COMBINED EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON THE GROWTH AND YIELD OF MUNGBEAN (BARI mung 6)

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CERTIFICATE

This is to certify that the thesis entitled" COMBINED EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON THE GROWTH AND YIELD OF MUNGBEAN (BARI Mung 6)"submitted to the DEPARTMENT OF SOIL SCIENCE, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE (M.S.) in SOIL SCIENCE, embodies the results of a piece of bona fide research work carried out by Z. M. RAKIBUL ISLAM,Registration. No.08-02844, 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.

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ABSTRACT

An experiment was conducted at the experimental field of the farm of Sher-e-Bangla Agricultural University during the period from February to April (kharif-I season) of 2014 to study the effect of different combinations of organic and inorganic fertilizers on growth and yield of mungbean (BARI Mung 6) using RCBD (Randomized Completely Block Design) with three replications. During the experiment, two different organic fertilizers (Poultry manure and Cowdung) were combined with two doses of inorganic fertilizers (50% and 70% of optimum dose) and one control treatment using no fertilizer were included. At 30 DAS and at harvest highest plant height, number of leaves plant^{-1} and branches plant^{-1} were found from the combination of 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} which was statistically similar or closely followed by 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1} treatment. Maximum numbers of pods plant^{-1}, seeds pod^{-1} and seed yield plant^{-1} were recorded in 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} and it was closely followed by 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}. Highest seed yield plant^{-1}and 1000-seed weight was recorded in 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}. It was observed that, for the above parameters; 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} showed better results. Lowest values for all of the growth and yield parameters obtained from the treatment using no fertilizer. Highest N and P contents in seed were recorded in 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} and it was statistically similar with the application of 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}. K content of mungbean seed was differed non-significantly due to the different combinations of organic and inorganic fertilizer doses. Although, the highest K content in seed was recorded in T_6 treatment that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}. Lowest N, P and K contents of mungbean seed were found from the treatment using no fertilizer (T_0).

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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.)] is one of the most important pulse crops grown in Bangladesh. **Mung bean** is also known as **mung dal, moog dal,** mash bean, **green gram,** golden gram, and green soy.Its ediblegrain is characterized by good digestibility, flavour, high protein content and absence of any flatulence effects (Ahmed *et al.*, 2001). 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 its supply of cheaper protein source, it is designated as “poor man’s meat”. Mungbean being drought tolerant and short duration can grow well under varied conditions (irrigated and rainfed).

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 management. Due to the shortage of land, the scope of its extensive cultivation is very limited. Therefore, attempts must be made to increase the yield per unit area by applying improved technology and management practices.

BARI mung-6 is a yield potential, prestigious variety, innovated by Bangladesh Agricultural Research Institute (BARI) that fits well in crop rotation between two cereal crops (BARI, 1998). It shows disease, insect and pest resistance compare to other mungbean varieties. It fixes atmospheric nitrogen symbiotically with Rhizobia and enriches the soil. Due to tap root it can go deep in search of water and nutrients. BARI mung-6 is a prestigious innovation among high yield potential mungbean varieties of Bangladesh Agricultural Research Institute (BARI).

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). 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. Mungbean yield and quality can be improved by the balanced use of fertilizers and also by managing the organic manures properly. Soil and fertilizer management is very complex and dynamic in nature. We are increasingly forced to meet up growing food needs from increase in yield from existing or even shrinking land areas. In this process, we are moving away from the traditional and rather static "soil dependent" agriculture to dynamic "fertilizer dependent" agriculture (BARC, 2005).

Environmental degradation is a major threat confronting the world, and the rampant use of chemical fertilizers contributes largely to the deterioration of the environment through depletion of fossil fuels, generation of carbon dioxide (CO_2) and contamination of water resources. It leads to loss of soil fertility due to imbalanced use of fertilizers that has adversely impacted agricultural productivity and causes soil degradation. Now there is a growing realization that the adoption of ecological and sustainable farming practices can only reverse the declining trend in the global productivity and environment protection (Aveyard 1988, Wani and Lee 1992, Wani *et al.* 1995). On one hand tropical soils are deficient in all necessary plant nutrients and on the other hand large quantities of such nutrients contained in domestic wastes and agricultural byproducts are wasted. Such large quantities of organic wastes generated also pose a problem for safe disposal. Most of these organic residues are burned currently or used as land fillings. In nature's laboratory there are a number of organisms (micro and macro) that have the ability to convert organic waste into valuable resources containing plant nutrients and organic matter, which are critical for maintaining soil productivity. Microorganisms and earthworms are important biological organisms helping nature to maintain nutrient flows from one system to another and also minimize environmental degradation.

