GROWTH, YIELD AND NUTRIENT CONTENTS OF MUNGBEAN (BARI Mung 6) AS AFFECTED BY NITROGEN FERTILIZER AND POULTRY MANURE

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CERTIFICATE

This is to certify that the thesis entitled "GROWTH, YIELD AND NUTRIENT CONTENTS OF MUNGBEAN (BARI Mung 6) AS AFFECTED BY NITROGEN FERTILIZER AND POULTRY MANURE" 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 bonafide research work carried out by MD. MAINUL ISLAM, Registration. No. 06-01979, 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 has duly been acknowledged.

Dated:

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Dedicated to my beloved

Parents

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ABSTRACT

An experiment was conducted during the period from February to April of 2012 at the experimental field of the farm of Sher-e-Bangla Agricultural University to study the effect of nitrogen fertilizers and poultry manure on growth, yield and nutrient contents of mungbean (BARI Mung 6). The two-factorial experiment was conducted by using RCBD (Randomized Completely Block Design) with three replications. During the experiment, following treatments were included : N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1} and P_0 – no poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3 - Poultry manure @ 10 t ha^{-1}. Both nitrogen and poultry manure doses as well as their interactions showed significant effect on almost all growth and yield parameters. At harvest highest plant height, number of leaves and branches $plant^{-1}$, average dry weight $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, 1000-seed weight, seed yield and stover yield recorded in N_3 (Nitrogen @ 25 kg ha^{-1}) and it were either closely followed by or statistically similar with N_2 (Nitrogen @ 20 kg ha^{-1}) and subsequently followed by N_1 (Nitrogen @ 10 kg ha^{-1}). N, P and K content in seed were recorded highest in N_3 (Nitrogen @ 25 kg ha^{-1}) and it was also either closely followed by or statistically similar with N_2 (Nitrogen @ 20 kg ha^{-1}). Lowest results for above parameters were found from the treatment using no nitrogen fertilizer (N_0). Similarly, in the case of sole effect of poultry manure the highest values for above parameters were recorded in P_3 (Poultry manure @ 10 t ha^{-1}) which was, in most of the cases, statistically similar with P_2 (poultry manure @ 7 t ha^{-1}) and then followed by P_1 (Poultry manure @ 4 t ha^{-1}). Lowest results were found from the treatment using no poultry manure (P_0). In the case of interaction of treatments, highest seed yield was recorded from nitrogen @ 25 kg ha^{-1} with poultry manure @ 10 t ha^{-1} which was either closely followed by or statistically similar with the interaction of nitrogen @ 25 kg ha^{-1} and poultry manure @ 7 t ha^{-1}; interaction of nitrogen @ 20 kg ha^{-1} and poultry manure @ 10 t ha^{-1} and interaction of nitrogen @ 20 kg ha^{-1} and poultry manure @ 7 t ha^{-1}. Stover yield and nutrient contents showed almost similar trend like seed yield.

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LIST OF ABBREVIATIONS

%	=	Percent
@	=	At the rate
°C	=	Degree Celsius
AEZ	=	Agro Ecological Zone
BARI	=	Bangladesh Agricultural Research Institute
BAU	=	Bangladesh Agricultural University
BBS	=	Bangladesh Bureau of Statistics
cv.	=	Cultivar (s)
DAS	=	Days After Sowing
DMRT	=	Duncan's Multiple Range Test
EC	=	Emulsifiable Concentrate
et al.	=	And Others
FAO	=	Food and Agriculture Organization
g	=	Gram
IRRI	=	International Rice Research Institute
LSD	=	Least Significant Difference
MoP		Muriate of Potash
ppm	=	Parts per million
RCBD	=	Randomized Complete Block Design
SAU	=	Sher-e-Bangla Agricultural University
t/ha	=	Ton per Hectare
Tk./ha	=	Taka per Hectare
TSP	=	Triple Super Phosphate

CHAPTER 1

INTRODUCTION

Mungbean [*Vigna radiata* (L.) Wilczek] is one of the most important pulse crops grown in Bangladesh. Its edible grain is characterized by good digestibility, flavour, high protein content and absence of any flatulence effects (Ahmed, 2003). Its seed contains 24.7% protein, 0.6% fat, 0.9% fiber and 3.7% ash (Potter and Hotchkiss, 1997) as well as sufficient quantity of calcium, phosphorus and important vitamins. Due to a cheaper protein source, it is designated as "poor man's meat".

Mungbean is cultivated on an area of 261.4 thousand hectares with total grain production of 134.4 thousand tonnes and average yield of 482.63 kg ha^{-1} (Anonymous, 2003). It has the potential of producing higher grain yield of about 1295 kg ha^{-1} (Bilal, 1994). Moreover, lack of attention on fertilizer use is also instrumental in lowering mungbean yields (Mansoor, 2007) Average yield of mungbean in Bangladesh is very low, which is primarily due to substandard methods of cultivation, poor crop stand, imbalanced nutrition, poor plant protection measures and lack of high yielding varieties.

Bangladesh is an agro-based country where many crops are grown. Among them, pulses constitute the main sources of vegetable protein for people, especially the poor people of Bangladesh. They are also the best sources of protein for domestic animals. They also help to overcome the malnutrition, which is a serious health problem in Bangladesh that has been threatening to the whole nation. In Bangladesh, the daily per capita consumption of pulses is only 13.29 g, whereas World Health Organization has suggested 45 g per capita per day for a balanced diet (BARI, 1998). Approximately, 1,08,000 tons of pulses are imported in Bangladesh each year. But to meet the suggested requirement of pulses of 45 g per capita per day, the productions to be increased even more than three folds

Animal manures are valuable sources of nutrients and the yield-increasing effect of manure is well established. Apart from the nutrients in manure, its effects on the improvement of soil organic matter, soil structure and the biological life of the soil are well recognized particularly at high rates of application in on-station trials. There is also some evidence that it may contain other growth-promoting substances like natural hormones and B vitamins (Leonard, 1986). Plants can only use nutrients that are in an inorganic form. Manure N and P are present in organic and inorganic forms, and are not totally available to plants. The organic forms must be mineralized or converted into inorganic forms over time before they can be used by plants. The availability of K in manure is considered similar to that in commercial fertilizer since the majority of K in manure is in the inorganic form (Motavalli *et al.*, 1989). In general, 90 to 100 % of K in manure is available during the first year of application. Many studies have demonstrated that application of manure will produce crop yields equivalent or superior to those obtained with chemical fertilizers (Xie and MacKenzie, 1986; Motavalli *et al.*, 1989). Crop quality has also been improved by manure application (Eck *et al.*, 1990; Pimpini *et al.*, 1992). When crop improvements with manure were greater than those attained with commercial fertilizer, response was usually attributedto manure supplied nutrients or to improved soil conditions not provided by commercial fertilizer (CAST, 1996). Zhang *et al.* (1998) found that 2 kg manure-N were equivalent to 1 kg of urea-N in terms of plant uptake and yield response during the first year following cattle feedlot manure application. Manure improves the physical condition of the soil and increases P and biological activity (Sommerfeldt and Chang, 1985; Chang *et al.*, 1990; CAST, 1996). The organic matter, total N and micronutrient content of the surface soil are increased as a result of manure application. The manure requirements for most of the crops are high, ranging from 5 to 20 tons of fresh manure ha^{-1}. Manure, when applied, will be mineralized gradually and nutrients become available. However, the nutrient content of manure varies, and the reason is that the fertilizer value of manure is greatly affected by diet, amount of bedding, storage and application method (Harris *et al.*, 2001).

In Bangladesh, total production of pulses is only 0.65 million ton against 2.7 million tons requirement. This means the shortage is almost 80% of the total requirement (Rahman & Ali, 2007). This is mostly due to low yield (MoA, 2005). The reasons for low yield are manifold: some are varietals and some are agronomic management. Due to the shortage of land, the scope of its extensive cultivation is very limited. As such mungbean yield and quality can be improved by the balanced use of fertilizers and also by managing organic manure properly. Therefore, attempts must be made to increase the yield per unit area by applying improved technology and management practices.

The present study was, therefore, contemplated to investigate the effect of different levels of nitrogen in combination with different levels of poultry manure on growth and yield as well as nutrient content of a mungbean cultivar.

2. Research objectives:

a) To study the effect of different doses of nitrogen and poultry manure on growth and yield of mungbean.

b) To study the nutrient content in mungbean as influenced by nitrogen and poultry manure doses.

c) To find out the best combination of nitrogen fertilizer and poultry manure for the better production and quality of mungbean.

CHAPTER 2

REVIEW OF LITERATURE

The literature pertaining to influence of different organic manures and inorganic manures on growth, seed yield and quality attributes and influence of seed treatment with chemicals and botanicals on seed storability of mungbean are presented in this chapter. However, relative information on effect of nitrogen and poultry manure on mungbean is not adequate; analogies from other fertilizer, manure and crops have also been included to emphasize certain point of view.

2.1 The role of nitrogen and its effect on crops

Panda *et al.* (2003) conducted field experiments in West Bengal, India to evaluate the effects of NK application on the productivity of yambean (*Pachyrhizus erosus*)-pigeonpea (*Cajanus cajan*) intercropping system and its residual effect on the succeeding mungbean (*Vigna radiata*). Marketable tuber yield of yambean increased linearly with increasing NK levels, with the highest being recorded with NK at 80 kg ha^{-1} applied in 2 splits (22.9 t ha^{-1}) closely followed by 100 kg NK ha^{-1} applied in 2 splits (22.4 t ha^{-1}). For pigeonpea, the maximum grain (14.38 q ha^{-1}), stick (8.08 q ha^{-1}) and bhusa yield (9.96 q ha^{-1}) were recorded with 80 kg NK ha^{-1} applied in 2 splits. The highest level of NK (100 kg ha^{-1}) applied in 3 splits to yambean-pigeonpea intercropping system registered the maximum grain yield of the succeeding mungbean (9.43 q ha^{-1}), which was 33% higher than the untreated control.

Ashraf *et al.* (2003) conducted a field experiment at Faisalabad in Pakistan to observe the effects of seed inoculation of a biofertilizer and NPK application on the performance mungbean cv. NM-98. The treatments consisted of the seed inoculation of *Rhizobium phaseoli* singly or in combination with 20:50:0, 40:50:0 or 50:50:50 NPK kg ha^{-1} (urea), P (single super phosphate) and K (potassium sulphate) were applied during sowing. The tallest plants (69.9 cm) were obtained with seed inoculation + 50:50:0 kg NPK ha^{-1}. Seed inoculation + 50:50:0 or 50:50:50 kg ha^{-1} resulted in the highest number of pods $plant^{-1}$ (29.0, 56.0, 63.9 and 32.6, respectively) and seed yield (1,053, 1,066, 1,075 and 1,072 kg ha^{-1}). Harvest index was the highest with seed inoculation in combination with NPK and 40:50:0 (25.23), 50:50:0 (24.70) or 50:50:50 (27.5). Seed inoculation along with NPK at 30:50:0 kg ha^{-1} was optimum for the production of high seed yield by mungbean cv. NM-98.

A field experiment was laid out by Oad and Buriro (2005) to determine the effect of different NPK levels (0-0-0, 10-20-20, 10-30-30, 10-30-40 and 10-40-40 kg ha^{-1}) on the growth and yield of mungbean cv. AEM 96 in Tandojam, Pakistan during the spring season of 2004. The different NPK levels significantly affected the crop parameters. The 10-30-30 kg NPK ha^{-1} was the best treatment, recording plant height of 56.3 cm, germination of 90.5%, satisfactory plant population of 162, prolonged days taken to maturity of 55.5, long pods of 5.02 cm, seed weight per plant of 10.5 g, seed index of 3.52 g and the highest seed yield of 1,205 kg ha^{-1}. There was no significant change in the crop parameters beyond this level.

Sultana *et al.* (2009) conducted a field experiment during the period from March 2007 to June 2007 at Sher-e-Bangla Agricultural University, Dhaka with nitrogen and weed management in mungbean where nitrogen (0, 20 kg ha^{-1} at vegetative, 20 kg N ha^{-1} at vegetative and flowering) and weeding (no weeding, one weeding at vegetative, two weeding at vegetative and flowering) was done. Result showed that application of 20 kg N ha^{-1} basal showed significantly higher values of all growth parameters like number of leaflet (24.3 at 20 DAS and 24.3 at 40 DAS), leaf area (23.3 cm^2 at 20 DAS and 102.2 cm^2 at 40 DAS), Leaf dry weight (0.30, 6.99 and 10.61 g at 10, 17 and 24 DAS, respectively) and shoot dry weight (2.76 and 4.69 g at 17 and 24 DAS, respectively). This treatment also produced significantly more number of branches (1.67), pods plant^{-1} (17.8) and seed yield (1,982 kg ha^{-1}).

Yaqub *et al.* (2010) carried out pattern based experiment at Pakistan to evaluate the induction of short-duration (maturity period, 55-70 days) mungbean [*Vigna radiata* (L.) Wilczek] as a grain legume in the pre-rice niche of the rice-wheat annual double cropping system and found that induction of a short-duration grain legume in the rice-wheat system appears to be more attractive as it offers short-term additional benefits to farmers and is equally beneficial in sustaining the productivity of rice-wheat system over time. The mungbean crop (grown without mineral N fertilizer) produced 1,166 kg ha^{-1} of grain in addition to 4,461 kg ha^{-1} of the manure biomass (containing 52 kg N ha^{-1}) that was ploughed under before planting rice with urea-N applied in the range of 0-160 kg N ha^{-1}. Averaged across urea-N treatments, manuring significantly increased the number of tillers $plant^{-1}$ (11% increases), rice grain yield (6% increase), grain N content (4% increase) and grain N uptake (9% increase). Significant residual effects of manuring were observed on the subsequent wheat crop showing higher grain yield (21% increases), grain N uptake (29% increase) and straw yield (15% increase). The results suggested the feasibility of including mungbean in the pre-rice niche to improve the productivity of the annual rice-wheat double cropping system.

