162.50/panicle) was recorded in $T_{12}$ treatment receiving no chemical and manure. Treatment $T_1$ produced 33.35% higher number of filled grains per panicle (Fig. 4.6). Mondal *et al.* (1990) stated that increasing NPK rates and FYM gave significant number of filled grains per panicle of rice.

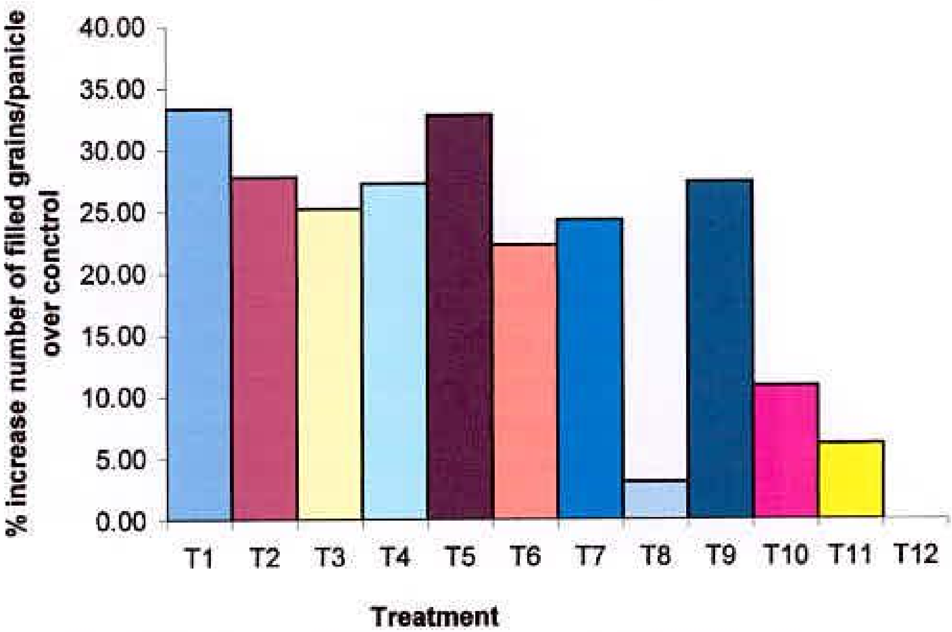


**Fig. 4.6.Efffect of integrated nutrient management on percent increase number of filled grains per panicle over control of BRRIdhan29**

**Number of unfilled grain per panicle**

The effects of different treatments on number of unfilled grains per panicle are shown in Table 4.2. With respect to number of unfilled grains per panicle, the highest number of unfilled grains per panicle (21.70/panicle) was noted in treatment $T_3$ receiving 120 kg N from urea and 20 N/ha from vermicompost. The lowest number of unfilled grains per panicle (5.66/panicle) was observed by control treatment ($T_{12}$) having no organic or inorganic fertilizers. Treatment $T_3$ produced 282.82% higher number of unfilled grains per panicle than control treatment of BRRIdhan29 (Fig. 4.7). This might be due to the nitrogenous fertilizer increase vegetative growth resulting decrease the number of filled grains, which enhanced number of unfilled grains per panicle.

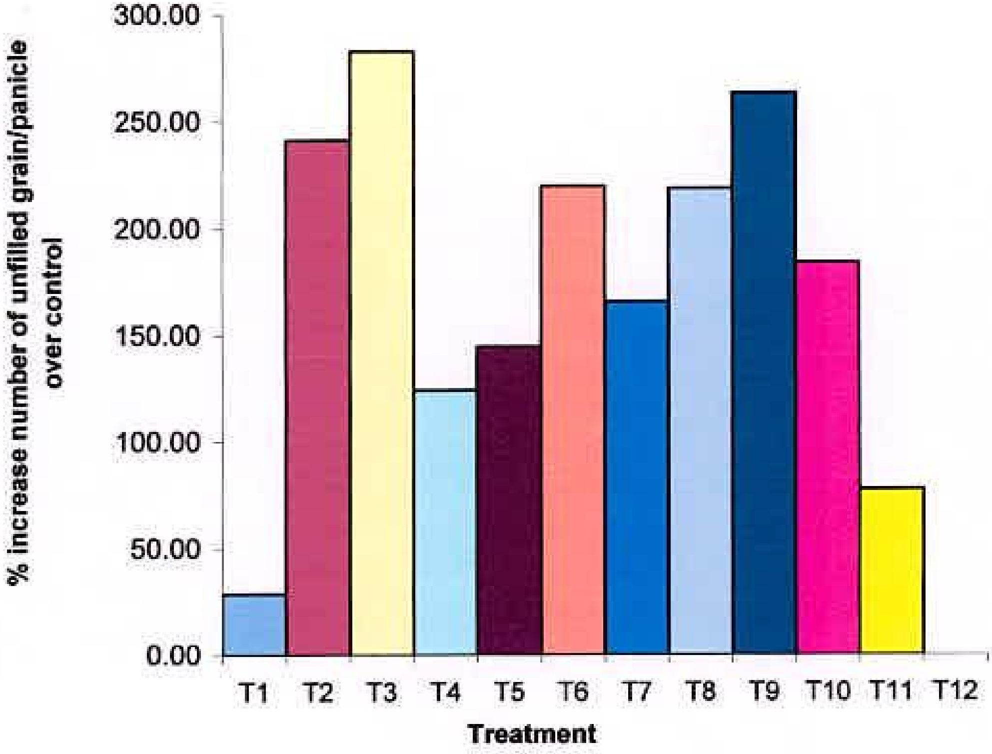


**Fig. 4.7 Efffect of integrated nutrient management on percent increase unfilled grain per panicle over control of BRRIdhan29**