Being leguminous in nature, mungbean needs low nitrogen but require optimum doses of other major nutrients as recommended. Phosphorous (P) is a vital yield determining nutrient in legumes (Chaudhary *et al.*, 2008). It is an important component of key molecules such as nucleic acids, phospholipids and ATP, and consequently, plants cannot grow without a reliable supply of this nutrient. P is also essential for the seed formation. It is known to stimulate root growth and is associated with early maturity of crops. It not only improves the quality of fruits, forages, vegetables and grains but also play role in disease resistance of plants. (Brady and Weil, 1999). Potassium (K) is the third macronutrient required for plant growth, after nitrogen (N) and phosphorus (P). Unlike N and P; K is not a component of cell structure. Instead, it exists in mobile ionic form, and acts primarily as a catalyst (Wallingford, 1980). Potassium has an important osmotic role in plants (Tisdale and Nelson, 1966) important function in arid environments for plants' metabolism.

Recently, the use of organic materials as fertilizers for crop production has received attention for sustainable crop productivity (Tejada *et al*., 2009). Organic materials hold great promise as a source of multiple nutrients and ability to improve soil characteristics (Moller, 2009). Organic farming preserves the ecosystem. Symbiotic life forms are cultured ensuring weed and pest control and optimum soil biological activity which maintain soil fertility. The synthetic fertilizers are harmful for soil and aerial environment a threat to entire globe, because the inorganic fertilizers mainly contain major nutrients NPK in large quantities and are neglecting the use of organic manures and bio-fertilizers and hence have paved the way for deterioration of soil health and in turn ill-effects on plants, human being and livestock (Choudhry, 2005).

Considering the above facts the present study is aimed at:

i) To observe the response of mungbean towards different combinations of organic and chemical fertilizers and

ii) To find out the best combination of organic and inorganic fertilizer doses for better yield 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 organic fertilizers on mungbean is not adequate, analogies from other crops have also been included to emphasize certain point of view

2.1 Effect of inorganic fertilizers

Haque *et al.* (2001) was conducted a field experiment to study the effect of continued fertilizer, organic manure and mungbean residues on soil properties and yield of crops. The grain and stover yield of mungbean increased significantly due to treatments over control. For mungbean (Binamoog-2) the highest grain yield of 1.06 t ha^{-1} was obtained with inoculums + P_{10} K_{12} S_4 kg ha^{-1} along with residual effect of fertilizer.

Mollah *et al*. (2011) was conducted a field experiment at the Multiplication Testing Site (MLT), Joypurhat Sadar upazila with Potato- Mugnbean –T. *Aman* rice cropping pattern during November/2007 to November/2008 to verify different nutrient management approaches and to determine the economic dose of fertilizer for the said cropping pattern. The treatments were, soil test based fertilizer dose for moderate yield goal, soil test based fertilizer dose for high yield goal, integrated plant nutrient management, farmers' practice, and control. Cowdung was applied at the first crop potato only in the cropping sequence. The varieties for potato, mungbean and T. *Aman* rice were Diamant, BARI Mung-6, and BR11, respectively. The results demonstrated that the tuber yield of potato, seed yield of mungbean, and grain yield of T. *Aman* rice were significantly influenced by the different treatments. In mungbean, the highest seed yield (1384 kg/ha) was also recorded from NPKS for high yield goal with residual cowdung treatment. The results of NPKS application for high yield goal with residual cowdung had a positive effect on seed yield of mungbean. So, considering crop productivity, economic return, and soil fertility, integrated plant nutrient management for high yield goal with 5 t/ha cowdung could be recommended for the Potato-Mungbean-T *Aman* rice cropping pattern at Joypurhat and similar soils of Level Barind agroecological zone for sustainable higher yield.