A field experiment was conducted by Mohammad *et al.* (2010) to study the effect of crop residues and tillage practices on BNF, WUE and yield of mungbean (*Vigna radiata* (L.) Wilczek) under semi-arid rainfed conditions at the Livestock Research Station, Surezai, Peshawar in North West Frontier Province (NWFP) of Pakistan. The experiment comprised of two tillage i) conventional tillage (T1) and ii) no-tillage (T0) and two residues i) wheat crop residues retained (+) and ii) wheat crop residues removed (-) treatments. Basal doses of N @ 20: P @ 60 kg ha^{-1} was applied to mungbean at sowing time in the form of urea and single super phosphate respectively. Labeled urea having 5% N-15 atom excess was applied @ 20 kg N ha^{-1} as aqueous solution in micro plots ($1m^2$) in each treatment plot to assess BNF by mungbean. Similarly, maize and sorghum were grown as reference crops and were fertilized with N-15 labeled urea as aqueous solution having 1% N-15 atom excess @ 90 kg N ha^{-1}. The results obtained showed that mungbean yield (grain/straw) and WUE were improved in no-tillage treatment as compared to tillage treatment. Maximum mungbean grain yield (1224 kg ha^{-1}) and WUE (6.61 kg ha^{-1} mm^{-1}) were obtained in no-tillage (+ residues) treatment. The N concentration in mungbean straw and grain was not significantly influenced by tillage or crop residue treatments. The amount of fertilizer-N taken up by straw and grain of mungbean was higher under no-tillage with residues-retained treatment but the differences were not significant. The major proportion of N (60.03 to 76.51%) was derived by mungbean crop from atmospheric N-2 fixation, the remaining (19.6 to 35.91%) was taken up from the soil and a small proportion (3.89 to 5.89%) was derived from the applied fertilizer in different treatments. The maximum amount of N fixed by mungbean (82.59 kg ha^{-1}) was derived in no-tillage with wheat residue-retained treatment. By using sorghum as reference crop, the biological nitrogen fixed by mungbean ranged from 37.00 to 82.59 kg ha^{-1} whereas with maize as a reference crop, it ranged from 34.74 to 70.78 kg ha^{-1} under different treatments. In comparison, non-fixing (reference) crops of sorghum and maize derived upto 16.6 and 15.5% of their nitrogen from the labeled fertilizer, respectively. These results suggested that crop productivity, BNF and WUE in the rainfed environment can be improved with minimum tillage and crop residues retention.

In plant nutrition, nitrogen is involved in the composition of all amino acids, proteins and many enzymes. Nitrogen is also part of the puric and pyrimidic bases, and therefore is a constituent of nucleic acids (Mills and Jones, 1996). Typically, N content in plants ranges between 1 and 6 % of the dry weight in leaf tissues. It is absorbed by plants in the form of nitrate and ammonium ions. In moist, warm, well-aerated soils the nitrate form is dominant. Once inside the plant, nitrate is reduced to NH_4^+-N using energy provided by photosynthesis.

Glucose consumption for protein production is about 50 % higher when N is provided as NO_3^- rather than as NH_4^+. In addition to its role in the formation of proteins, nitrogen is an integral part of chlorophyll, which is the primary absorber of light energy needed for photosynthesis. An adequate supply of N is associated with vigorous vegetative growth and a dark green colour and an imbalance of N or an excess of this nutrient in relation to other nutrients, such as P, K, and S can prolong the growing period and delay crop maturity (Marti and Mills, 1991).

The supply of N is related to carbohydrate utilization. When N supply is insufficient, carbohydrates will be deposited in vegetative cells, which will cause them to thicken (Sasseville and Mills, 1979; Marti and Mills, 1991; Mills and Jones, 1996). When N supplies are adequate, and conditions are favourable for growth, proteins are formed from the manufactured carbohydrates, less carbohydrate is thus deposited in the vegetative cells and more protein is formed, and because protoplasm is highly hydrated, a more succulent plant results. Excessive succulence in some crops may have a harmful effect. With grain crops, lodging may occur.

When plants are deficient in N, they become stunted and yellow in appearance. This yellowing, or chlorosis, usually appears first on the lower leaves; the upper leaves remaining green. In cases of severe N shortage the leaves will turn brown and die (Mills and Jones, 1996). The tendency of the young upper leaves to remain green as the lower leaves yellow or die is an indication of the mobility of N in the plant. When the roots are unable to absorb sufficient amounts of this element to meet the growing requirement, N compounds in the older plant parts will undergo lysis. This involves the conversion of protein N to a soluble form, which are translocated to the active meristematic regions and reused in the synthesis of new protoplasm.

2.2 Effect of organic manures

Appavu *et al* (2000) reported that the application of poultry manure @ 5 t per ha had significantly recorded higher seed yield (1039 kg/ha) followed by the application of FYM @ 12.50 t per ha (899 kg/ha) over control (638 kg/ha) in soybean.

Channabasavanna *et al*. (2001) observed in rice that the application of poultry manure @ 2 t per ha recorded significantly higher seed yield (4883 kg/ha) followed by FYM @ 7 t per ha (4459 kg/ha) and press mud @ 2 t per ha (4545 kg/ha) and control (4124 kg/ha). The application of poultry manure and FYM increased the seed yield by 18.40 per cent and 11.30 per cent respectively.

A field experiment was conducted by Raundal and Sabale (2000) during 1997-98 in Maharashtra, in India showed that application of vermicompost to mungbean gave highest nitrogen content and protein in grain.

Karmegam and Daniel (2000) reported that application of vermicompost resulted in significant increase in growth and yield of cowpea.

A field trial was conducted by Reddy *et al.* (1998) during kharif season of 1997-98 showed that application of 60 kg P_2O_5 per hectare through phospho-vermicompost significantly increased the growth, dry matter and yield of pea.

An experiment was carried out by Bhuiyan *et al.* (2003) at the Bangladesh Agricultural University (BAU) Farm, Mymensingh from *rabi* season of 1999 to *kharif-II* season of 2002 in the Old Brahmaputra Floodplain Soils (AEZ 9) of Bangladesh to investigate the effect of integrated use of organic and inorganic fertilizers on yield and nutrient uptake of T. Aus rice and mungbean in the Wheat-T. Aus/ Mungbean-T. Aman cropping pattern. The results showed that application of organic manure along with chemical fertilizers resulted in markedly higher uptake of nutrients. The application of NPKS (HYG) fertilizers remarkably increased the crop yield. The lowest grain yield and the lowest nutrient uptake were noted in control plots receiving no fertilizer or manure.

A field experiment was conducted by Shukla and Tyagi (2009) during 2004–07 in summer season to ascertain the effect of 2 organic inputs, viz enriched compost and vermicompost applied @ 2 tonnes/ha, on selected soil parameters for soil health, growth and nodulation of 'Pusa Ratna' mungbean [*Vigna radiata* (L.) Wilczek]. The beneficial effects were compared not only to soils but also the growth of the crop without organic inputs. Organic matters, like vermicompost and enriched compost enhanced soil physical properties and plant nutrients (N, P and K) at the time of crop establishment and early growth. Incorporation of vermicompost and enriched compost before sowing had a greater beneficial impact, especially on physical properties of soil. The added organic materials, like vermicompost and enriched compost increased germination growth of shoots, roots and enhanced nodulation, the slightly greater benefits were derived with vermicompost as compared to enriched compost. The selected microorganisms used were *Rhizobium*, a symbiotic nitrogen fixer and phosphate-solubilizing bacteria which helps in solubilization of fixed phosphorus.

A field experiment was conducted by Kumar *et al.* (2002) during 2001-02 on the sandy loam soil of Haryana, India to investigate the effect of *Rhizobium* sp. seed inoculation, FYM (farmyard manure) at 5 t ha^{-1}, vermicompost at 2.5 and 5 t ha^{-1}, and 4 levels of fertilizers (control, no chemical fertilizer; 75% recommended dose of fertilizer, RDF; 100% RDF. N:P at 20:40 kg ha^{-1}; and 125% RDF) on the performance of mungbean cv. Asha. *Rhizobium* sp. inoculation significantly increased the grain yield. Increasing RDF levels up to 100% also increased grain yield. Vermicompost at 5 t ha^{-1} produced 16.5 and 9.5% higher grain yield compared to FYM at 5 t ha^{-1} and vermicompost at 2.5 t ha^{-1}, respectively, in 2002. However, the organic amendment did not affect the grain pod^{-1} in 2001 and the 1000-grain weight in both years. The interaction of the different treatments was significant in 2002. Vermicompost application at both levels resulted in higher yield compared to FYM. Yield increased with increasing fertilizer rate up to 125% RDF, when applied with FYM, but yield was higher under the treatment 100% RDF + vermicompost (both rates).

Chinnamuthu and Venkatakrishnan (2001) reported that the application of vermicompost @ 2 t per ha recorded significantly higher plant height (147.80 cm) and 100 seed weight (4.14 g) compared to application of FYM @ 5 t per ha (140.80 cm and 4.06 g, respectively) to sunflower.

Govindan and Thirumurugan (2005) observed that the application of vermicompost (75%) had significantly recorded higher plant height (84.70 cm), leaf area index (3.40) over press mud (100%N) (78.20 cm and 2.70, respectively) in soybean.

Aruna and Narsa Reddy (1999) reported that the application of vermicompost @ 15 t per ha to soybean recorded significantly higher number of pods per plant (59.00), 100 seed weight (15.80 g), seed yield (1143 kg/ha), seed protein content (41.80 %) and seed oil content (24.30%) over the application of FYM @ 5 t per ha + 50 kg N per ha (29.70, 13.9 g, 782 kg/ha, 38.70% and 23.00%, respectively).

Roy and Singh (2006) reported in malt barley that the application of vermicompost @10 t per ha recorded higher ears per meter row length (75.40), test weight (47.70 g), seed yield (44 q per ha) protein content (8.30%) and starch content (60.90%) over control (70.10, 45.30 g, 40 q/ha, 7.70 % and 60.05%, respectively).

2.3 Combined effect of organic and inorganic fertilizers

Effects of organic and inorganic fertilizers on mungbean (*Vigna radiata.* (L.)) yield under arid climate were studied by Abbas *et al.* (2011) at adaptive research farm Karor and at farmer's field during two kharif seasons of 2006 and 2007. In these experiments different combinations of organic and inorganic fertilizers were used for comparison. Experiments were laid in randomized complete block design with seven treatments. AZRI 2006, a promising variety of mung-bean (*Vigna radiata* (L.) for arid climate was used as a test variety. The results revealed that different combinations of organic and inorganic fertilizers significantly affected the pod number plant^{-1}, seed number pod^{-1} and grain yield. Maximum grain yield was obtained from the application of DAP at 124 Kg along with 10 tons ha^{-1} of poultry litter during both years, while application of DAP at 62 Kg and 10 tons of FYM ha^{-1} ranked second for grain yield.

Rajkhowa *et al.* (2002) reported that the application of 100 per cent RDF along with vermicompost @ 2.5 t per ha recorded significantly higher plant height (52.7 cm), number of pods per plant (12.67), seeds per pod (12.00), 100 seed weight (4.6 g), seed yield (5.35 q ha^{-1}), seed yield (5.4 q ha^{-1}) and it was on par with the application of 75% or 50% RDF + vermicompost (2.5 t/ha) over control in mungbean.

Malligawad *et al.* (2000) in groundnut revealed that application of RDF (25:75:25 kg NPK kg/ha) + vermicompost @ 1 t/ha recorded significantly higher pod yield (3389 kg/ha) compared to FYM @ 4 t/ha + 50% RDF (3232 kg/ha), RDF alone (3148 kg/ha) and no NPK application (2742 kg/ha).

Kale *et al.* (1994) observed that the application of vermicompost @ 5 t per ha + 50%RDF recorded significantly higher value of growth yield components and yield of sunflower compared to FYM @ 5 t per ha + RDF.

Channaveerswami (2005) reported that combined application of vermicompost @ 2.5 t per ha + RDF (25:50:50 kg NPK per ha) + copper ore tailing recorded higher plant height (43.94 cm), number of branches (6.92), and less number of days to 50% flowering (35.15), number of matured pods (17.06), pod yield (3337 kg/ha) and kernel yield (2362 kg/ha) 100 seed weight (35.26 g). This seed obtained with this treatment also recorded higher seed quality parameters like, germination (94.31%), seedling length (23.85cm), seedling dry weight (4.60 g), seedling vigour index (2249) and lower electrical conductivity (0.186 dSm^{-1}) in groundnut.

Pawar *et al.* (1995) reported that the application of vermicompost @ 2.50 t per ha along with 100 per cent RDF recorded significantly higher seed yield (74.80 q/ha). However, *in situ* vermiculture and application of 50 per cent RDF recorded a yield equivalent to that with 100 per cent RDF. They further observed that the application of vermicompost @ 2.50 t per ha along with 50 per cent RDF recorded seed yield on par with 100 per cent RDF in maize.

Patil (1998) reported that in groundnut the maximum pod yield (30.04 q/ha) was recorded with the application of vermicompost @ 2.50 t per ha + fly ash @ 30 t per ha + RDF. Whereas, the lowest pod yield (20.66 q/ha) was recorded with the application of RDF alone.

A field investigation was carried out by Aslam *et al.* (2010) in Pakistan to evaluate the effect of organic and inorganic sources of phosphorous on the growth and yield of mungbean (*Vigna radiata* L.). FYM, poultry manure and chemical fertilizer were accumulated at various concentrations to formulate different treatments. Analysis of data revealed significant differences with respect to plant height, number of plants m^{-2}, leaf area (cm^{2}), root length (cm), number of pod bearing branches plant $^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, pod size (cm), number of seeds plant $^{-1}$, 1000 seed weight (g), biological yield (Kg ha^{-1}), seed yield (Kg ha^{-1}), harvest index (%) and grain protein contents (%) indicating primacy of integration of the two sources in having improved mungbean productivity.

CHAPTER 3

MATERIALS AND METHODS

Details of the experimental materials and methods followed in the study are presented in this chapter. The experiment was carried out during the period from February to April of 2012 for finding out the effect of nitrogen and poultry manure on growth and yield performance as well as nutrient content of a mungbean cultivar.

3.1 Experimental site

The experiment was carried out at the Sher-e-Bangla Agricultural University (SAU) Farm, Dhaka. The experimental site is situated at $23^{0}77'$ North Latitude and $90^{0}30'$ East Longitude. The elevation of the experimental site is 1.0 m above the sea level. The area belongs to the Agro-ecological Zone (AEZ- 28): Madhupur Tract.