**Table 4.2. Effect of integrated nutrient management on panicle length, number of grain, number of filled grain, number of unfilled grain of BRRIdhan29**

| Treatment | Panicle length (cm) | Number of grain/panicle | Number of filled grain/panicle | Number of unfilled grain/panicle |
|---|---|---|---|---|
| $T_1$ | 26.53cd | 224.00a | 216.70a | 7.30h |
| $T_2$ | 26.67bc | 227.00a | 207.70abc | 19.30bc |
| $T_3$ | 26.43cd | 225.20a | 203.50abc | 21.70a |
| $T_4$ | 25.70cde | 219.50a | 206.80abc | 12.70f |
| $T_5$ | 27.73ab | 229.70a | 215.80ab | 13.90ef |
| $T_6$ | 26.70bc | 216.80a | 198.70c | 18.10c |
| $T_7$ | 26.17cde | 217.00a | 202.00bc | 15.0de |
| $T_8$ | 27.90a | 185.60b | 167.50de | 18.10c |
| $T_9$ | 26.43cd | 227.60a | 207.00abc | 20.60ab |
| $T_{10}$ | 26.30cde | 196.30b | 180.20d | 16.10d |
| $T_{11}$ | 25.53de | 182.60bc | 172.50de | 10.10g |
| $T_{12}$ | 25.27e | 168.10c | 162.50e | 5.60i |
| CV (%) | 2.41 | 4.14 | 4.40 | 6.13 |

Means in a column followed by same letter (s) are not significantly different at 5% level of significance by LSD

**Weight of grain per panicle**

Weight of grain per panicle was significantly influenced by different combinations of organic and inorganic fertilizer (Table 4.3). Weight of grain per panicle ranged from 3.36 to 4.88 g. The maximum weight of grains per panicle (4.887 g) was recorded by the treatment $T_1$ whose effect was statistically similar to $T_3$ and $T_5$ treatments but superior to the rest of the treatments. Treatments $T_4$, $T_9$ and $T_{10}$ were statistically similar in respect of weight of grains per panicle. Treatment $T_3$ produced 45.45% higher weight of grains per panicle than control treatment of BRRIdhan29 (Fig. 4.7). The lowest weight of grains per panicle (3.487 g) was noted in control treatment ($T_{12}$). The effect of this treatment was statistically identical to $T_{11}$ treatment of BRRIdhan29. The highest 1000-grain weight in rice was found when chemical fertilizer along with poultry manure was applied at the rate of 3 t/ha (Anonymous 2007).

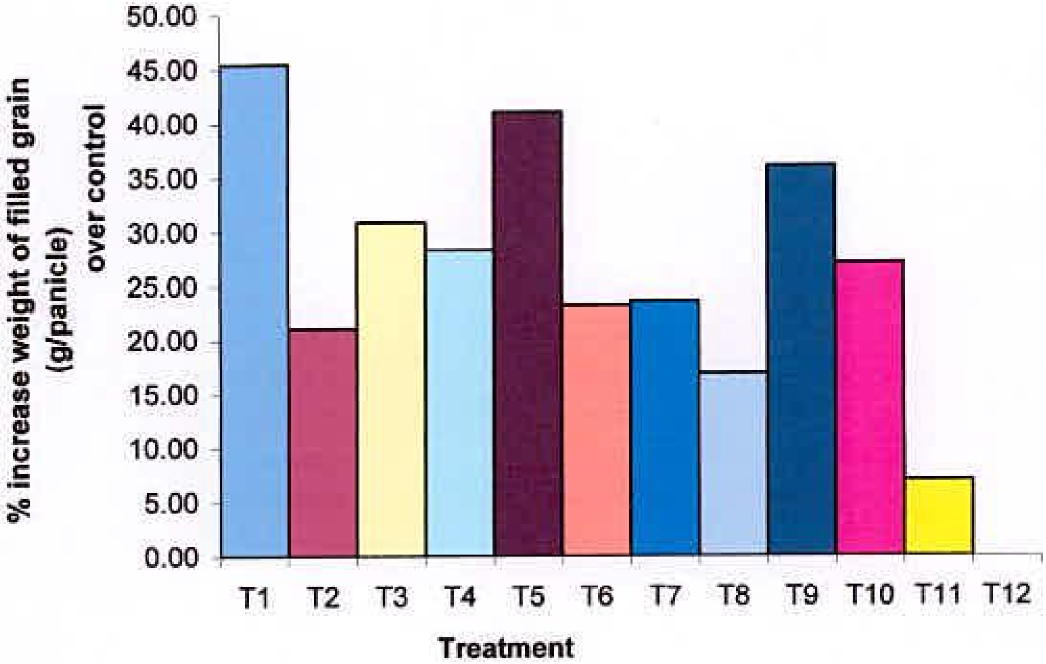


**Fig. 4.8. Effect of integrated nutrient managemnt on percent increase weight of grains (g/panicle) over control of BRRIdhan29**