Salahin *et al.* (2011) was conducted a field experiment for three consecutive years to observe the effect of tillage and integrated nutrient management on soil physical properties and yield under tomato-mungbean- T. aman cropping pattern during 2007-08, 2008-09 and 2009-10 at BARI, Gazipur. There were nine treatment combinations comprising three tillage practices i.e. T_1: tillage up to 8 cm depth, T_2: tillage up to 12 cm depth and T_3: tillage up to 20 cm depth and three levels of fertilizers i.e. F_1: recommended dose of chemical fertilizers only, F_2: cowdung @ 5 t ha^{-1} + (Recommended dose of chemical fertilizers-nutrients from cow dung) and F_3: native fertility (no fertilizer used) were tested in a split-plot design with three replications. Soil bulk density, particle density, porosity and field capacity were not significantly affected by tillage and organic and inorganic fertilizers but soil moisture significantly influenced by both treatments. The crop yields were significantly influenced by different treatment combinations of organic and inorganic fertilization but not by tillage practices. The combined effect of tillage and organic and inorganic fertilizers was non-significant in all aspects

Rupa *et al.* (2014) was conducted an experiment at Sher-e-Bangla Agricultural University farm during the period from February to April 2012 to study the effect of organic and inorganic fertilizers on growth and yield of mungbean (BARI Mung 5). The experiment was followed by Randomized Completely Block Design with three replications. During the experiment following treatments were incorporated T_0; Control, T_1; 10 tha^{-1} Cowdung (Recommended dose), T_2; 10 tha^{-1} Cowdung + 25 % of recommended dose of inorganic fertilizer, T_3; 10 tha^{-1} Cowdung + 50 % of recommended dose of inorganic fertilizer, T_4; 10 tha^{-1} + 75% of recommended dose of inorganic fertilizer, T_5; 10 tha^{-1} Vermicompost (Recommended dose), T_6; 10 tha^{-1} Vermicompost + 25% of recommended dose of inorganic fertilizer, T_7; 10 tha^{-1} Vermicompost + 50 % of recommended dose of inorganic fertilizer, T_8; 10 tha^{-1} Vermicompost + 75 % of recommended dose of inorganic fertilizer, T_9; 100 % Inorganic fertilizer. Maximum numbers of pods/plant (25.6), seeds/pod (12.1), seeds/plant (312.6), seed yield/plant (14.6 g), 1000-seed weight (35.6 g), seed yield (1127.5 kg/ha), N content in seeds (3.39%), P content in seeds (0.35%) and K content in seeds (2.25%) was found from T_8 treatment while lowest was found from T_0.

Khalilzadeh *et al.* (2012) was done the study to determine the effect of foliar spraying of Bio-organic fertilizers and urea on root and vegetative growth of mung bean (Vigna radiata L.) in a

greenhouse condition. The experiment was conducted with four replications in Randomized Complete Design with ten treatments (Urea, Nitroxin, Amino acid, Green hum, Biocrop L-45, Nutriman N24 and Mas Raiz, cattle manure, water and control). Results showed that all traits were significantly affected by treatments except the number of second roots. Foliar application of urea and organic manure substantially improved the plant height, leaf area, shoot and root dry weights, root and shoot length, volume and number of roots. Similarly shoot and leave number and nodules root were also improved by the foliar spraying of Green hum and Amino acid, respectively. While the lowest nodules root was observed in plants treated by nutriman N24 and urea. This improved growth of mainly due to nutrient availability in bio-organic fertilizer and uptake by plants.

An experiment was carried out by Bhuiyan *et al.* (2011) 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.