3.2 Soil

The experiment was conducted on silty clay loam soil of the order Inceptisols. The soil of SAU farm is high land having irrigation facilities. The morphological, physical and chemical characteristics of the experimental soil are presented in Tables 3.1 and 3.2.

3.3 Climate

The climate of the experimental site is sub-tropical, wet and humid. Heavy rainfall occurs in the monsoon (mid-April to mid-August) and scanty during rest of the year.

3.4 Crop: Mungbean

BARI Mung 6 was used in the study.

3.5 Year: Kharif-I, 2012

Table 3.1. Morphological characteristics of the experiment field

Characters	SAU farm
Locality	SAU, Dhaka
Geographic position	23°77'North Latitude 90°30'East Longitude 1.0 m height above the mean sea level
Agro-ecological zone	Madhupur Tract (AEZ-28)
General soil type	Deep Red Brown Terrace Soil
Soil Series	Tejgaon
Parent material	Madhupur Terrace
Topography	Fairly level
Drainage	Well drained
Land type	High land

(FAO and UNDP, 1988)

Table 3.2. Physical and chemical characteristics of the soils

Characteristics	SAU farm
Mechanical fractions:	
%Sand (0.2-0.02 mm)	29.93
%Silt (0.02-0.002 mm)	40.27
%Clay (< 0.002 mm)	29.80
Textural class	Clay loam
Soil pH	6.9
Organic C (%)	0.61
Organic matter (%)	1.05
Total N (%)	0.08
Available P (ppm)	12.78
Available K (ppm)	43.29
Available S (ppm)	23.74
Available B (ppm)	0.36

3.6 Treatments and experimental design

The experiment was laid out in a randomized complete block design with three replications. Each plot was measured 3 m x 2 m.

Factor 1: Potassium treatment:

N_0 - Control

N_1 - Nitrogen @ 10 kg ha^{-1}

N_2- Nitrogen @ 20 kg ha^{-1}

N_3 - Nitrogen @ 25 kg ha^{-1}

Factor 2 : Poultry manure treatment:

P_0- No Poultry manure

P_1- Poultry manure @ 4 t ha^{-1}

P_2- Poultry manure @ 7 t ha^{-1}

P_3- Poultry manure @ 10 t ha^{-1}

Treatment combinations:

N_0 (Control)	X	P_0(Control) P_1(Poultry manure @ 4 t ha^{-1}) P_2(Poultry manure @ 7 t ha^{-1}) P_3(Poultry manure @ 10 t ha^{-1})
N_1 (Nitrogen @ 10 kg ha^{-1})	X	P_0(Control) P_1(Poultry manure @ 4 t ha^{-1}) P_2(Poultry manure @ 7 t ha^{-1}) P_3(Poultry manure @ 10 t ha^{-1})
N_2 (Nitrogen @ 20 kg ha^{-1})	X	P_0(Control) P_1(Poultry manure @ 4 t ha^{-1}) P_2(Poultry manure @ 7 t ha^{-1}) P_3(Poultry manure @ 10 t ha^{-1})
N_3 (Nitrogen @ 25 kg ha^{-1})	X	P_0(Control) P_1(Poultry manure @ 4 t ha^{-1}) P_2(Poultry manure @ 7 t ha^{-1}) P_3(Poultry manure @ 10 t ha^{-1})

3.7 Land preparation

The experimental lands was opened with a power tiller on 07^{th} February 2012 and subsequently ploughed twice followed by laddering. Weed stubble and crop residues were removed. The lands were finally prepared on 12^{th} February 2012.

3.8 Fertilizer application

Nitrogen fertilizer (Urea) and Organic manure (Poultry manure) was applied as per treatments along with zinc sulphate (@ 2.0 kg ha^{-1}) during the final land preparation.

3.9 Sowing

Sowing of Mungbean was done on 21^{st} February 2012. Healthy seeds of mungbean @ 35 kg ha^{-1} were sown by hand as uniformly as possible in furrows. Seeds were sown in the afternoon and immediately covered with soil to avoid sunlight. Line to line distance was 30 cm.

3.10 Intercultural operation

Weeding was done at 12 and 35 days after sowing. Thinning was done on the same date of 1^{st} weeding to maintain optimum plant density. Plant to plant distance was maintained at 10 cm. A light irrigation was given after sowing for germination of seed. Pest did not infest the mungbean crop at the early stage. The insecticide Sumithion 57 EC was sprayed @ 0.02% at the time of pod formation to control pod borer. No disease was observed in the experimental field.

3.11 Harvesting and sampling

The crops were harvested at a time due to synchronous maturity of pods. At first 50% of early matured pods were harvested by hand picking at 55 days after sowing. Finally 4 days after first harvesting all plants were harvested plot-wise by uprooting and were bundled separately, tagged and brought to the threshing floor of the SAU farm. All of the harvested pods were kept separately in properly tagged gunny bags. Ten plants were randomly selected prior to maturity from each plot for data recording.

3.12 Threshing, drying, cleaning and weighing

The crop bundles were sun dried for two days on threshing floor. Seeds were separated from the plants by beating the bundles with bamboo sticks. The collected seeds were dried in sun to lower the moisture content to 12% level. The dried and cleaned seed and stover were weighed plot-wise.

3.13 Data collection

i) Plant height

The plant height was measured from base of the plant to the tip of the main shoot for ten randomly tagged plants with the help of scale at harvest. The average of ten plants was computed and expressed as the plant height in centimeters.

ii) Number of leaves per plant

The numbers of green trifoliate leaves present on each plant were counted manually from the ten tagged plants at harvest. The mean number of leaves per plant was calculated and expressed in number per plant.

iii) Number of branches per plant

The total number of branches originating from the main stem was counted at harvest from ten earlier tagged plants. Average was worked out and expressed as number of branches per plant.

iv) Number of pods per plant

The total number of pods from ten randomly selected plants was counted manually from each treatment. Average was worked out and recorded as number of pods per plant.

v) Number of seeds pod^{-1}

Ten pods were selected at random from the total number of pods harvested from tagged ten plants. The seeds from each pod were separated, counted and average was worked out and expressed as number of seeds pod^{-1}.

vi) Weight of thousand seed

One hundred seeds were counted from the seed sample of each plot separately and then their weight was recorded by the help of an electrical balance. These values were multiplied by ten to determine the weight of thousand seed.

vii) Seed yield and stover yield

The seed yield and stover yield obtained from the net plot area of each treatment was added with the yield obtained for ten tagged and harvested plants. The seeds were cleaned and dried in shade for five days. After size grading seed weight per plant was recorded in gram. The seed yield and stover yield per hectare was computed and expressed in kg per hectare.

3.14 Determination of N, P and K

3.14.1 Preparation of plant sample for N

The plant material (seed) were dried in an oven at 60^0 C at 72 hours after sun drying and finely ground in a grinder machine for chemical analysis. Then the prepared samples were put into paper bags.

3.14.1.1 Determination of Nitrogen

The total nitrogen was determined from the seed sample by macro Kjeldahl method. The samples were digested by commercial H_2SO_4 in presence of catalyst mixture K_2SO_4, $CuSO_4$ and selenium powder. The formed $(NH_4)_2$ SO_4 was mixed with NaOH during distillation. The liberated ammonia was received in 4% boric acid (H_3BO_3) solution and 5 drops of mixed indicator of bromocresol green ($C_{21}H_{14}O_5Br_4S$) and methyl red ($C_{15}H_{15}N_3O_2$) solution. Finally the distillate was titrated with standard (0.05N) H2SO_4 until the color changed to pink (Jackson, 1973).

The %N in plant was calculated by the following formula:

$$\% \text{ N} = \frac{(\text{T} - \text{B}) \times \text{N} \times 0.014 \times 100}{\text{S}}$$

Where,

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 mL N H_2SO_4 ≡ 0.014 g N

3.14.2 Preparation of plant extract for P and K

Exactly 0.5 g plant sample was taken in a 250 ml conical flask and 10 ml of di-acid mixture (HNO_3 : $HClO_4$ = 2 : 1) was added to each conical flask. The flask was then placed on an electric hot plate and heated until white fumes were evolved. Then the flask was removed from the hot plate and allowed to cool. After cooling, the digest was filtered and transferred to a 100 ml volumetric flask and the final volume was made up to 100 ml with distilled water (Singh, 1999). From the digest, phosphorus, potassium and sulphur were analyzed by following standard methods.

3.14.2.1 Determination of phosphorus

Phosphorus in the digest was determined colorimetrically using $SnCl_2$ as reducing agent. The intensity of color read at 660 nm wave length with a spectrophotometer (Jackson, 1973).

3.14.2.2 Determination of potassium

Potassium of the plant sample was determined with the help of flame emission spectrophotometer. The samples were aspirated into a gas flame. The air pressure was fixed at 10 PSI. Percent emission was recorded following the method described by Ghosh *et al.* (1983).

3.16 Statistical analysis

The collected data on different growth and yield parameters and nutrient contents of mungbean were statistically analyzed. The means for all treatments were calculated and the analyses of variances for all the characters were performed by 'F' variance test using MSTAT-C computer package program. The significance of difference between pair of means was performed by the Dancan's Multiple Range Test (DMRT) (Russel, 1986).

CHAPTER 4

RESULTS AND DISCUSSION

The experiment was conducted at-e-Bangla Agricultural University farm. The results have been presented and discussed, and possible interpretations have been given under the following headings:

4.1 Plant height

The plant height at harvest differed significantly due to different nitrogen doses. Significantly higher plant height (40.52 cm) was recorded in N_3 (Nitrogen @ 25 kg ha^{-1}) and it was closely followed by the application of Nitrogen @ 20 kg ha^{-1} (N_2 : 40.31cm) and subsequently followed by N_1 (Nitrogen @ 10 kg ha^{-1}) (38.60 cm). Lowest plant height at harvest was found from the treatment using no nitrogen fertilizer (N_0 : 36.22 cm). Results show that plant height was positively influenced by higher nitrogen fertilizer doses. Ashraf *et al.* (2003) found that, seed inoculation with *Rhizobium phaseoli* + 50:50:0 kg NPK ha^{-1} was the best treatment for mungbean's (cv. NM-98) plant height. Sultana *et al.* (2009) showed that application of 20 kg N ha basal showed significantly higher values of all growth parameters in mungbean.

Poultry manure doses showed significant differences in case of the plant height. The highest plant height (40.44 cm) was recorded in P_3 (Poultry manure @ 10 t ha^{-1}) which was closely followed by P_2 (Poultry manure @ 7 t ha^{-1}) (39.49 cm) and followed by P_1 (Poultry manure @ 4 t ha^{-1}) (38.26 cm). Application of no poultry manure (P_0) gave the lowest plant height (37.46 cm) among the treatments. From the above results it can be stated that, increased rate of poultry manure is favorable for plant height of mungbean. Karmegam and Daniel (2000) found similar results in case of cowpea by using organic manure.

Plant height of BARI Mung 6 differed significantly due to the interaction effect of nitrogen and poultry manure treatments. Highest plant height (41.21 cm) was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 (41.20 cm) and N_2P_3 (41.20 cm). Better performances were also shown by N_2P_2 (40.53 cm) and N_3P_1 (39.99 cm). Application of no nitrogen and no poultry manure (N_0P_0) gave the lowest plant height (33.12 cm) (Table 4.1).

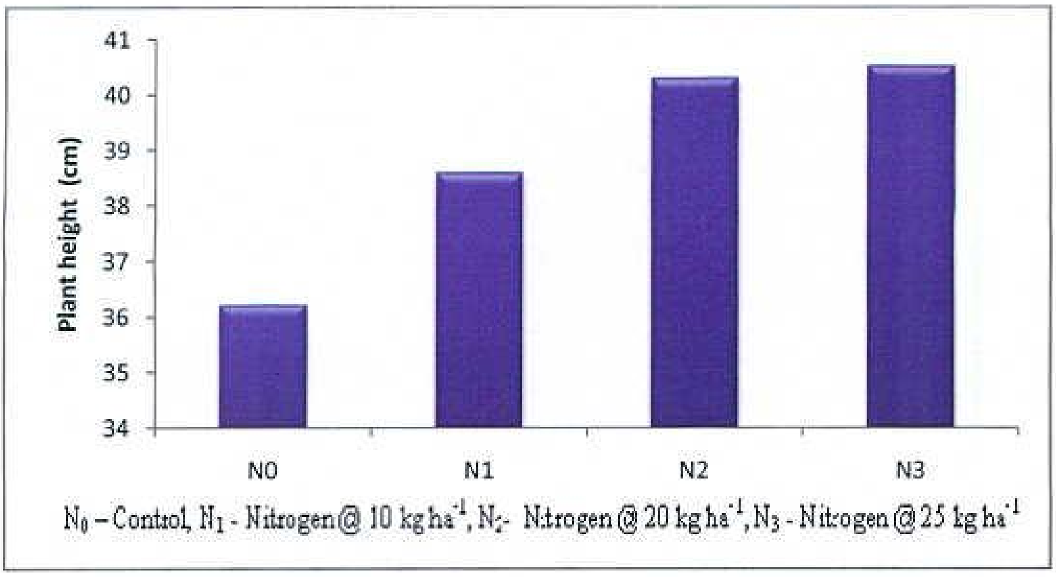


Figure 4.1: Effect of various doses of nitrogen fertilizer on plant height of BARI Mung 6 at harvest