**Weight of filled grain**

The effects of different treatments on weight of filled grains per panicle were statistically significant and shown in Table 4.3. With respect to weight of filled grains per panicle, the highest weight of filled grains per panicle (4.887/panicle) was observed in treatment $T_5$ receiving 100 kg N from urea and 40 kg N/ha as the source of cowdung. This might be due to the balanced supply of nutrients from nitrogenous fertilizer with combination of cowdung, which enhanced weight of filled grains per panicle. The lowest weight of filled grains per panicle (3.487/panicle) was found by control treatment having no cowdung nor vermicompost or chemical fertilizers. Treatment $T_5$ roduced 45.45% higher number of filled grains per panicle than control treatment (Fig. 4.8).

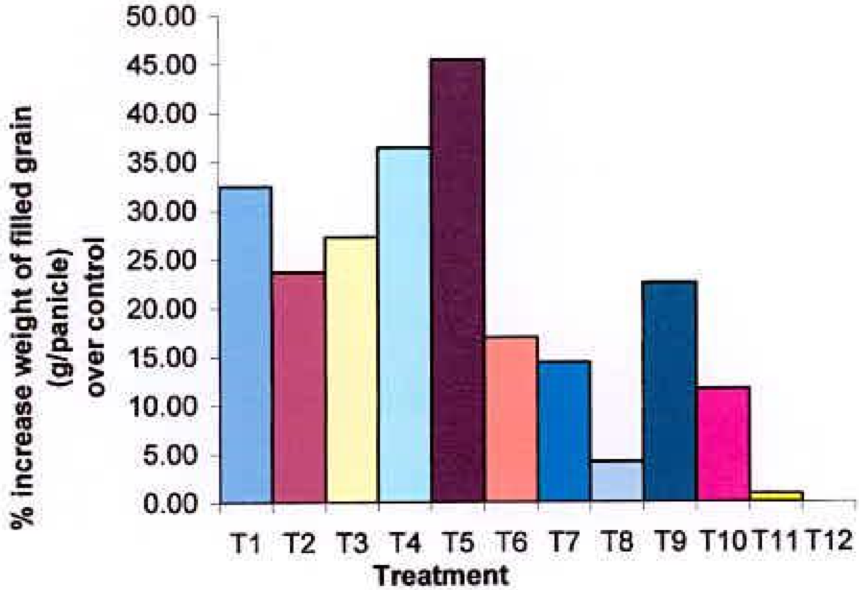


**Fig. 4.9.Effect of integrated nutrient management on percent increase weight of filled grain per panicle over control of BRRIdhan29**

### Weight of unfilled grain per panicle

The weight of unfilled grains per panicle was significantly influenced by different levels of organic and inorganic fertilizers (Table 4.3). The maximum weight of unfilled grains per panicle (0.4533) was noted in $T_3$ treatment which was statistically identical to $T_8$ and $T_9$ treatments. Organic manure in association with chemical nitrogenous fertilizer exerted positive effect on the weight of unfilled grains per panicle of BRRIdhan29. The lowest weight of unfilled grains (0.123 g/panicle) was produced by control ($T_{12}$) treatment which was statistically identical to $T_1$ treatment.

**1000-grain weight**

A significant difference in 1000-grain weight was observed at different levels of nitrogen along with cowdung and vermicompost (Table 4.3). The highest weight of 1000- grain (23.50 g) observed in the treatment $T_8$ receiving 80 kg N as the source of urea and 60 kg N/ha from cowdung. The effect of this treatment was statistically identical to $T_4$, $T_5$ and $T_9$ treatments and ranks in second position. All the treatments including chemical nitrogen with the association of cowdung and vermicompost performed better in recording 1000-grain weight over only nitrogen treatment and control. The lowest 1000-grain weight (2.54 g) was found in control treatment.

**Table 4.3. Effect of integrated nutrient management on weight of grain, filled grain, unfilled grain per panicle and 1000-grain weight of BRRIdhan29**

| Treatment | Weight of grain (g/panicle) | Weight of filled grain (g/panicle) | Weight of unfilled grain (g/panicle) | 1000-grain weight (g) |
|---|---|---|---|---|
| $T_1$ | 4.74ab | 4.45ab | 0.15g | 21.46cd |
| $T_2$ | 4.06cde | 3.68bcd | 0.38bc | 20.54bcd |
| $T_3$ | 4.40abc | 3.95bc | 0.45a | 21.01bcd |
| $T_4$ | 4.31bcd | 4.03ab | 0.28e | 22.15abc |
| $T_5$ | 4.88a | 4.43a | 0.31de | 22.64ab |
| $T_6$ | 4.14cde | 3.78cde | 0.36cd | 20.03d |
| $T_7$ | 4.15def | 3.84bcd | 0.31de | 20.52cd |
| $T_8$ | 3.92cdef | 3.50cde | 0.42ab | 23.50a |
| $T_9$ | 4.57bcd | 4.12ab | 0.45a | 22.10abc |
| $T_{10}$ | 4.27bcd | 3.75de | 0.52cd | 20.79bcd |
| $T_{11}$ | 3.59ef | 3.38e | 0.21f | 20.84bcd |
| $T_{12}$ | 3.36f | 3.24e | 0.12g | 19.42d |
| CV (%) | 8.11 | 7.13 | 7.98 | 5.36 |