Phanphruek *et al.* (2006) was conducted a field experiment in Pak Chong soil series at Lop Buri field crops experiment station in 2004 to investigate the effect of chicken manure and nitrogen fertilizer in sweet corn-mungbean cropping system under no-tillage system. The experimental design was a split plot with 5 replications. Main plot consisted of 2 soil preparations: conventional tillage and no-tillage. Subplot were nitrogen fertilizer and chicken manure (CM) applied for sweet corn (1st crop) which were 3 rates of nitrogen: 0, 10, 20 kgN/rai and CM 500 kg/rai + 5 kgN/rai, CM 500 kg/rai + 10 kgN/rai and CM 1000 kg/rai+5 kgN/rai. Nitrogen 20 kgN/rai produce highest yield (1515 kg/rai) significantly difference from the plot applied with 10 kgN/rai and treatment CM 500 kg/rai+5kgN/rai. However no significantly difference in corn yield as the effect of treatment CM 500 kg/rai+10 kgN/rai, CM 1000 kg/rai + 5 kgN/rai and 20 kgN/rai were observed. For mungbean (2nd crop) the result showed that CM residual effect significantly increased growth and seed weight.

Saleem *et al.* (2010) conducted an experiment of bio-economic efficiency of maize - legumes based intercropping systems under different fertility treatments and its effects on subsequent wheat crop were evaluated at National Agriculture Research Center (NARC) Islamabad Pakistan. Higher CGR, NAR values were recorded of maize with half PM + half PK + inoculation. Wheat grain yield improved by 12 % and 11 % sown after mashbean and mungbean treated with PK (80:60 kg ha^{-1}) + Rhizobium inoculation respectively. In similar fashion, wheat grain yield increased by 20 % after 15 t ha^{-1} poultry manure and 15 % wheat grain yield was improved with poultry manure @ 7.5 t ha^{-1} + PK (40:30 kg ha-1) + inoculation. In maize higher crop growth rate (CGR) and net assimilation rate (NAR) were registered in poultry manure plots 7.5 t ha^{-1} + PK (40:30 kg ha^{-1}) + inoculation treatment.Same variables increased the pH, NPK and organic matter in soil. Maize + mungbean with NPK (120:80:60 kg ha-1) gave the highest net benefit of Rs. 68720.75 ha-1 without wheat in succession and Rs. 96543.95 ha-1 with wheat in succession, respectively. According to partial budget analysis highest net benefit of Rs.148069.92 ha-1 was accrued in maize + mungbean – wheat sequence with half poultry manure + half PK + inoculation.

Rahman *et al.* (2014). was conducted an experiment to investigate the effect of different nutrients application on common bean at experimental field, Department of Botany, Hazara University, Mansehra during 2012-13 in Randomized Complete Block Design with three replicates and four treatments i.e. control (H_2O spray alone), poultry manure, DAP (Di-ammonium Phosphate) and foliar spray of (NPK 20:20:20). The results showed that foliar spray of NPK significantly increased number of pods $plant^{-1}$, number of seeds pod^{-1}, number of seeds $plant^{-1}$, biomass and grain yield.

2.2 Effect of inorganic fertilizers

Malik *et al.* (2003) carried out a field experiment on mungbean (*Vigna radiata* L.) in Pakistan to determine the effect of varying levels of nitrogen (0, 25 and 50 kg ha^{-1}) and phosphorus (0, 50, 75 and 100 kg ha^{-1}) on the yield and quality of mungbean (*Vigna radiata*) cv. NM-98. Although plant population was not affected significantly, various growth and yield components were significantly affected by varying levels of nitrogen and phosphorus. A fertilizer combination of 25 kg N + 75 kg P ha^{-1} resulted in the maximum seed yield (1,113 kg ha^{-1}). Protein content (25.6%) was maximum in plots treated with 50 kg N + 75 kg P ha^{-1}, followed by 25.1% protein content in plots treated at 25 kg N + 75 kg P ha^{-1}. The highest net income (Rs. 21,375) was obtained by applying 25 kg N + 75 kg P ha^{-1}.

Srinivas and Shaik (2002) conducted field experiment during the kharif seasons to study the effects of N (0, 20, 40 and 60 kg ha^{-1}) and P (0, 25, 50 and 75 kg ha^{-1}) along with seed inoculation with *Rhizobium* culture on the growth and yield components of greengram. Plant height generally increased with increasing rates of P and with increasing rates of N up to 40 kg ha^{-1} followed by decrease with further increase in N. Number of seeds pod^{-1}, 1000-seed weight, seed and haulm yields generally increased. Seed inoculation with *Rhizobium* resulted in higher values for the parameters measured relative to the control. The interaction effects between N and P were not significant for the number of pods $plant^{-1}$, pod length, seed and haulm yield.