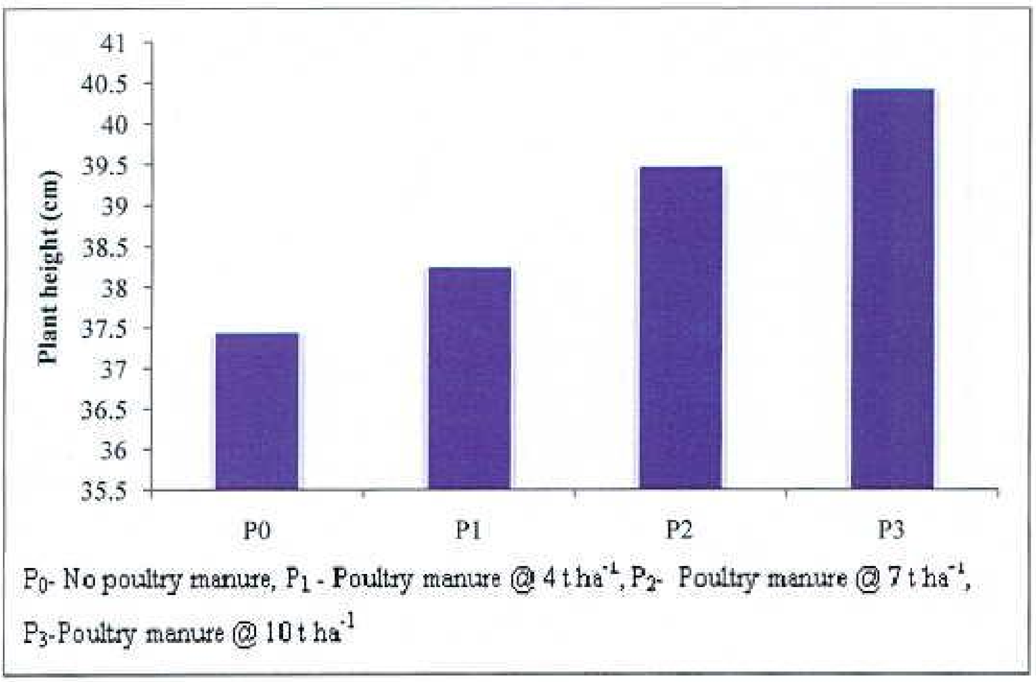


Figure 4.2: Effect of various doses of poultry manure on plant height of BARI Mung 6 at harvest

Table 4.1. Interaction effect of nitrogen and poultry manure on plant height of BARI Mung 6 at harvest

Treatments	Plant height (cm)
N_0P_0	33.12 e
N_0P_1	35.11 de
N_0P_2	37.18 cd
N_0P_3	39.48 a-c
N_1P_0	37.39 b-d
N_1P_1	38.10 a-d
N_1P_2	39.04 a-c
N_1P_3	39.86 a-c
N_2P_0	39.67 a-c
N_2P_1	39.86 a-c
N_2P_2	40.53 ab
N_2P_3	41.20 a
N_3P_0	39.67 a-c
N_3P_1	39.99 a-c
N_3P_2	41.20 a
N_3P_3	41.21 a
LSD	3.193
CV %	2.33
Level of significance	**

** - Significant at 1% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1} P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

It seems from the results that combination of poultry manure and inorganic nitrogen fertilizers significantly increased the plant height. 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. Combination of organic and inorganic fertilizers was found better by Channaveerswami (2005) in groundnut and Rajkhowa *et al.* (2002) in green gram than only inorganic fertilizers.

4.2 Number of leaves

The number of leaves plant^{-1} differed significantly due to different nitrogen doses. Significantly higher number of leaves plant^{-1} (19.14) was recorded with N_3 treatment and subsequently followed by N_1. Lowest number of leaves plant^{-1} was found from the plots with no nitrogen fertilizer (N_0 : 15.41). Results showed that number of leaves plant^{-1} was positively influenced by higher doses of nitrogen fertilizer. This is in conformity with Marti and Mills, 1991 who said that an adequate supply of N is associated with vigorous vegetative growth.

Different doses of poultry manure showed significant differences on number of leaves plant^{-1}. Highest number of leaves plant^{-1} (19.01) was recorded in P_3 which was statistically similar with P_2 and P_1. Application of no poultry manure (P_0) gave the lowest number of leaves plant^{-1} (16.48) among the treatments and it was statistically similar with P_1 (Figure 4.4). These results are in agree with Shukla and Tyagi (2009) who showed that application of organic inputs significantly increased the growth, dry matter and yield of mungbean.

Number of leaves plant^{-1} of BARI Mung 6 differed significantly due to the interaction effect of nitrogen and poultry manure treatments. Highest number of leaves plant^{-1} (20.23) was recorded in N_3P_3 but no differences were found with N_3P_2, N_2P_3 and N_2P_2. Application of no nitrogen and no poultry manure (N_0P_0) gave the lowest number of leaves plant^{-1} (12.83) among the treatments which was statistically similar with N_0P_1 (14.01) (Table 4.2).

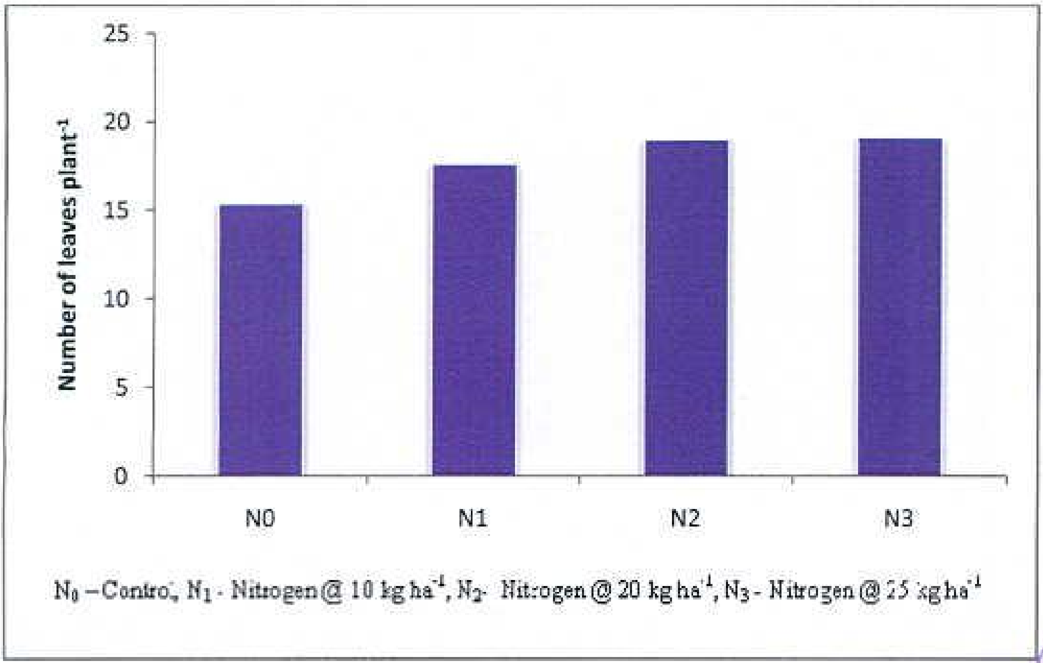


Figure 4.3: Effect of various doses of nitrogen fertilizer on number of leaves plant^{-1} of BARI Mung 6 at harvest

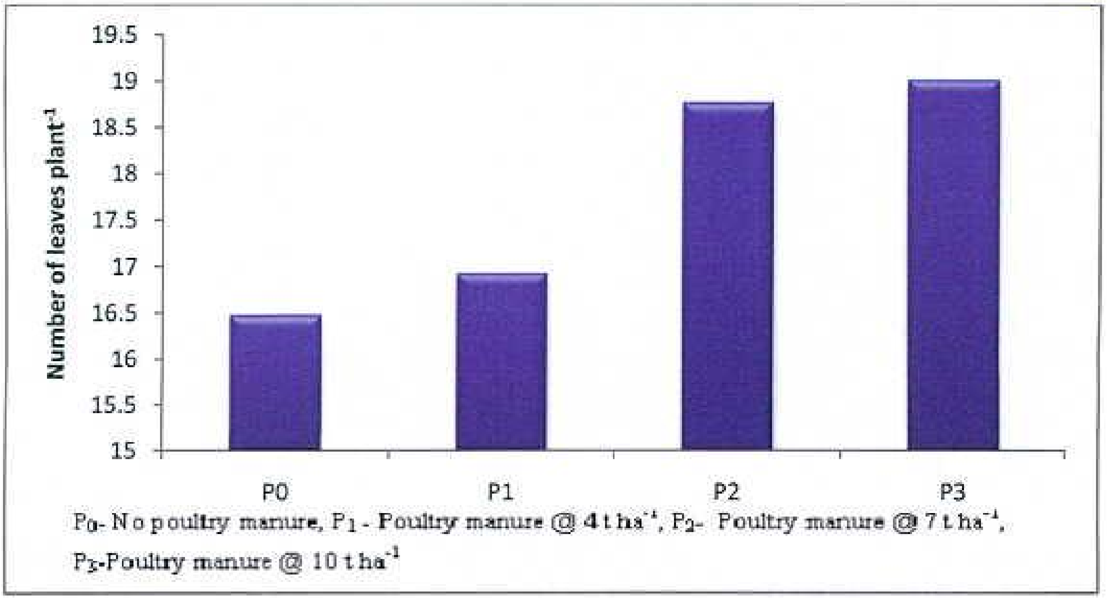


Figure 4.4: Effect of various doses of poultry manure on number of leaves plant^{-1} of BARI Mung 6 at harvest

Results showed that the combination of poultry manure and inorganic nitrogen fertilizers significantly increased the number of leaves plant^{-1} than sole use of inorganic fertilizer. As organic fertilizers help to improve the soil condition and inorganic fertilizers facilitate quick availability of essential nutrients, the combination of two sources of fertilizer proved better than single use of the each. Patil (1998) found better growth by using combination of organic and inorganic fertilizers than only inorganic fertilizers in groundnut.

Table 4.2 : Interaction effect of nitrogen and poultry manure on number of leaves plant^{-1} of BARI Mung 6

Treatments	Number of leaves plant^{-1}
N_0P_0	12.83 c
N_0P_1	14.01 c
N_0P_2	17.09 b
N_0P_3	17.70 b
N_1P_0	17.28 b
N_1P_1	17.57 b
N_1P_2	17.73 b
N_1P_3	17.93 b
N_2P_0	17.75 b
N_2P_1	18.04 b
N_2P_2	20.10 a
N_2P_3	20.16 a
N_3P_0	18.07 b
N_3P_1	18.11 b
N_3P_2	20.16 a
N_3P_3	20.23 a
LSD	1.595
CV %	3.13
Level of significance	**

** - Significant at 1% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1} P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

4.3 Number of branches

The number of branches plant^{-1} differed significantly due to different nitrogen doses. Higher number of branches plant^{-1} (10.09) was recorded in N_3 but no significant different differences was found between N_2 and N_1. Lowest number of branches plant^{-1} was found from the treatment using no nitrogen fertilizer N_0 (8.142) (Figure 4.5). It clearly seems from the results that, number of branches plant^{-1} increased with increasing rate of nitrogen fertilizer. Sultana *et al.* (2009) found similar results while experimenting with mungbean.

Different doses of poultry manure showed significant differences in the case of number of branches plant^{-1}. Highest number of branches plant^{-1} (10.21) was recorded in P_3 which was statistically similar with P_2 and P_1. Application of no poultry manure (P_0) gave the lowest number of branches plant^{-1} (7.825) among the treatments (Figure 4.6). With increasing the level of poultry manure, the number of branches plant^{-1} of BARI Mung 6 also increased. These results are in agree with Karmegam and Daniel (2000) who showed that application of vermicompost resulted in significant increase in growth and yield of cowpea.

Number of branches plant^{-1} differed significantly due to the interaction effect of nitrogen and poultry manure treatments. Highest number of branches plant^{-1} (10.70) was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 (10.67), N_2P_3 (10.65), N_2P_2 (10.63) and N_1P_3 (10.03). Application of no nitrogen and no poultry manure (N_0P_0) yielded with the lowest number of branches plant^{-1} (5.93) Table 4.3. among the treatments which was followed by N_0P_1 (8.30) and N_0P_2 (8.87) (Table 4.3).

It is evident from the results that, combination of poultry manure and inorganic nitrogen fertilizers significantly increased the number of branches plant^{-1}. As organic fertilizers help to improve the soil condition and inorganic fertilizers assure quick availability of essential nutrients, the combination of two proved better than single use of the each. Channaveerswami (2005) reported that combined application of vermicompost @ 2.5 t per ha + RDF (25:50:50 kg NPK per ha) + copper ore tailing recorded higher number of branches (6.92) in groundnut.

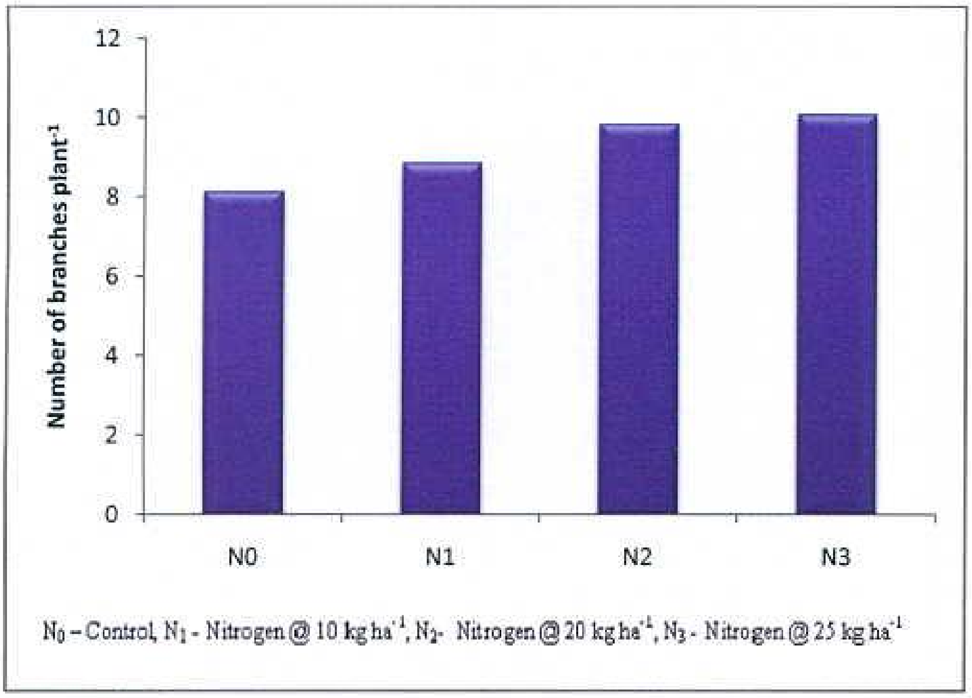


Figure 4.5: Effect of various doses of nitrogen fertilizer on number of branches plant^{-1} of BARI Mung 6 at harvest