Means in a column followed by same letter (s) are not significantly different at 5% level of significance by LSD

**Raw grain yield**

There was a significant effect of the treatments on number of grains per panicle (Table 4.4). The highest raw grain yield (12.50 t/ha) was found when 100 kg N as the source of urea along with 40 kg N from cowdung per hectare was applied. The effect of this treatment was statistically at par to $T_1$ but superior to the rest of the treatments. Treatment $T_3$, $T_7$, $T_8$, $T_9$ and $T_{10}$ were statistically identical in recording raw grain yield and ranked in second position. Treatment $T_7$ and $T_8$ were closely related for the determination of raw grain yield of the crop. The lowest raw grain yield (7.167 t/ha) was noted in control ($T_{12}$) treatment but the effects of this treatment was statistically identical to $T_{11}$ treatment.

**Raw straw yield**

Raw straw yield was significantly influenced by different combinations of cowdung and vermicompost along with chemical nitrogen fertilizer (Table 4.5). Raw straw yield ranged from 14.17 to 23.33 t/ha of BRRIdhan29. The highest raw straw yield (15.80 t/ha) was recorded by the treatment $T_5$ whose effect was statistically similar to $T_1$ and $T_4$ treatment but superior to the rest of the treatments. The lowest raw straw yield (9.59 t/ha) was found in control ($T_{12}$) treatment.

**Dry grain yield**

Dry grain yield was significantly influenced by different fertilizer treatments (Table 4.4). The maximum dry grain yield (7.72t/ha) was recorded in $T_5$ treatment which effect was statistically at par to $T_1$, $T_7$, $T_8$, $T_9$ and $T_{10}$ treatment of BRRIdhan29 and the lowest dry grain yield (4.42t/ha) was obtained from the control ($T_{12}$) treatment.

**Dry straw yield**

There was a significant effect of different levels of cowdung and vermicompost along with chemical nitrogenous fertilizer of BRRIdhan29 (Table 4.4). The highest dry straw yield (6.25 t/ha) was noted in $T_5$ treatment. The effect of this treatment was statistically similar to $T_2$, $T_3$, $T_7$, $T_8$, $T_9$ and $T_{10}$ treatment of BRRIdhan29. The lowest dry straw yield (4.40t/ha) was obtained from the control ($T_{12}$) treatment.

**Table 4.4. Effect of integrated nutrient management on raw grain yield, raw straw yield, dry grain yield and dry straw yield of BRRIdhan29**

| Treatment | Raw grain yield (t/ha) | Raw straw yield (t/ha) | Dry grain yield (t/ha) | Dry straw yield (t/ha) |
|---|---|---|---|---|
| $T_1$ | 8.40a | 15.12ab | 7.67a | 4.91bc |
| $T_2$ | 6.77cd | 12.13def | 6.45bcd | 5.75ab |
| $T_3$ | 7.49bc | 13.32cde | 6.65bcd | 5.52ab |
| $T_4$ | 6.26d | 14.67ab | 5.92cd | 4.57cd |
| $T_5$ | 8.46a | 15.80a | 7.72a | 6.25a |
| $T_6$ | 6.26d | 14.11bc | 5.75de | 4.06cd |
| $T_7$ | 7.56b | 12.98cde | 6.93ab | 5.64ab |
| $T_8$ | 7.56b | 13.54cd | 7.04ab | 6.09a |
| $T_9$ | 7.38bc | 14.00bc | 6.77abc | 5.52ab |
| $T_{10}$ | 7.38bc | 11.97ef | 6.84abc | 5.98a |
| $T_{11}$ | 5.30e | 11.17f | 4.80ef | 3.88d |
| $T_{12}$ | 4.85e | 9.59g | 4.42f | 4.40cd |
| CV (%) | 6.34 | 6.82 | 9.12 | 10.67 |

Means in a column followed by same letter (s) are not significantly different at 5% level of significance by LSD

**Nitrogen content in grain**

There was significant difference among the treatments in recording nitrogen content in grain (Table 4.5). The maximum nitrogen content in grain (1.199%) was note in the treatment $T_8$ receiving 80 kg N as the source of urea along with 60 kg N/ha from cowdung which was statistically identical to $T_1$ and $T_5$ treatments. Treatment $T_8$ was closely related to $T_1$ treatment. Nitrogen at the rate of 100 kg N as the source of urea, 20 kg N from cowdung along with 20 kg N/ha from vermicompost ($T_7$), 80 kg N from urea and 60 kg N/ha from vermicompost ($T_9$), 80 kg N from urea with the combination of 30 kg N from cowdung and 30 kg N/ha from vermicompost ($T_{10}$) and 70 kg N from cowdung along with 70 kg N/ha as the source of vermicompost were statistically similar in recording nitrogen content in grian. The lowest nitrogen content in grain (0.5047%) was found in control treatment ($T_{12}$). Jeong *et al.* (1996) found that 5 t/ha fermented chicken manure increased nitrogen concentration in rice plant.