Patel *et al*. (2003) conducted a field experiment in Gujrat, India during the summer seasons of 1995 to 1998 on sandy loam soils to determine the suitable sowing date, and nitrogen and phosphorus requirements of summer mungbean (cv. GM3). Treatments comprised: all the 27 combinations of three sowing dates: 15 February, 1 March and 15 March; three nitrogen rates: 10, 20 and 30 kg N ha^{-1}; and three phosphorus rates: 20, 40 and 60 P ha^{-1}. Results indicated that sowing mungbean on 1 March recorded significantly higher grain yields, 37 and 16% higher than those of early (15 February) or late-sown crops (15 March), respectively. Application of 10 kg N ha^{-1} recorded significantly higher grain yield over the control. Treatment with 40 kg P ha^{-1} produced 15 and 18% higher grain yields than treatments with 20 and 60 kg P ha^{-1}, respectively. The highest net return of Rs. 18,240 ha^{-1} was recorded from mungbean sown on 1 March and treated with 20 kg N ha^{-1} and 40 kg P ha^{-1}.

Sharma *et al*. (2001) carried out a field experiment on mungbean cv. Pusa Baisakhi which was fertilized with various levels of nitrogen (0, 10 and 20 kg N ha^{-1}) and phosphorus (0, 30 and 60 kg P_2O_5 ha^{-1}) under mid-hill conditions in Himachal Pradesh, India during the kharif seasons of 1998 and 1999. The highest levels of N and P_2O_5 applications resulted in the average maximum test weight, biological and grain yields, harvest index and seed protein content.

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.

Sangakhara (2003) carried out a field experiment in Sri Lanka in 1999 to determine the impact of effective microorganisms (EM) on N dynamics in a cereal (maize cv. Ruwan)-legume (mungbean) cropping system, using ^{15}N labeled maize or mungbean residues. EM increased the ^{15}N concentrations of maize at the V8 growth stage indicating better use of applied nutrients from organic matter. The uptake of ^{15}N was greater from mungbean residues rather than from maize. EM also increased biological N fixation. The synergistic effects of EM in organic systems were evident from this field study.

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.

Hayat *et al*. (2004) conducted a field experiment during kharif 2000 in Rawalpindi, Pakistan to find out the effect of N and *Rhizobium* sp. inoculation on the yield, N uptake and economics of mungbean (cultivars NM 92 and NCM 209). The treatments were: control; 500 g *Rhizobium* inoculum, 30, 60 and 90 kg N ha^{-1} and inoculum combined with N at 30, 60 and 90 kg ha^{-1}. N content was higher in nodules of NM 92 than NCM 209. The highest N content in nodules (2.80%) was obtained with inoculation + 30 kg N ha^{-1}. NCM 209 had higher N shoot content (2.13%) than NM 92 (1.87%). The highest shoot N content was obtained with inoculation + 30 kg N ha^{-1}. The highest soil N content was obtained with inoculation + 90 kg N ha^{-1}. NCM 209 produced higher yield than NM 92. The maximum economic yield for NM 92 and NCM 209 (768 and 910 kg ha^{-1}, respectively) was obtained with inoculation + 90 kg N ha^{-1}. The maximum biological yield (4,889 kg ha^{-1}) was obtained in NCM 209 with inoculation + 30 kg N ha^{-1}. NCM 209 showed higher biological yield than NM 92. The highest harvest index of 18.45% was obtained with inoculation + 30 kg N ha^{-1}. The maximum net income (Rs. 18,329 and Rs. 13,003 ha^{-1}) in NCM 209 and NM 92 was obtained with inoculation alone and inoculation + 30 kg N ha^{-1}, respectively. The highest benefit: cost ratio was obtained in NCM 209 with the inoculation treatment alone.

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.