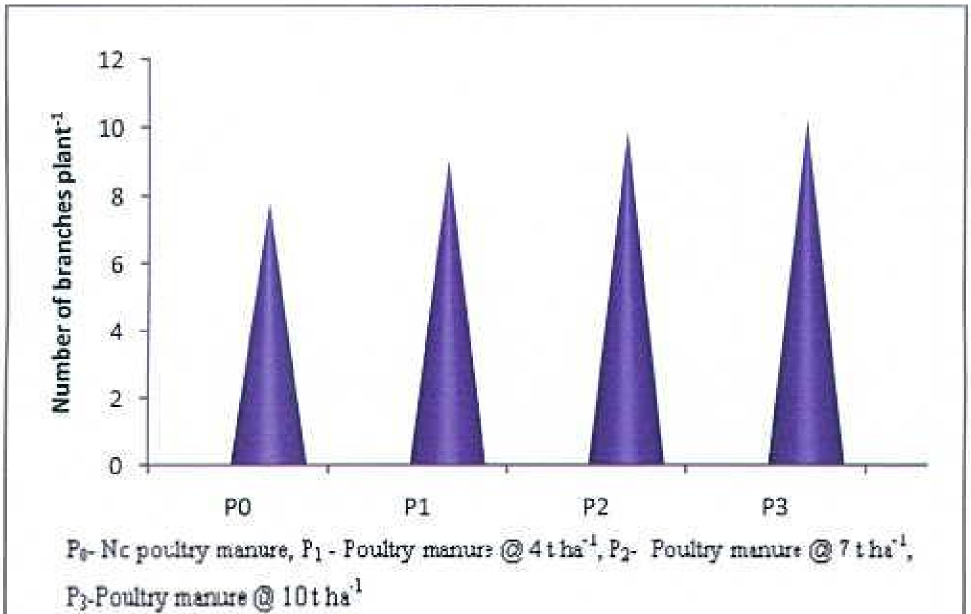


Figure 4.6: Effect of various doses of poultry manure on number of branches plant^{-1} of BARI Mung 6 at harvest

Table 4.3 : Interaction effect of nitrogen and poultry manure on number of branches plant^{-1} of BARI Mung 6

Treatments	Number of branches plant^{-1}
N_0P_0	5.93 f
N_0P_1	8.30 d
N_0P_2	8.87 cd
N_0P_3	9.47 bc
N_1P_0	7.00 e
N_1P_1	9.07 cd
N_1P_2	9.33 bc
N_1P_3	10.03 ab
N_2P_0	8.97 cd
N_2P_1	9.13 c
N_2P_2	10.63 a
N_2P_3	10.65 a
N_3P_0	9.40 bc
N_3P_1	9.60 bc
N_3P_2	10.67 a
N_3P_3	10.70 a
LSD	0.8176
CV %	6.50
Level of significance	**

** - Significant at 1% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1}
P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

4.4 Average dry weight plant^{-1}

The average dry weight plant^{-1} differed significantly due to different nitrogen doses. Significantly higher average dry weight plant^{-1} (7.345 g) was recorded in N_3 (Nitrogen @ 25 kg ha^{-1}) and it was statistically similar with the application of Nitrogen @ 20 kg ha^{-1} (N_2 : 7.307 g) and was followed by the N_1 (Nitrogen @ 10 kg ha^{-1}) (6.80 g). Lowest average dry weight plant^{-1} at harvest was found from the treatment using no nitrogen fertilizer (N_0 : 5.743 g) (Figure 4.7). Results show that average dry weight plant^{-1} was positively influenced by higher nitrogen fertilizer doses. This is in conformity with

Sultana *et al.* (2009) who found that 20 kg N ha^{-1} significantly gave higher values for all growth parameters in mungbean.

Highest average dry weight $plant^{-1}$ (7.160 g) was recorded in P_3 (Poultry manure @ 10 t ha^{-1}) which was statistically similar with P_2 (Poultry manure @ 7 t ha^{-1}) (7.020 g) and subsequently followed by P_1 (Poultry manure @ 4 t ha^{-1}) (6.658 g). Application of no poultry manure (P_0) gave the lowest average dry weight $plant^{-1}$ (6.358 g) among the treatments (Appendix II). Increased level of poultry manure increased the dry weight $plant^{-1}$ of BARI Mung 6.

Average dry weight $plant^{-1}$ of the crop differed significantly due to the interaction effect of nitrogen and poultry manure treatments. Highest average dry weight $plant^{-1}$ (8.05 g) was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 (7.75 g) and N_2P_3 (7.95 g). Without nitrogen and poultry manure (N_0P_0) showed the lowest average dry weight $plant^{-1}$ (5.46 g) among the treatments which was followed by N_0P_1 (5.73 g) and N_0P_2 (5.86 g) (Table 4.4). Channaveerswami (2005) reported that combined application of vermicompost @ 2.5 t per ha + RDF (25:50:50 kg NPK per ha) + copper ore tailing recorded higher seedling dry weight in groundnut. Kale *et al.* (1994) observed that the application of vermicompost @ 5 t per ha + 50%RDF recorded significantly higher value of growth, yield components and yield of sunflower.

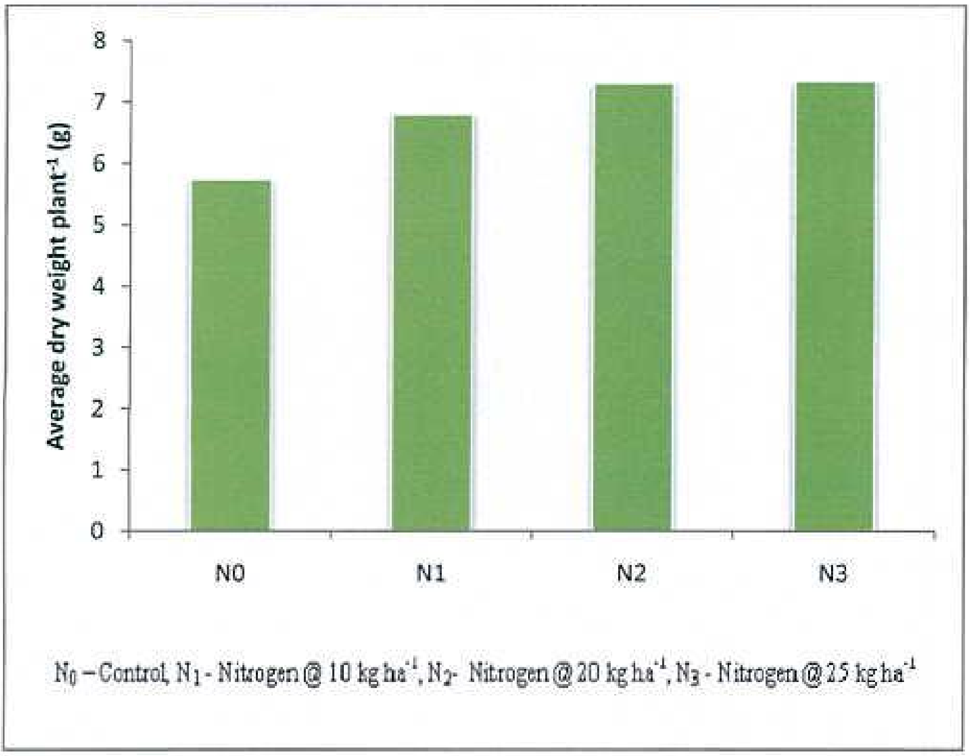


Figure 4.7: Effect of various doses of nitrogen fertilizer on average dry weight plant^{-1} of BARI Mung 6 at harvest

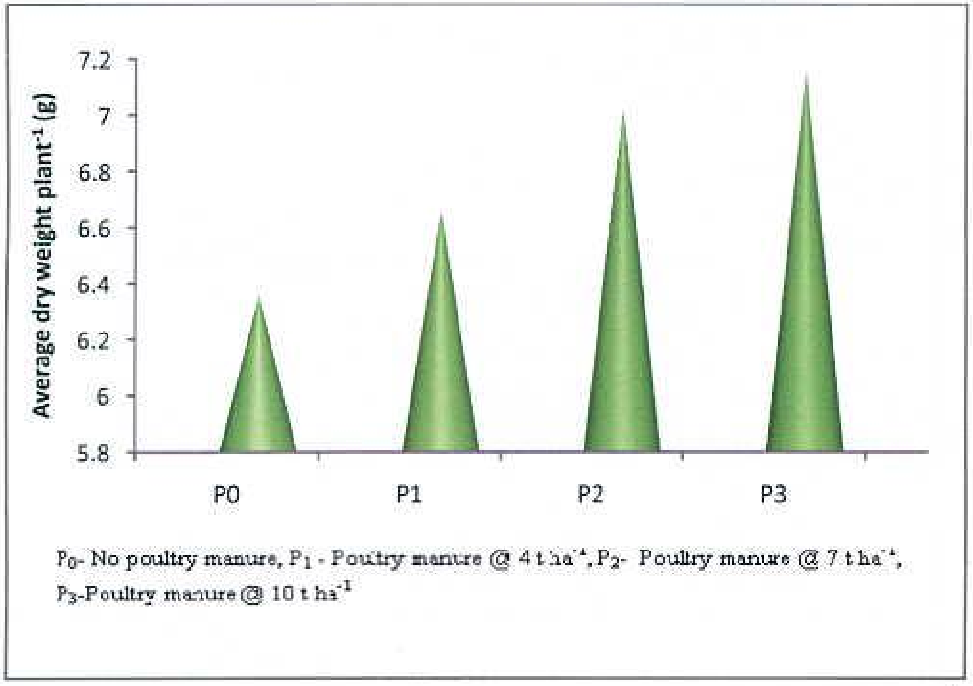


Figure 4.8: Effect of various doses of poultry manure on average dry weight plant^{-1} of BARI Mung 6 at harvest

Table 4.4 : Interaction effect of nitrogen and poultry manure on average dry weight plant^{-1} of BARI Mung 6

Treatments	Average dry weight plant^{-1} (g)
N_0P_0	5.46 f
N_0P_1	5.73 ef
N_0P_2	5.86 e
N_0P_3	5.92 e
N_1P_0	6.59 d
N_1P_1	6.79 cd
N_1P_2	6.90 cd
N_1P_3	6.92 c
N_2P_0	6.79 cd
N_2P_1	7.32 b
N_2P_2	7.37 b
N_2P_3	7.95 a
N_3P_0	6.59 d
N_3P_1	6.79 cd
N_3P_2	7.75 a
N_3P_3	8.05 a
LSD	0.3256
CV %	11.01
Level of significance	**

** - Significant at 1% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1} P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

4.5 Number of pods plant^{-1}

The number of pods plant^{-1} differed significantly due to different nitrogen doses. Significantly higher number of pods plant^{-1} (15.90) was recorded in N_3, N_2 and N_1. Lowest number of pods plant^{-1} at harvest was found without nitrogen fertilizer (N_0 : 9.358) (Figure 4.9). From the results it can be stated that nitrogen has a positive effect on number of pods plant^{-1} of BARI Mung 6.

Poultry manure showed significant differences in the case of number of pods plant^{-1}. Highest number of pods plant^{-1} (14.59) was recorded in P_3, P_2 and P_1. Application of zero poultry manure (P_0) gave the lowest number of pods plant^{-1} (12.03) among the treatments (Appendix IV). Aruna and Narsa Reddy (1999) reported that the application of poultry manure @ 15 t per ha to soybean recorded significantly higher number of pods per plant.

Number of pods plant^{-1} of BARI Mung 6 differed significantly due to the combined effect of nitrogen and poultry manure treatments. Highest number of pods plant^{-1} (16.50) was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 (16.17), N_2P_3 (16.17) and N_2P_2 (16.00). Better results were also shown by N_3P_1 (15.67) and N_2P_1 (15.34). Application of no nitrogen and no poultry manure (N_0P_0) gave the lowest number of pods plant^{-1} (8.03). Combination of poultry manure and inorganic nitrogen fertilizers increased the number of pods plant^{-1} than use of inorganic fertilizer alone. Channaveerswami (2005) reported that combined application of vermicompost @ 2.5 t per ha + RDF (25:50:50 kg NPK per ha) + copper ore tailing recorded higher number of matured pods (17.06) in groundnut. Patil (1998) reported that in groundnut the maximum pod yield (30.04 q/ha) was recorded with the application of vermicompost @ 2.50 t per ha + fly ash @ 30 t per ha + RDF, whereas, the lowest pod yield (20.66 q/ha) was recorded with the application of RDF alone. Abbas *et al.* (2011) found that application of DAP at 124 kg along with 10 tons ha^{-1} of poultry litter yielded maximum number of pods plant^{-1}.