**Phosphorus content in grain**

Phosphorus content in grain was varied significantly due to the influence of inorganic and organic fertilizer (Table 3.5). The phosphorus content in grain varied from 0.3648 to 0.5014%. The highest phosphorus content (0.5014%) in grain was found in treatment $T_5$ which was statistically at par to $T_2$, $T_3$, $T_7$, $T_8$ and $T_9$ treatments in recording phosphorus content in grain but superior to the rest of the treatments of the BRRIdhan29. The lowest phosphorus content in grain 0.3648% was found in control ($T_{12}$).

**Potassium content in grain**

Potassium content in grain was statistically significant due to the application of different levels of organic and inorganic fertilizer (Table 3.5). The maximum potassium content in grain (0.2325%) was recorded in treatment $T_5$ receiving 100 kg N from urea with the combination of 40 kg N/ha from cowdung. The effect of this treatment was statistically identical to $T_8$ treatment. This might be due to the application of cowdung along with urea fertilizer which supplied sufficient potassium for growth and development of crop resulting increase potassium content in grain. The lowest potassium content in grain (0.1502%) was noted in control ($T_{12}$) treatment. Kudu *et al.* (1991) obtained highest potassium content in rice grain due to the application of highest doses of NPK with the association of farmyard manure. Verma *et al.* (1991) reported significantly increased potassium content in rice grain by the application of farmyard manure and chemical fertilizer.

**Table 4.5. Effect of integrated nutrient management on nitrogen, phosphorus and potassium content of grain of BRRIdhan29**

| Treatment | Nitrogen content (%) | Phosphorus content (%) | Potassium content (%) |
|---|---|---|---|
| $T_1$ | 1.164a | 0.458b | 0.218ab |
| $T_2$ | 0.643de | 0.464ab | 0.189def |
| $T_3$ | 0.698cd | 0.490ab | 0.192cde |
| $T_4$ | 0.592de | 0.461b | 0.183ef |
| $T_5$ | 1.097a | 0.501a | 0.232a |
| $T_6$ | 0.581de | 0.458b | 0.181ef |
| $T_7$ | 0.904b | 0.470ab | 0.204bcd |
| $T_8$ | 1.199a | 0.477ab | 0.209bc |
| $T_9$ | 0.798bc | 0.471ab | 0.192cde |
| $T_{10}$ | 0.872b | 0.462b | 0.203bcd |
| $T_{11}$ | 0.894b | 0.456b | 0.172f |
| $T_{12}$ | 0.504e | 0.364c | 0.150g |
| CV (%) | 10.66 | 4.84 | 5.25 |

Means in a column followed by same letter (s) are not significantly different at 5% level of significance by LSD

**Nitrogen content in straw**

There was significant difference among the treatments in recording nitrogen content in straw (Table 4.6). The maximum nitrogen content in straw (0.7303%) was found in the treatment $T_1$ which was statistically similar to $T_3$ and $T_4$ treatments. Nitrogen content in straw varied from 0.4074% to 0.7303%. Treatment along with chemical nitrogen performed better in recording nitrogen content in straw over other treatments including organic manure even control. This might be due to the application of urea fertilizer which supplied adequate nitrogen produced protein or amino acid which was converted to nitrogen and ultimately increased nitrogen content in straw. The lowest nitrogen content in grain (0.4074%) was found in control treatment. Jeong *et al.* (1996) found that 5 t/ha fermented chicken manure increased nitrogen concentration in rice plant.

**Phosphorus content in straw**

Phosphorus content in straw was varied significantly due to the application of chemical nitrogenous fertilizer along with organic manure (Table 4.6). The highest phosphorus content (0.1851%) in straw was found in treatment $T_5$ treatment which was statistically superior to the rest of treatment. Treatments $T_2$, $T_3$, $T_4$, $T_6$, $T_7$, $T_8$, $T_9$ $T_{10}$ and $T_{11}$ were statistically identical in recording phosphorus content in straw and ranked second in position of the crop. The lowest phosphorus content (0.0975%) in straw was found in control ($T_{12}$).

**Potassium content in straw**

The content of potassium in straw was significantly influenced due to the application of different levels of chemical nitrogenous fertilizer along with organic manure (Table 4.6). The highest potassium content in straw (1.234%) was found in treatment $T_5$ receiving 100 kg N from urea along 40 kg N/ha from cowdung which was statistically similar to $T_3$, $T_7$, $T_8$ and $T_{10}$ treatment. The lowest potassium content in straw (1.139%) was noted in control treatment. Poultry manure at the rate of 3t/ha along with 50% recommended chemical fertilizer significantly increased potassium content in straw of BRRIdhan29 rice over control (Anonymous 2007a).