Rana and Choudhary (2006) conducted a field experiment during 2000 and 2001 in New Delhi, India to evaluate the relative moisture utilization by maize grown as sole crop or in maize-mungbean intercropping system. Total grain production in terms of maize equivalent was higher in maize (75 cm) + two rows of mungbean. Total N uptake and water use efficiency were also highest in maize (75 cm) + two rows of mungbean. All parameters increased with increasing concentration of N up to 120 kg ha^{-1}.

Tickoo *et al.* (2006) carried out a field experiment in Delhi, India during the kharif season of 2000 with mungbean cultivars Pusa 105 and Pusa Vishal which were sown at 22.5 and 30 m spacing and supplied with 36-46 and 58-46 kg NP ha^{-1}. Cultivar Pusa Vishal recorded higher biological and grain yield (3.66 and 1.63 t ha^{-1}, respectively) compared to cv. Pusa 105. Differences in the values of the parameters examined. NP rates had no significant effects on both the biological and grain yield of the crop. Row spacing at 22.5 cm resulted in higher grain yields in both crops.

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 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.

Kayani *et al*. (2010) conducted experiment to investigate the impact of legume on the oncoming wheat crop. Mungbean (NM92) was planted during Kharif 2007. The wheat variety Inqalab-91 was sown before and after the mungbean plantation during Rabi 2006-07 and 2007-08. Twelve different treatments were applied having different doses of N and P but Farm Yard Manure (FYM) remained constant. Six parameters were selected to investigate the potential effects of the legume viz., soil physico-chemical properties, plant height, spike length, number of grains $spike^{-1}$, 1000 grains weight and yield $plot^{-1}$. The results showed significant increase in plant height, spike length, number of grains/spike, 1000-grains weight and yield/plot after cropping mungbean. The yield was obtained at an increase of 26.90% after mungbean application. Based on results, cereal legume crop rotation is highly recommended.

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.

Field studies was carried by out by Sangakkara *et al*. (2011) for testing the impact of fertilizer K on root development, seed yields, harvest indices, and N-use efficiencies of maize and mungbean, two popular smallholder crops over major and minor seasons. Application of 120 kg K ha^{-1} optimized all parameters of maize in the major wet season, whereas the requirement was 80 kg K ha^{-1} in the minor season. Optimal growth yields and N-use efficiencies of mungbean was with 80 kg K ha^{-1} in both seasons. Information regarding rates of fertilizer K that optimized N use and yield of maize and mungbean during each of the two tropical monsoonal seasons of South Asia is presented.

2.3 Combined effect of organic and inorganic fertilizers

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.

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.

Naeem *et al.* (2006) was carried a field experiment out to determine the effect of organic manures and inorganic fertilizers on growth and yield of mungbean (Vigna radiata L.). Experiment comprised of two varieties (NM-98 & M-1) and four fertility levels as NPK @ 25 -50 -50 kg ha^{-1}, poultry manure @ 3.5 t ha^{-1}, FYM @ 5 t ha^{-1} and Bio-fertilizer @ 8 g kg^{-1} seed. NPK fertilizers and organic manures were applied at the time of seed bed preparation. Wheat grain yield was recorded highest (1104 kg ha^{-1}) with the application of the inorganic fertilizers (NPK @ 25 -50 -50 kg ha^{-1}). Among organic nutrient a source, poultry manure @ 3.5 t ha^{-1} was found the best followed by FYM @ 5 t ha^{-1}. Both varieties were equal in grain yield. Numbers of pods, number of seeds per pod, 1000 grain weight were also almost higher in inorganic fertilizer treatment. The economic analysis revealed maximum net benefit from the treatment, where poultry manure was applied.

Shen *et al.* (2001) was conducted a pot experiment to investigate the effects of organic materials on the alleviation of Al toxicity in acid red soil Crop production in red soil areas may be limited by Al toxicity. A possible alternative to ameliorate Al toxicity is the application of such organic manure as crop straw and animal manure. Ground wheat straw, pig manure or $CaCO_3$ were mixed with the soil and incubated, at 85% of water holding capacity and 25°C, for 8 weeks. Growth of mung bean seedling was improved substantially by the application of organic material or $CaCO_3$. Pig manure or wheat straw was more effective in ameliorating Al toxicity than was $CaCO_3$. Mung bean plants receiving pig manure or wheat straw contained relatively high concentrations of P, Ca and K in their leaves. It is suggested that the beneficial effect of organic manure on mung bean is likely due to decreasing concentrations of monomeric inorganic Al concentrations in soil solution and improvement of mineral nutrition.