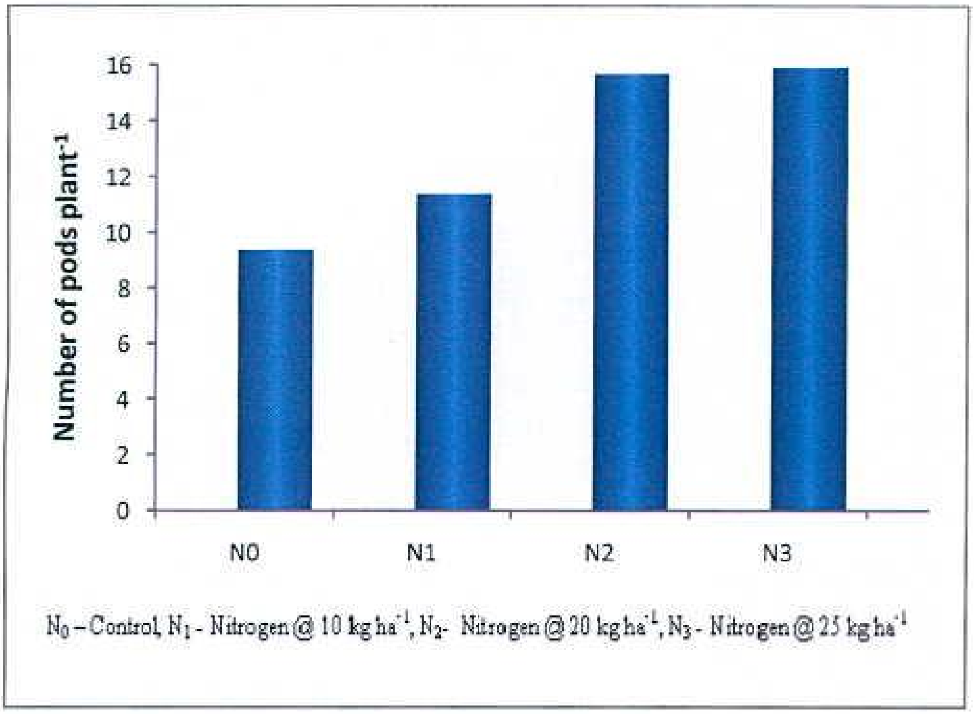


Figure 4.9: Effect of various doses of nitrogen fertilizer on number of pods plant^{-1} of BARI Mung 6

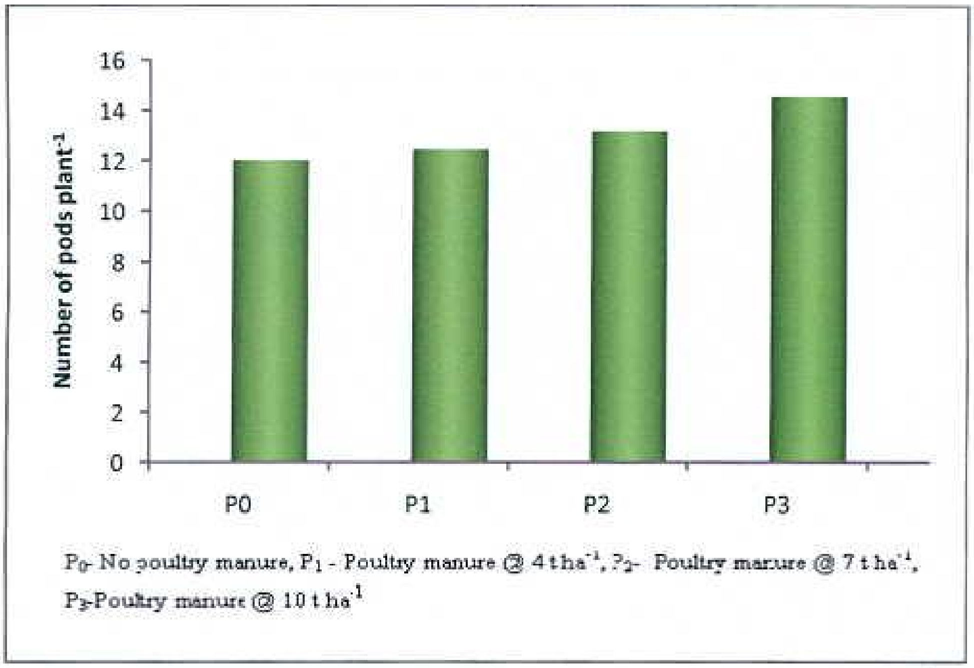


Figure 4.10: Effect of various doses of poultry manure on number of pods plant^{-1} of BARI Mung 6

Table 4.5 : Interaction effect of nitrogen and poultry manure on number of pods $plant^{-1}$ of BARI Mung 6

Treatments	Number of pods $plant^{-1}$
N_0P_0	8.03 e
N_0P_1	8.23 e
N_0P_2	9.67 de
N_0P_3	11.50 c
N_1P_0	9.67 de
N_1P_1	10.67 cd
N_1P_2	11.00 cd
N_1P_3	14.17 b
N_2P_0	15.17 ab
N_2P_1	15.34 ab
N_2P_2	16.00 a
N_2P_3	16.17 a
N_3P_0	15.27 ab
N_3P_1	15.67 ab
N_3P_2	16.17 a
N_3P_3	16.50 a
LSD	1.817
CV %	5.44
Level of significance	**

** - Significant at 1% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1}
P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

4.6 Number of seeds pod^{-1}

Nitrozen fertilizer treatments showed no effect on the number of seeds/pod.

However poultry manure doses showed significant differences in case of number of seeds pod^{-1}. Highest number of seeds pod^{-1} (4.400) was recorded in P_3 which was statistically similar with P_2 and P_1. Application of no poultry manure (P_0) gave the lowest number of seeds pod^{-1} (3.570) among the treatments (Figure 4.12). These results are against of those of Kumar *et al.* (2002) who found that organic amendment did not affect the grain pod^{-1} of mungbean.

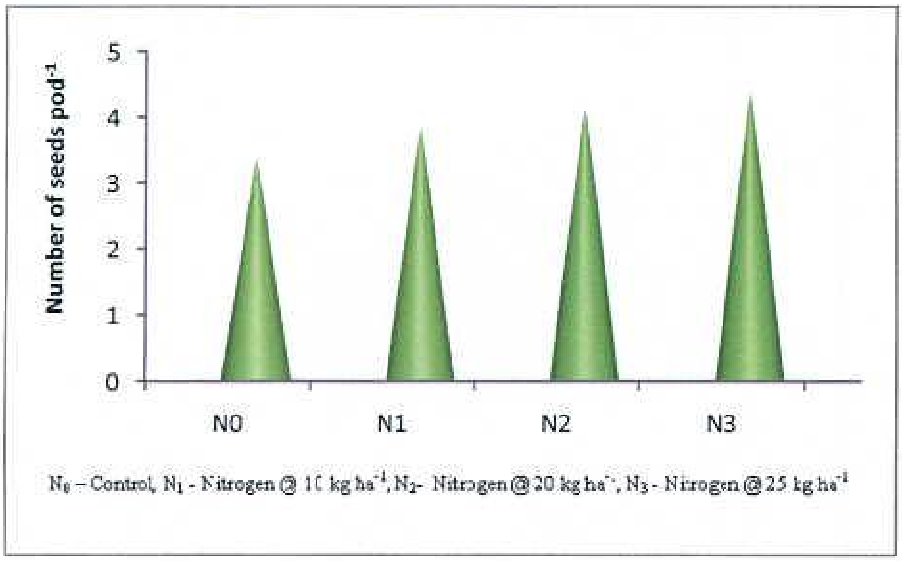


Figure 4.11: Effect of various doses of nitrogen fertilizer on number of seeds pod^{-1} of BARI Mung 6

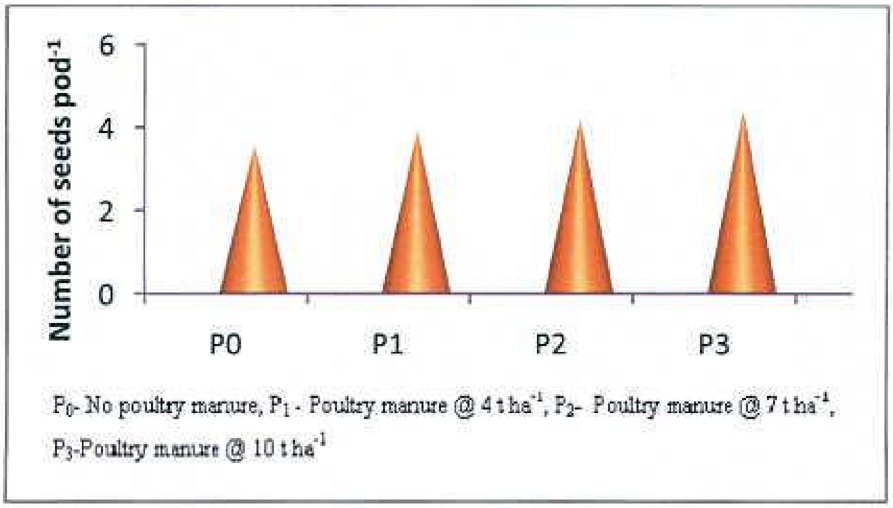


Figure 4.12: Effect of various doses of poultry manure on number of seeds pod^{-1} of BARI Mung 6

Number of seeds pod^{-1} of BARI Mung 6 differed significantly due to the interaction effect of nitrogen and poultry manure treatments. Highest number of seeds pod^{-1} (4.69) was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 (4.63) and N_2P_3 (4.57).

Table 4.6 : Interaction effect of nitrogen and poultry manure on number of seeds pod^{-1} of BARI Mung 6

Treatments	Number of seeds pod^{-1}
N_0P_0	2.67 f
N_0P_1	3.41 e
N_0P_2	3.49 de
N_0P_3	4.19 ab
N_1P_0	3.53 c-e
N_1P_1	3.91 b-e
N_1P_2	4.12 a-d
N_1P_3	4.15 a-c
N_2P_0	3.89 b-e
N_2P_1	3.93 b-e
N_2P_2	4.52 ab
N_2P_3	4.57 a
N_3P_0	4.19 ab
N_3P_1	4.43 ab
N_3P_2	4.63 a
N_3P_3	4.69 a
LSD	0.6312
CV %	2.89
Level of significance	**

** - Significant at 1% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1}
P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

Combination of poultry manure and inorganic nitrogen fertilizers increased the number of seeds pod^{-1} This may be because combination of organic and inorganic fertilizers improves soil physical properties, which provide health and favourable soil conditions to enhance nutrient use efficiency. Similar results were reported by Channaveerswami (2005) in groundnut and Rajkhowa *et al.* (2002) in green gram.

4.7 1000-seed weight

The 1000-seed weight differed significantly due to different nitrogen doses. Highest 1000-seed weight (42.56 g) was recorded in N_3 (Nitrogen @ 25 kg ha^{-1}) and it was identical to theN_2 treatment (41.22g). Lowest 1000-seed weight was found from the treatment using no nitrogen fertilizer (35.44 g) (Figure 4.13). From the results, it is confirmed that 1000-seed weight was positively affected by higher nitrogen doses. The 10-30-30 kg NPK ha^{-1} was find out as the best treatment by Oad and Buriro (2005) for mungbean cv. AEM 96 in Tandojam, Pakistan during the spring season of 2004.

Different doses of poultry manure showed significant differences in case of 1000-seed weight. Highest 1000-seed weight (41.56 g) was recorded in P_3 which was statistically similar with P_2 . Application of no poultry manure (P_0) showed the lowest 1000-seed weight (37.01 g) among the treatments (Figure 4.14 and Appendix IV). These results are contradictory to that of Kumar *et al.* (2002) who found that seeds $plant^{-1}$ was not influenced by organic amendment. However Chinnamuthu and Venkatakrishnan (2001) reported that the application of poultry manure @ 2 t per ha recorded significantly higher 100 seed weight (4.14 g) in sunflower.

In the case of combined effect of treatments the highest 1000-seed weight (45.02 g) was recorded from N_3P_3 but it was statistically similar with N_3P_2 (44.95) and closely followed by N_2P_3 (44.01 g). Interaction of no nitrogen and no poultry manure (N_0P_0) gave the lowest 1000-seed weight (32.72 g) (Table 4.7).

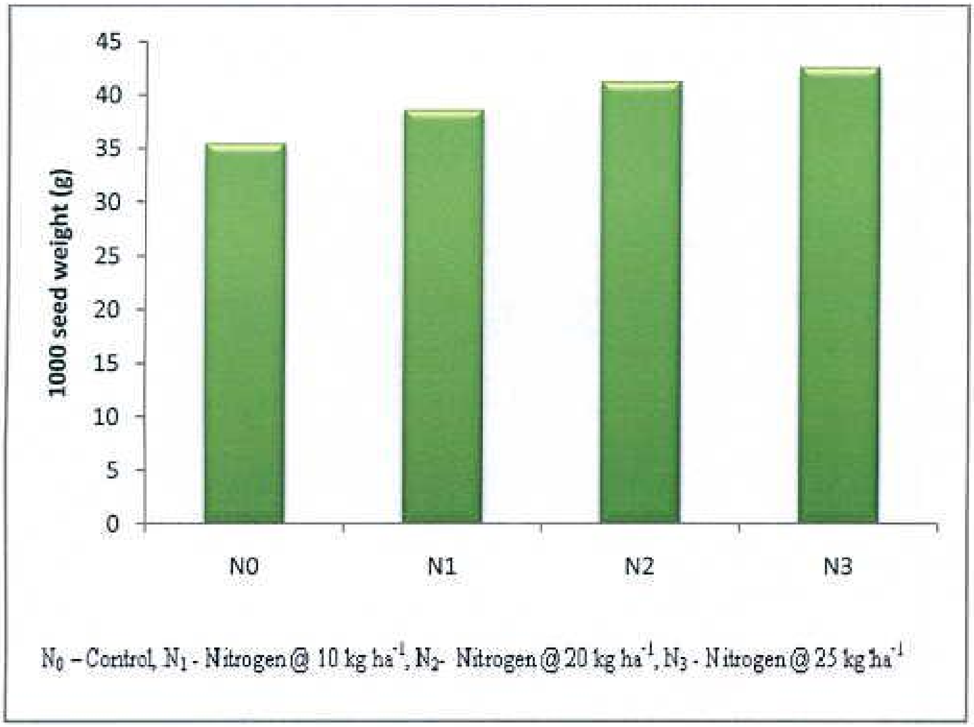


Figure 4.13: Effect of various doses of nitrogen fertilizer on 1000-seed weight of BARI Mung 6

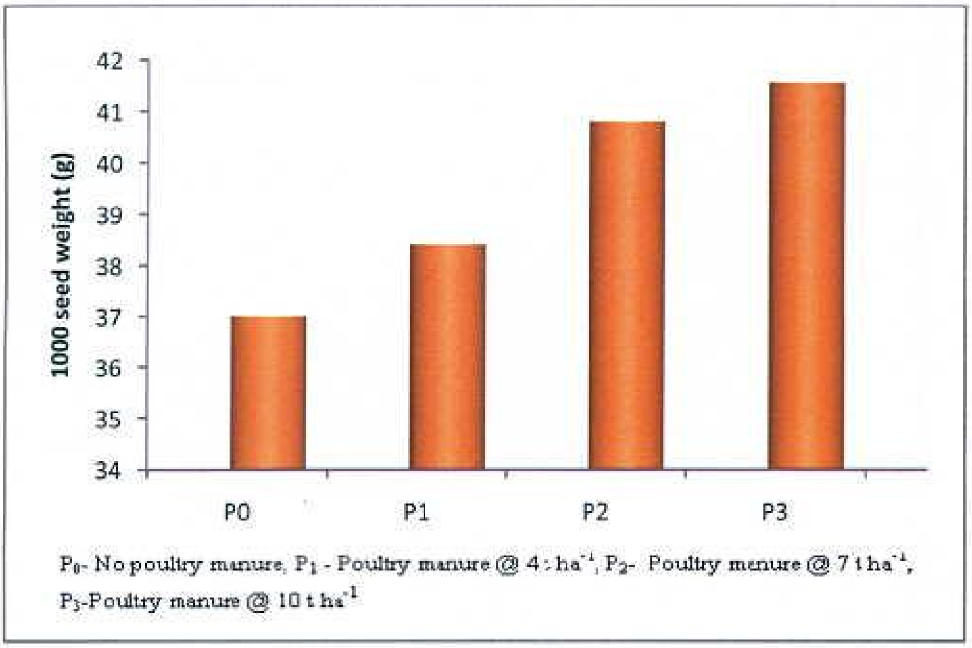


Figure 4.14: Effect of various doses of poultry manure on 1000-seed weight of BARI Mung 6

Table 4.7 : Interaction effect of nitrogen and poultry manure 1000-seed weight of BARI Mung 6

Treatments	1000 seed weight (g)
N_0P_0	32.72 h
N_0P_1	34.69 g
N_0P_2	36.98 f
N_0P_3	37.36 ef
N_1P_0	36.98 f
N_1P_1	38.68 c-e
N_1P_2	38.8 c-e
N_1P_3	39.86 cd
N_2P_0	38.3 d-f
N_2P_1	40.05 c
N_2P_2	42.5 b
N_2P_3	44.01 ab
N_3P_0	40.02 c
N_3P_1	40.23 c
N_3P_2	44.95 a
N_3P_3	45.02 a
LSD	1.641
CV %	7.51
Level of significance	**

** - Significant at 1% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1} P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

It is revealed from the result that combination of poultry manure and inorganic nitrogen fertilizers increased the 1000-seed weight. Patil (1998) reported that in groundnut the maximum 1000-seed weight was recorded with the application of vermicompost @ 2.50 t per ha + fly ash @ 30 t per ha + RDF, whereas, the lowest 1000-seed weight was recorded with the application of RDF alone.