**Table 4.6. Effect of integrated nutrient management on nitrogen, phosphorus and potassium content of straw of BRRIdhan29**

| Treatment | Nitrogen content (%) | Phosphorus content (%) | Potassium content (%) |
|---|---|---|---|
| $T_1$ | 0.730a | 0.119d | 1.148de |
| $T_2$ | 0.614bc | 0.161bc | 1.168cde |
| $T_3$ | 0.661abc | 0.163b | 1.193abcd |
| $T_4$ | 0.676ab | 0.153bc | 1.150de |
| $T_5$ | 0.594bc | 0.185a | 1.234a |
| $T_6$ | 0.373d | 0.163b | 1.142de |
| $T_7$ | 0.618bc | 0.154bc | 1.221ab |
| $T_8$ | 0.578c | 0.154bc | 1.214abc |
| $T_9$ | 0.617bc | 0.161bc | 1.146de |
| $T_{10}$ | 0.588bc | 0.153bc | 1.221ab |
| $T_{11}$ | 0.397d | 0.152bc | 1.174bcde |
| $T_{12}$ | 0.207e | 0.097e | 1.139e |
| CV (%) | 4.51 | 8.25 | 6.35 |

Means in a column followed by same letter (s) are not significantly different at 5% level of significance by LSD

**Nitrogen uptake by grain**

Nitrogen uptake by grain was significantly influenced by the application of different levels of cowdung and vermicompost along with chemical nitrogen fertilizer (Table 4.7). The highest nitrogen uptake by grains (133.20 kg/ha) of rice was observed in $T_1$ treatment receiving 140 kg N which was statistically superior to the rest of the treatments. Treatment $T_5$ and $T_8$ were statistically identical in recording N uptake by grain and closely related to $T_1$ treatment. The uptake of nitrogen by grain ranged from 35.97 to 133.20 kg/ha. However, only nitrogen fertilizer as the source of urea responded better than treatment receiving cowdung or vermicompost along with chemical nitrogen fertilizer or even only cowdung or vermicompost. The lowest nitrogen uptake by grain (35.97 kg/ha) was found in control ($T_{12}$). These results are in good agreement with the findings of Sharma and Mitra (1991). Azim (1999) and Hoque (1999) carried out experiments with organic manures and fertilizers and found significantly higher N uptake in grain over control.

**Phosphorus uptake by grain**

A significant variation in phosphorus uptake by grain was observed due to the application of different levels of cowdung or vermicompost along with nitrogen fertilizer (Table 4.7). The maximum phosphorus uptake (57.11 kg/ha) was noted in the treatment $T_5$ which was statistically similar to $T_1$ and $T_8$ treatment. The lowest phosphorus uptake (23.82 kg/ha) by grain was found in control treatment ($T_{12}$). Gupta *et al.* (1995) reported the highest phosphorus uptake by rice with combined application of poultry manure (PM) and fertilizer phosphorus. Similar results were also reported by Hoque (1999) and Azim (1999).

**Potassium uptake by grain**

A significant variation in potassium uptake by grain was observed due to the application of different levels of nitrogen fertilizer along with organic manures (Table 4.7). The maximum potassium uptake by grain (140.60 kg/ha) was found by $T_5$ treatment. The lowest potassium uptake by grain (74.40 kg/ha) was found in control ($T_{12}$) treatment. The results of this experiment show that potassium uptake by rice grain was increased due to the application of chemical nitrogen fertilizers along with manures. Cassman (1995) found that potassium uptake increased with the increasing organic matter. These results are in good agreement with Jeegadeeswari *et al.* (2001)

who reported increased potassium uptake in rice grain due to the application of cowdung along with NPK fertilizers.

**Table 4.7. Effect of integrated nutrient management on nitrogen, phosphorus and potassium uptake by grain of BRRIdhan29**

| Treatment | Nitrogen uptake by grain (kg/ha) | Phosphorus uptake by grain (kg/ha) | Potassium uptake by grain (kg/ha) |
|---|---|---|---|
| $T_1$ | 89.27a | 35.12ab | 16.72ab |
| $T_2$ | 42.75f | 29.92cde | 12.19cde |
| $T_3$ | 46.41e | 32.58cde | 12.76bcd |
| $T_4$ | 35.04gh | 27.29 de | 10.83de |
| $T_5$ | 84.68 b | 38.67a | 17.91a |
| $T_6$ | 33.40h | 26.33ef | 10.40ef |
| $T_7$ | 62.73c | 32.57bc | 14.13abc |
| $T_8$ | 83.77b | 33.58abc | 14.71abc |
| $T_9$ | 53.48d | 31.88cd | 12.99bcd |
| $T_{10}$ | 59.64c | 31.60cd | 13.88bc |
| $T_{11}$ | 42.91i | 21.88f | 8.25fg |
| $T_{12}$ | 22.27g | 16.08g | 6.63g |
| CV (%) | 6.23 | 10.22 | 8.90 |

Means in a column followed by same letter (s) are not significantly different at 5% level of significance by LSD

**Nitrogen uptake by straw**

Nitrogen fertilizer along with cowdung and vermicompost significantly increased N uptake by straw (Table 4.8). The maximum N uptake of 83.41 kg/ha was noted in treatment $T_5$. Treatment $T_1$, $T_2$, $T_3$, $T_4$, $T_7$, $T_8$, $T_9$ and $T_{10}$ were statistically identical in recording nitrogen uptake by straw. The lowest N uptake (26.62 kg/ha) was noted in control ($T_{12}$) treatment.