Ahmad *et al.* (2014) was the study describes the optimizing organic and inorganic fertilizers recommendations for wheat-sorghum and wheat-mung bean crop rotations under rainfed conditions. Five different treatments including T_0 as Control, T_1 with farmyard Manure (FYM) at 30 tons ha^{-1}, T_2 include NPK at120-80-60 at kg ha^{-1}, T_3 using poultry manure at 20 tons ha^{-1}, T_4 included compost (Press mud) at 12.5 tons ha^{-1} and in T_5, Inoculation by Phosphorus mobilizing microorganisms at 2.5 packets ha^{-1} was used only for wheat while, sorghum and mungbean were planted on the residual nutrients. Net benefits for the poultry manure were highest mainly due to high wheat yield and marginal rate of return are also high. The results were also confirmed using residual analysis.

Crop productivity of maize-legume intercropping system for yield and yield attributes were evaluated by Saleem *et al.* (2011) under different fertility treatments at National Agriculture Research Center (NARC), Islamabad, Pakistan during 2007 and 2008 using complete randomized strip block design replicated thrice. Three cropping systems were kept in vertical blocks and five fertility treatments were placed in horizontal blocks. According to results of the study it was revealed that half poultry manure + half PK+ inoculation gave maximum maize grain yield of 4830.95 kg ha^{-1} and biological yield of 15330.29 kg ha^{-1} respectively, while cropping systems did not have an affect on grain and biological yields of maize to the significant extent. On the basis of agronomic as well as economic performance of maize + mashbean intercropping, it was well evident that combined use of organic, biofertilizers and chemical fertilizers was proved to be more productive and remunerative and can be recommended for maize growers to elevate income.

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 April to June (kharif-I season) of 2014 for finding out the effect of different combinations of organic and inorganic fertilizers on growth and yield of a selected 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 $23^{o}77'$ North Latitude and $90^{o}30'$ East Longitude. The elevation of the experimental site is 8.0 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.

Table 3.1. Morphological characteristics of the experiment field

Locality	SAU, Dhaka
Geographic position	$23^{o}77'$North Latitude $90^{o}30'$East Longitude 8.0 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

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	Silty 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

3.4 Crop: Mungbean

BARI mung-6 was used in the study. The salient characteristics of this variety are presented below:

BARI mung-6

BARI released BARI mung-6 in 2003. Plant height of this variety ranges from 40 to 45 cm and seeds are deep green in colour. One thousand seed weight is about 51-52 g. The variety requires 55 to 60 days to mature, and average yield is 1,500 kg ha^{-1}. It is also resistant to *Cercospora* leaf spot and tolerant to yellow mosaic virus (BARI, 2009).

3.5 Year: Kharif-I, 2014

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. Variety-1 (BARI mung-6)

Organic and Inorganic Fertilizers and Doses :

1. Organic Fertilizers

a) Poultry manure
b) Cowdung

These rates of the different organic fertilizers are almost equal in consideration of essential nutrient contents.

Table 3.3. Chemical compositions of the organic manures used for the experiment (Oven dry basis)

Organic fertilizer	N (%)	P (%)	K (%)
Poultry manure	1.3	0.5	1.3
Cowdung	0.9	0.5	1.1

Source : SRDI

2. Inorganic Fertilizer

a) Urea for nitrogen @ 40-50 kg ha^{-1}
b) TSP for phosphorous@ 80-85 kg ha^{-1}
c) MoP for potassium at @ 30-35 kg ha^{-1}
d) Gypsum for sulphur @30 kg ha^{-1}
e) Zinc sulphate for zinc @ 2.0 kg ha^{-1}
f) Boric acid for boron @ 1.5 kg ha^{-1}