4.9 Seed yield ha^{-1}

Significantly higher seed yield (1.058 t ha^{-1}) was recorded in N_3 and it was statistically similar with the application of N_2. The lowest seed yield ha^{-1} was found when no nitrogen fertilizer used (N_0 : 0.5365 t ha^{-1}) (Appendix V). Sultana *et al.* (2009)

found that application of 20 kg N ha^{-1} produced significantly more seed yield (1,982 kg ha^{-1}) in mungbean.

Highest seed yield (1.012 t ha^{-1}) was recorded in P_3 which was statistically similar with P_2. Application of no poultry manure (N_0) gave the lowest seed yield (0.5155 t ha^{-1}) among the treatments (Figure 4.1). Roy and Singh (2006) reported in malt barley that the application of poultry manure @10 t per ha recorded higher seed yield (44 q per ha). Aruna and Narsa Reddy (1999) reported that the application of poultry manure @ 15 t per ha to soybean recorded significantly seed yield (1143 kg/ha).

Highest seed yield (1.272 t ha^{-1}) was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 (1.256 t ha^{-1}), N_2P_3 (1.262 t ha^{-1}) and N_2P_2 (1.246 t ha^{-1}). Interaction of no nitrogen and no poultry manure (N_0P_0) gave the lowest seed yield (0.469 t ha^{-1}) among the treatments which was followed by N_0P_1 (0.512 t ha^{-1}) and N_0P_2 (0.536 t ha^{-1}) (Table 4.8).

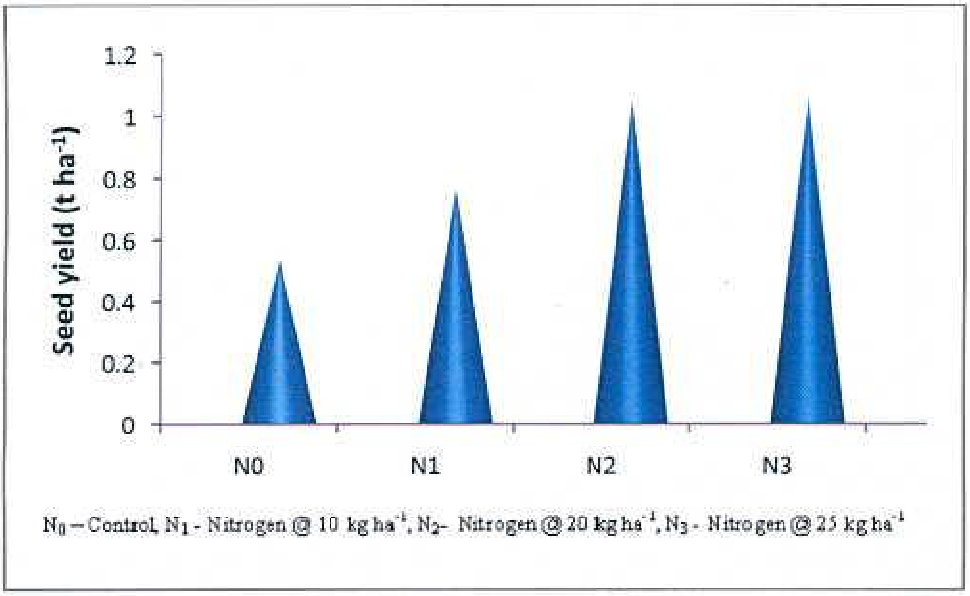
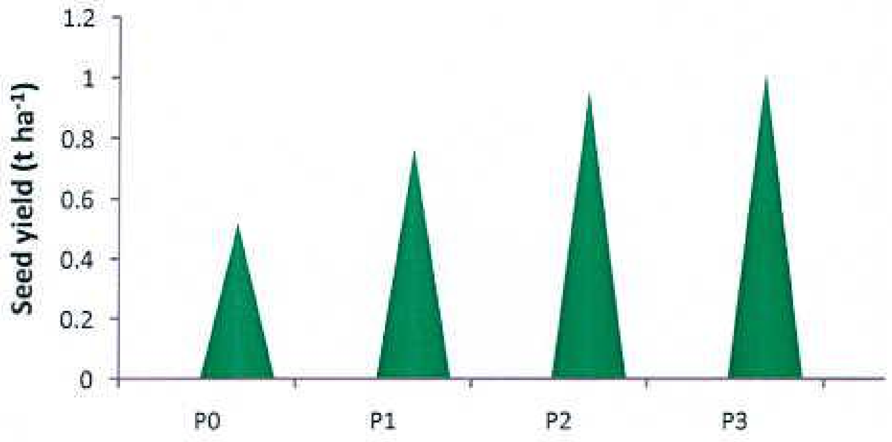


Figure 4.15: Effect of various doses of nitrogen fertilizer on seed yield ha^{-1} of BARI Mung 6



P₀- No poultry manure, P₁ - Poultry manure @ 4 t ha⁻¹, P₂- Poultry manure @ 7 t ha⁻¹, P₃-Poultry manure @ 10 t ha⁻¹

Figure 4.16: Effect of various doses of poultry manure on seed yield ha^{-1} of BARI Mung 6

It is revealed from the study that combination of poultry manure and inorganic nitrogen fertilizers affected seed yield ha^{-1}. Similar results were reported by Channaveerswami (2005) in groundnut and Rajkhowa *et al.* (2002) in green gram. Abbas *et al.* (2011) found that application of DAP at 124 Kg along with 10 tons ha^{-1} of poultry litter yielded maximum seed yield ha^{-1}. Rajkhowa *et al.* (2002) reported that the application of 100 per cent RDF along with vermicompost @ 2.5 t per ha recorded significantly higher plant height (52.7 cm), number of pods per plant (12.67), seeds per pod (12.00), 100 seed weight (4.6 g), seed yield (5.35 q ha^{-1}), seed yield (5.4 q ha^{-1}) and it was on par with the application of 75% or 50% RDF + vermicompost (2.5 t/ha) over control in mungbean.

Table 4.8 : Interaction effect of nitrogen and poultry manure seed yield ha^{-1} of BARI Mung 6

Treatments	Seed yield (t ha^{-1})
N_0P_0	0.469 e
N_0P_1	0.512 de
N_0P_2	0.536 c-e
N_0P_3	0.629 b-e
N_1P_0	0.679 b-e
N_1P_1	0.712 b-e
N_1P_2	0.786 b-d
N_1P_3	0.886 b
N_2P_0	0.812 bc
N_2P_1	0.912 b
N_2P_2	1.246 a
N_2P_3	1.262 a
N_3P_0	0.742 b-e
N_3P_1	0.922 b
N_3P_2	1.256 a
N_3P_3	1.272 a
LSD	0.2657
CV %	3.91
Level of significance	**

** - Significant at 1% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1}
P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

4.10 Stover yield ha^{-1}

The stover yield differed due to nitrogen doses. Significantly higher stover yield (2.084 t ha^{-1}) was recorded in N_3, N_2 and N_1. Lowest stover yield ha^{-1} was recorded from the treatment using no nitrogen fertilizer N_0 (1.514 t ha^{-1}) (Figure 4.17).

Different doses of poultry manures sffected stover yield. Highest stover yield (1.926 t ha^{-1}) was recorded in P_3. Application of no poultry manure (P_0) gave the lowest stover yield (1.635 t ha^{-1}) among the treatments (Figure 4.18).

Stover yield ha^{-1} of BARI Mung 6 varied significantly due to the interaction effect of nitrogen and poultry manure treatments. Highest stover yield (2.412 t ha^{-1}) was recorded from the combination of (N_3P_3) but it was statistically similar with N_3P_2 (2.355) and rest of the treatments did not differ much among themselves.

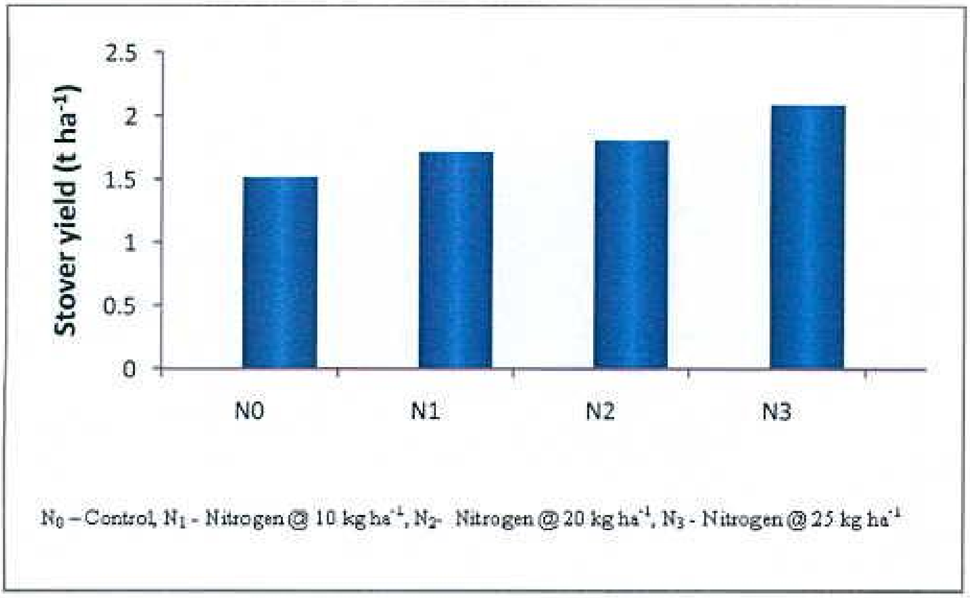


Figure 4.17: Effect of various doses of nitrogen fertilizer on stover yield ha^{-1} of BARI Mung 6

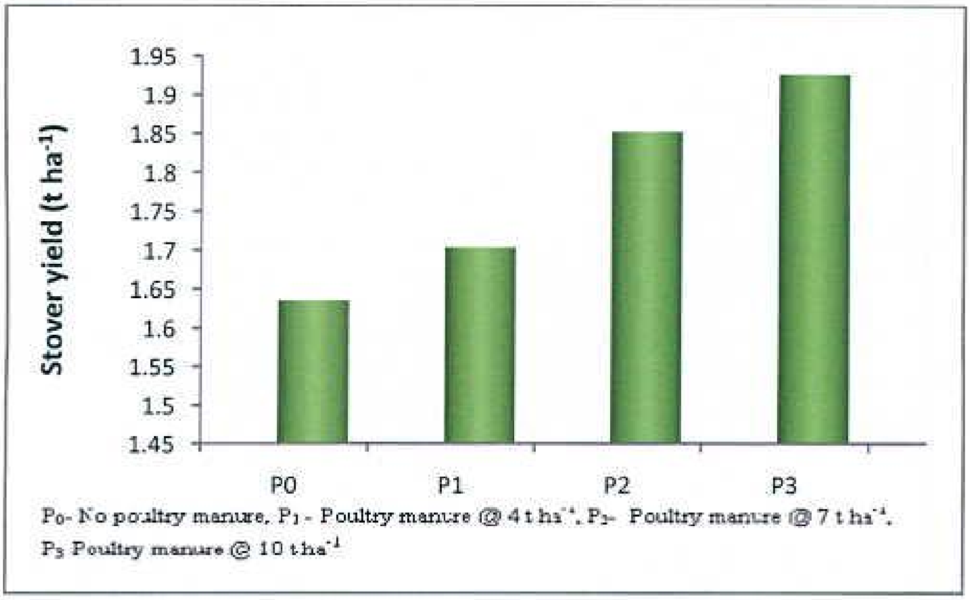


Figure 4.18: Effect of various doses of poultry manure on stover yield ha^{-1} of BARI Mung 6

Table 4.9 : Interaction effect of nitrogen and poultry manure on stover yield ha^{-1} of BARI Mung 6

Treatments	Stover yield (t ha^{-1})
N_0P_0	1.458 d
N_0P_1	1.462 d
N_0P_2	1.465 cd
N_0P_3	1.672 b-d
N_1P_0	1.572 b-d
N_1P_1	1.742 b-d
N_1P_2	1.752 bc
N_1P_3	1.782 b
N_2P_0	1.755 b
N_2P_1	1.792 b
N_2P_2	1.835 b
N_2P_3	1.838 b
N_3P_0	1.755 b
N_3P_1	1.815 b
N_3P_2	2.355 a
N_3P_3	2.412 a
LSD	0.2882
CV %	5.01
Level of significance	**

** - Significant at 1% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1}
P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

4.11 Nitrogen content in seeds (%)

Variation of nitrogen (N) content in seed differed significantly due to different nitrogen doses. Higher N content in seed (3.598 %) was recorded in N_3 (Nitrogen @ 25 kg ha^{-1}). Lowest N content in seed was found from the treatment using no nitrogen fertilizer (3.132%) (Table 4.10).