**Phosphorus uptake by straw**

Effect of cowdung, vermicompost along with nitrogen fertilizer on phosphorus uptake by straw was significant (Table 4.8). Treatment $T_8$ recorded the maximum P uptake (14.02 kg/ha) which was statistically similar to $T_1$, $T_2$, $T_3$, $T_7$, $T_9$ and $T_{10}$ treatment. The minimum P uptake by straw (7.72 kg/ha) was found in control. This might be due to the application of chemical nitrogen fertilizer in association with organic manures which might have increased efficiency of phosphorus accumulation in straw result higher phosphorus uptake in straw. Chemical fertilizer along with poultry manure at the rate of 3 t/ha increased phosphorus uptake in rice (Anonymous, 2007a).

**Potassium uptake by straw**

Potassium uptake by straw was significantly varied with different levels of chemical nitrogen fertilizer along with cowdung and vermicompost (Table 4.8). The maximum K uptake (113.90 kg/ha) by straw was found in $T_5$ treatment. Chemical nitrogen fertilizer as the source of urea along cowdung increased potassium uptake by straw. Control treatment produced the minimum potassium uptake (73.93 kg/ha). Jeegadeeswari *et al.* (2001) also observed that the potassium uptake by rice was increased by the application of organic manure with nitrogen, phosphorus and potassium. Chemical fertilizer with the association of poultry manure at the rate of 2 t/ha increased phosphorus uptake in rice (Anonymous, 2007b).

**Table 4.8. Effect of integrated nutrient management on nitrogen, phosphorus and potassium uptake by straw of BRRIdhan29**

| Treatment | Nitrogen uptake by straw (kg/ha) | Phosphorus uptake by straw (kg/ha) | Potassium uptake by straw (kg/ha) |
|---|---|---|---|
| $T_1$ | 35.84b | 5.84ab | 56.36cde |
| $T_2$ | 35.30b | 9.25ab | 67.16abc |
| $T_3$ | 36.48b | 8.99ab | 65.85bc |
| $T_4$ | 30.89b | 6.99bc | 52.55de |
| $T_5$ | 37.12a | 11.56bc | 77.12a |
| $T_6$ | 15.02c | 6.61bc | 46.36e |
| $T_7$ | 34.85b | 8.68ab | 63.28ab |
| $T_8$ | 35.20b | 9.37a | 73.93ab |
| $T_9$ | 34.05b | 8.88ab | 63.25bcd |
| $T_{10}$ | 34.63b | 9.14ab | 73.01ab |
| $T_{11}$ | 15.40c | 5.89c | 45.55e |
| $T_{12}$ | 9.10c | 4.26c | 50.16e |
| CV (%) | 3.94 | 4.10 | 10.61 |

Means in a column followed by same letter (s) are not significantly different at 5% level of significance by LSD

**pH of post harvest soil**

There was an insignificant effect of the different levels of treatments on soil pH of post harvest soil of research farm (Table 4.9). pH of post harvest soil insignificantly varied among the different levels of cowdung and vermicompost along with chemical nitrogen fertilizers. Treatment $T_2$ showed the highest pH (6.50) and $T_{12}$ is the lowest pH (6.183) in post harvest soil.

**Organic matter**

Organic matter was significantly influenced by different levels of cowdung and vermicompost along with chemical nitrogen fertilizer of post harvest soil (Table 4.9). The level of organic matter in post harvest soil increased due to combined application of cowdung and vermicompost with the combination of chemical nitrogenous fertilizer. The maximum organic matter of post harvest soil (2.80%) was recorded from $T_5$ which was statistically identical to all the treatments except $T_1$, $T_{10}$ and $T_{12}$ treatments of the crop. Treatments $T_1$, $T_2$, $T_6$, $T_7$, $T_8$, $T_9$, $T_{10}$ and $T_{11}$ were statistically identical in respect of organic matter content of post harvest soil. The lowest organic matter (1.02%) of post harvest soil was recorded in control ($T_{12}$) and the effect of this treatment was statistically similar to $T_1$ treatment. Xu *et al.* (2008) reported that application of chemical fertilizer with organic manure increase soil organic matter.

**Total nitrogen of post harvest soil**

The combined effect of different levels of cowdung and vermicompost with the association of chemical nitrogen fertilizer on total nitrogen of post harvest soil was significant (Table 4.9). The highest total nitrogen of post harvest soil (0.070%) was recorded through the application of 100 kg N from urea in the combination of 40 kg N/ha as the source of cowdung. The effect of this treatment was statistically similar to $T_3$, $T_4$ and $T_7$ but superior to the rest of the treatments of post harvest soil. The lowest total nitrogen of post harvest soil (.026%) was recorded $T_{12}$ treatment.