Poultry manure showed significant differences in case of N content in seed. Highest N content in seed (3.555%) was recorded in P_3 (Poultry manure @ 10 t ha^{-1}).

Application of no poultry manure (P_0) gave the lowest N content in seed (3.195%) among the treatments (Table 4.10).

Moreover highest N content in seed (3.7%) was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3). Interaction of no nitrogen and no poultry manure (N_0P_0) gave the lowest N content in seed (2.57%) among the treatments (Table 4.10).

4.12 Phosphorus content in seeds (%)

The phosphorus (P) content in seed also differed significantly due to nitrogen doses. Higher P level in seed (0.4800%) was recorded in N_3 (Nitrogen @ 25 kg ha^{-1}). Lowest P content in seed was found from the treatment using no nitrogen fertilizer (0.4200%) (Table 4.10).

Though the highest P content in seed (0.4697%) was recorded in P_3 (Poultry manure @ 10 t ha^{-1}). But no poultry manure (P_0) resulted with the lowest P content in seed (0.4250%) among the treatments (Table 4.10).

P content differed non-significantly due to the interaction effect of nitrogen and poultry manure treatments. The highest P content in seed (0.491%) was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3). Interaction of no nitrogen and no poultry manure (N_0P_0) gave the lowest P content in seed (0.352%) among the treatments (Table 4.10).

4.13 Potassium content in seeds (%)

The potassium (K) content was found different due to different nitrogen doses. Significantly higher K content in seed (1.264%) was recorded in N_3 (Nitrogen @ 25 kg ha^{-1}). Lowest K content in seed was found from the treatment using no nitrogen fertilizer (1.126%) (Table 4.10).

Levels of poultry manure showed significant differences in case of K content in seed. Highest K content in seed (1.248%) was recorded in P_3 (Poultry manure @ 10 t ha^{-1}) which was closely followed by P_2 (Poultry manure @ 7 t ha^{-1}) (1.236%) and P_1 (Poultry manure @ 4 t ha^{-1}) (1.199%). Application of no poultry manure (P_0) gave the lowest K content in seed (1.142%) among the treatments (Table 4.10).

K content differed significantly due to the interaction effect of nitrogen and poultry manure treatments. Highest K content in seed (1.3031%) was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3). Interaction of no nitrogen and no poultry manure (N_0P_0) gave the lowest K content in seed (0.9831%) among the treatments (Table 4.10).

Bhuiyan *et al.* (2003) investigate the effect of integrated use of organic and inorganic fertilizers on yield and nutrient uptake of T. Aus rice and mungbean in the Wheat-T. Aus/ Mungbean-T. Aman cropping pattern. The results showed that application of organic manure along with chemical fertilizers resulted in markedly higher uptake of nutrients. The application of NPKS fertilizers remarkably increased the crop yield. The lowest grain yield and the lowest nutrient uptake were noted in control plots receiving no fertilizer or manure.

Table 4.10. Interaction effect of nitrogen and poultry manure on N, P and K content in seed of BARI Mung 6

Treatments	N content in seeds (%)	P content in seeds (%)	K content in seeds (%)
Effect of Nitrogen			
N_0	3.132 c	0.4200 b	1.126 c
N_1	3.460 b	0.4475 ab	1.198 b
N_2	3.517 ab	0.4663 ab	1.237 ab
N_3	3.598 a	0.4800 a	1.264 a
LSD	0.1369	0.05954	0.04684
Level of significance	**	**	**
Effect of poultry manure			
P_0	3.195 c	0.4250	1.142 c
P_1	3.438 b	0.4552	1.199 b
P_2	3.520 a	0.4638	1.236 ab
P_3	3.555 a	0.4697	1.248 a
LSD	0.08009	0.06997	0.04309
Level of significance	**	**	**
Interaction effect			
N_0P_0	2.57 e	0.352	0.9831 e
N_0P_1	3.27 d	0.438	1.1534 d
N_0P_2	3.33 cd	0.443	1.1737 cd
N_0P_3	3.36 b-d	0.447	1.1931 a-d
N_1P_0	3.32 cd	0.437	1.1738 cd
N_1P_1	3.45 a-d	0.443	1.1832 b-d
N_1P_2	3.53 a-d	0.448	1.2135 a-d
N_1P_3	3.54 a-d	0.462	1.2233 a-d
N_2P_0	3.44 a-d	0.446	1.1935 a-d
N_2P_1	3.45 a-d	0.464	1.215 a-d
N_2P_2	3.56 a-c	0.476	1.2637 a-d
N_2P_3	3.62 ab	0.479	1.2739 a-c
N_3P_0	3.45 a-d	0.465	1.217 a-d
N_3P_1	3.58 a-c	0.476	1.2431 a-d
N_3P_2	3.66 a	0.488	1.2939 ab
N_3P_3	3.7 a	0.491	1.3031 a
LSD	0.2738	0.1856	0.1153
CV %	3.51	4.09	6.29
Level of significance	**	**	**

** - Significant at 1% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1}
P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

CHAPTER 5

SUMMARY AND CONCLUSION

A field experiment was carried out during Kharif-I season of 2012 at Sher-e-Bangla Agricultural University (SAU) farm under the Madhupur Tract (AEZ 28, Paleaustult) of Bangladesh with an objective of finding out the effect of inorganic nitrogen fertilizers and poultry manure on growth, yield and nutrient contents of BARI Mung 6.

A two factorial experiment was designed with four nitrogen levels and four doses of poultry manure such as : N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1} and P_0 – no poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3 - Poultry manure @ 10 t ha^{-1} repestively. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Each plot size was 3 m x 2 m.

The seeds were sown in 21[st] February 2012. At first 50% of early matured pods were harvested by hand picking at 60 days after sowing. Finally 7 days after first harvesting, all plants were harvested plot-wise. All recommended cultural practices were followed to grow the crop. Seed yields were recorded at 14% moisture content. The seed samples were analyzed chemically for N, P and K content. All the data were statistically analyzed by MSTAT-C programme and the differences between treatments means were adjudged by Duncan's Multiple Range Test (DMRT).

Significant variations were found in growth & yield parameters and nutrient contents of BARI Mung 6 at harvest due to the effect of inorganic nitrogen fertilizers. Significantly higher plant height, number of leaves and branches $plant^{-1}$, average dry weight $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1} and 1000-seed weight were recorded in N_3 (Nitrogen @ 25 kg ha^{-1}). Higher seed yield was recorded in N_3 (Nitrogen @ 25 kg ha^{-1}) and it was statistically similar with the application of Nitrogen @ 20 kg ha^{-1} (N_2). Higher stover yield was recorded in N_3 (Nitrogen @ 25 kg ha^{-1}) and it was followed by the application of Nitrogen @ 20 kg ha^{-1} (N_2) and then N_1 (Nitrogen @ 10 kg ha^{-1}). Highest N, P and K content in seed content in seed were recorded in N_3 (Nitrogen @ 25 kg ha^{-1}). Lowest results for above parameters were found from the treatment using no nitrogen fertilizer (N_0).

Significant variations were found in growth & yield parameters and nutrient contents at harvest due to the effect of poultry manure. The highest plant height, number of leaves and branches $plant^{-1}$, average dry weight $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1} and 1000-seed weight were recorded in P_3 (poultry manure @ 10 t ha^{-1}). Higher seed yield was recorded in P_3 (poultry manure @ 10 t ha^{-1}). Highest stover yield was recorded in P_3 (poultry manure @ 10 t ha^{-1}) which was closely followed by P_2 and then by P_1. Lowest results for above parameters were found from the treatment using no poultry manure (P_0).

Significant variations were found in growth & yield parameters and nutrient contents due to the interaction effect of inorganic nitrogen fertilizers and poultry manure. Highest plant height was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 and N_2P_3. Better performances were also shown by N_2P_2 and N_3P_1. Highest number of leaves $plant^{-1}$ was recorded from the combination Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2, N_2P_3 and N_2P_2. Highest number of branches $plant^{-1}$ was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2, N_2P_3 and N_2P_2. Better results were also shown by N_1P_3. Highest average dry weight $plant^{-1}$ was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 and N_2P_3. Highest number of pods $plant^{-1}$ was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2, N_2P_3 and N_2P_2. Better results were also shown by N_3P_1 and N_2P_1. Highest number of seeds pod^{-1} was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 and N_2P_3. Better results were also shown by N_2P_2, N_3P_1 and

N_3P_0. Highest 1000-seed weight was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 and closely followed by N_2P_3. Highest seed yield was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2, N_2P_3 and N_2P_2. Highest stover yield was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 and rest of the treatments did not vary much among themselves. Highest N content in seed was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) but it was statistically similar with N_3P_2 and closely followed by N_2P_3. P content in seed of BARI Mung 6 also differed non-significantly due to the interaction effect of nitrogen and poultry manure treatments. Though highest P content in seed was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3). Highest K content in seed was recorded from the combination of Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1} (N_3P_3) which was closely followed by N_3P_2 and N_2P_3. Lowest results for above parameters were found from the interaction treatment using no nitrogen fertilizer and no poultry manure (N_0P_0).

From the above results it can be concluded that combination of organic and inorganic fertilizer is more productive. It is evident from the results that, in case of BARI Mung 6, Nitrogen @ 20 kg ha^{-1} and poultry manure @ 7 t ha^{-1} gave statistically same yield with Nitrogen @ 25 kg ha^{-1} and poultry manure @ 10 t ha^{-1}. So, if we use the former combination, it will allow us to get better yield as well as higher economical return.

Recommendations for further researches :

1. Such studies should be conducted in different AEZs.
2. Research works may be initiated on the residual effects of poultry manure on seed yield and quality of following crops.
3. Other improved cultivars may be tested under such fertilizer combinations.

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APPENDICES

Appendix I: Effect of various doses of nitrogen fertilizer on plant height, number of leaves and branches $plant^{-1}$ and average dry weight $plant^{-1}$ of BARI Mung 6

Treatments	Plant height	Number of leaves $plant^{-1}$	Number of branches $plant^{-1}$	Average dry weight $plant^{-1}$ (g)
N_0	36.22 c	15.41 c	8.142 c	5.743 b
N_1	38.60 b	17.63 b	8.858 bc	6.800 ab
N_2	40.31 ab	19.01 a	9.845 ab	7.307 a
N_3	40.52 a	19.14 a	10.09 a	7.345 a
LSD	1.771	1.366	1.161	1.287
CV %	2.33	3.13	6.50	11.01
Level of significance	**	*	*	**

** = Significant at 1% level, * = Significant at 5% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1}

Appendix II: Effect of various doses of poultry manure on plant height, number of leaves and branches $plant^{-1}$ and average dry weight $plant^{-1}$ of BARI Mung 6

Treatments	Plant height	Number of leaves $plant^{-1}$	Number of branches $plant^{-1}$	Average dry weight $plant^{-1}$ (g)
P_0	37.46 c	16.48 b	7.825 c	6.358 c
P_1	38.26 bc	16.93 b	9.025 b	6.658 bc
P_2	39.49 ab	18.77 a	9.875 a	7.020 ab
P_3	40.44 a	19.01 a	10.21 a	7.160 a
LSD	1.453	0.6509	0.7871	0.3668
CV %	2.33	3.13	6.50	11.01
Level of significance	*	**	**	**

** = Significant at 1% level, * = Significant at 5% level

P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

Appendix III : Effect of various doses of nitrogen fertilizer on number of pods plant^{-1}, seeds pod^{-1} and seeds plant^{-1} and 1000-seed weight of BARI Mung 6

Treatments	Number of pods plant^{-1}	Number of seeds pod^{-1}	1000-seed weight (g)
N_0	9.358 c	3.440	35.44 c
N_1	11.38 b	3.928	38.58 b
N_2	15.67 a	4.227	41.22 a
N_3	15.90 a	4.485	42.56 a
LSD	1.487	1.325	1.887
CV %	5.44	2.89	7.51
Level of significance	**	ns	*

** = Significant at 1% level, * = Significant at 5% level, ns: non-significant

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1}

Appendix IV : Effect of various doses of poultry manure on number of pods plant^{-1}, seeds pod^{-1} and seeds plant^{-1} and 1000-seed weight of BARI Mung 6

Treatments	Number of pods plant^{-1}	Number of seeds pod^{-1}	1000 seed weight (g)
P_0	12.03 c	3.570 c	37.01 c
P_1	12.48 bc	3.920 bc	38.41 b
P_2	13.21 b	4.190 ab	40.81 a
P_3	14.59 a	4.400 a	41.56 a
LSD	1.096	0.3939	1.096
CV %	5.44	2.89	7.51
Level of significance	**	*	*

** = Significant at 1% level, * = Significant at 5% level

P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}

Appendix V: Effect of various doses of nitrogen fertilizer on seed yield and stover yield of BARI Mung 6

Treatments	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
N_0	0.5365 c	1.514 c
N_1	0.7657 b	1.712 b
N_2	1.058 a	1.805 b
N_3	1.048 a	2.084 a
LSD	0.1931	0.1293
CV %	3.91	5.01
Level of significance	*	**

** = Significant at 1% level, * = Significant at 5% level

N_0 – Control, N_1 - Nitrogen @ 10 kg ha^{-1}, N_2- Nitrogen @ 20 kg ha^{-1}, N_3 - Nitrogen @ 25 kg ha^{-1}

Appendix VI : Effect of various doses of poultry manure on seed yield and stover yield of BARI Mung 6

Treatments	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
P_0	0.5155 c	1.635 c
P_1	0.7645 b	1.703 bc
P_2	0.9560 a	1.852 ab
P_3	1.012 a	1.926 a
LSD	0.1833	0.1887
CV %	3.91	5.01
Level of significance	**	*

** = Significant at 1% level, * = Significant at 5% level

P_0- No poultry manure, P_1 - Poultry manure @ 4 t ha^{-1}, P_2- Poultry manure @ 7 t ha^{-1}, P_3-Poultry manure @ 10 t ha^{-1}