**Available Phosphorus of post harvest soil**

A significant difference in available phosphorus content of post harvest soil was observed at different levels of cowdung and vermicompost along with chemical nitrogen fertilizer as the source of urea (Table 4.9). The highest available P (11.77 ppm) in post harvest soil was recorded in $T_6$ treatment and the lowest was noted in $T_{12}$ treatment.

**Exchangeable K of post harvest soil**

There was significant difference among the treatments in recording exchangeable potassium content of post harvest soil (Table 4.9). The maximum exchangeable potassium of post harvest soil (22.42ppm) was found in treatment $T_6$ which was statistically superior to the rest of the treatments under study. The lowest exchangeable potassium content (7.32ppm) in post harvest was found in control ($T_{12}$) treatment.

**Table 4.9. Effect of integrated nutrient management on the pH, organic carbon and NPK content in post harvest soil of BRRIdhan29**

| Treatment | pH | Organic matter (%) | Total N (%) | Available P (ppm) | Exchangeable K (ppm) |
|---|---|---|---|---|---|
| $T_1$ | 5.320 | 1.10b | 0.050d | 10.10ab | 8.25g |
| $T_2$ | 5.500 | 1.45ab | 0.060cd | 10.26ab | 18.44cd |
| $T_3$ | 5.360 | 1.60a | 0.063abc | 11.40ab | 19.44bc |
| $T_4$ | 5.370 | 1.75a | 0.065ab | 11.06ab | 20.48b |
| $T_5$ | 5.390 | 1.80a | 0.070a | 11.62a | 17.49d |
| $T_6$ | 5.120 | 1.50ab | 0.068a | 11.77a | 22.42a |
| $T_7$ | 5.990 | 1.50ab | 0.068a | 9.740b | 16.67d |
| $T_8$ | 5.110 | 1.70ab | 0.065ab | 10.72ab | 11.12f |
| $T_9$ | 5.360 | 1.50ab | 0.059cd | 10.84ab | 11.83f |
| $T_{10}$ | 5.160 | 1.90b | 0.054d | 9.673b | 14.39e |
| $T_{11}$ | 5.280 | 1.50ab | 0.052d | 9.997ab | 16.95d |
| $T_{12}$ | 5.183 | 1.02c | 0.026e | 10.04ab | 7.32g |
| CV (%) | NS | NS | 5.65 | 10.18 | 7.10 |

Means in a column followed by same letter (s) are not significantly different at 5% level of significance by LSD

# CHAPTER 5
# SUMMARY AND CONCLUSION

# CHAPTER- V

# SUMMARY

To evaluate the effects of integrated nutrient management of cowdung and vermicompost along with nitrogen as the source of urea were conducted in boro season during 2011-12 at the research farm of Sher-e-Bangla Agricultural University, Dhaka-1207.

The experiment was carried out to assess the integrated nutrient management on BRRIdhan29 in boro season.

The results of the experiment revealed that yield and yield contributing characters and nutrients content and uptake by rice were increased due to the application of varried levels of cowdung and vermicompost along with nitrogen from urea. However, combined application of cowdung and nitrogen at the rate of 100 kg N from urea along with 40 kg N/ha as the source of cowdung performed best in recording yield and yield contributing characters and nitrogen content and uptake by grain and straw of BRRIdhan29.

In post harvest soils, the contents of pH, organic matter, total nitrogen, available phosphorus and exchangeable potassium were increased due to application of cowdung and vermicompost compared to initial soil. Soil pH insignificantly decreased slightly as compared to that of the initial soil. Fertilized with urea-nitrogen alone decreased the values of organic matter, total N, available P and excchangeble potassium in post harvest soil.

The maximum plant height was recorded in $T_1$ treatment, number of effective tillers per hill in $T_2$, panicle length, number of dry grain and straw yield, number of filled grains per panicle in $T_5$, 1000-grain weight in $T_8$ and

NPK content in $T_5$. But the maximum N uptake by dry grain was found in $T_1$ treatment and PK uptake by dry grain in $T_5$ treatment of BRRIdhan29. Control treatment $T_{12}$ produced the lowest yield and yield contributing characters as well as NPK content and uptake by grain.

# CONCLUSIONS AND RECOMMENDATIONS

## Conclusions

- Combined application of 100 kg N as the source of urea along with 40 kg N/ha from cowdung performed the best in recording yield and yield contributing characters of BRRIdhan29.
- Among the organic sources, cowdung performed the best in recording yield and yield attributing characters as well as NPK content and uptake by BRRIdhan29.
- Cowdung and vermicompost alone or with the combination of nitrogenous fertilizer insignificantly decreased (slight) soil pH than in initail soil.
- Organic manuring slightly increased total N, available P and exchangeable K in post harvest soil compared to initial soil
- Increasing trend in cowdung and vermicompost content was observed in soil where organic manures were applied

## Recommendations

- In farmer's field, 100 kg N as the source of urea along with 40 kg N/ha from cowdung may be recommended for higher yield of BRRIdhan29.
- Similar study should be done to evaluate the integrated nutrient management to get maximum yield of BRRIdhan29 in other places of Bangladesh.

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# CHAPTER VI

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