(BARI, 2009)

Different treatments:

T_0 –Control

T_1 –6 ton cowdung ha^{-1}

T_2 –50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}

T_3 –70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}

T_4– 4 ton poultry manure ha^{-1}

T_5 –50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}

T_6 –70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}

T_7 –3 ton cowdung ha^{-1} and 2 ton poultry manure ha^{-1}

3.7 Land preparation

The experimental lands were opened with a power tiller and subsequently ploughed twice followed by laddering. Weed stubble and crop residues were removed. Finally, the land was leveled and the experimental plot was partitioned into the unit plots in accordance with the experimental design mentioned in the following section.

3.8 Fertilizer application

Organic fertilizers (poultry manure and cowdung) were applied along with urea, TSP, MoP, gypsum, zinc sulphate and boric acid as per treatments during the final land preparation.

3.9 Sowing

Mungbean was sown on 27 February 2014. 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 1st 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 of growth and yield parameters

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 30 DAS and 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 30 DAS and 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 30 DAS and 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} and seed yield plant^{-1}(g)

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}.The yield of seeds from ten randomly selected plants were counted from each treatment. Average was calculated and recorded as seed yield plant^{-1}(g).

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.

viii) Seed yield

The seed 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 per hectare was computed and expressed in kg per hectare.

3.14 Determination of N, P and K

3.14.1 Preparation of seed sample for N

Seeds 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 ($C_2H_{14}O_5BO_4S$) and methyl red ($C_{10}H_{10}N_3O_2$) solution. Finally the distillate was titrated with standard (0.05N) H_2SO_4until the color changed to pink (Jackson, 1973).

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

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

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 seed sample was taken in a digestion tube and 10 ml of di-acid mixture (HNO_3 : $HClO_4$ = 2 : 1) was added to each digestion flask. The tubes were 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 *et al.* 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).

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

4.1 Plant Height (cm)

The data on plant height (cm) of mungbean at different growth stages as influenced by organic and inorganic fertilizers are presented in Table 1.

The average values of the treatments involving cowdung (T_1-T_3) and poultry manure (T_4-T_6) were observed; it was found that both at 30 DAS and at harvest the highest plant height was obtained in T_6 treatment (30.25 cm and 44.81 cm respectively) i.e. 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} and the lowest plant height was obtained from T_0 treatment (21.13 cm and 33.11 cm respectively) that is control.

It seems from the results that combination of organic and inorganic fertilizers significantly increased among the treatment combination. Actually organic fertilizers help to increase the organic matter content of soil, thus reducing the bulk density and decreasing compaction. Thus plants get a suitable growing environment which promotes better growth and development. Similar sort of findings were found by many scientists while experimenting with various crops. 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 plant^{-1}

The data on number of leaves plant^{-1} of mungbean at different growth stages as influenced by organic and inorganic fertilizers are presented in Table 1. The average values of the treatments involving cowdung (T_1-T_3) and poultry manure (T_4-T_7) were observed; it was found that both at 30 DAS and at harvest the highest number of leaves was obtained from T_6 treatment (13.88 and 21.72 respectively) that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} which is statistically similar with T_3 (12.90 and 20.97 respectively) and T_5 (13.77 and 21.63 respectively) and the lowest number of leaves was obtained from T_0 treatment (9.90 and 14.17 respectively) that is control.

Results showed that the combination of organic and inorganic fertilizers significantly increased the number of leaves 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) and Rajkhowa *et al*. (2002) found better growth by using combination of organic and inorganic fertilizers than only inorganic fertilizers in groundnut and in green gram respectively.

The results showed that application of organic manure along with chemical fertilizers resulted in markedly higher uptake of nutrients. Aslam *et al.* (2010) reported that combined application of FYM, poultry manure and chemical fertilizer recorded higher leaf area (cm^2) in mungbean.

Table 1. Effect of various combinations of organic and inorganic fertilizer on plant height and number of leaves plant^{-1} (at 30 DAS and at harvest)

Treatment	Plant height (cm)		Number of leaves plant^{-1}	
	30 DAS	At harvest	30 DAS	At harvest
T_0	21.13 f	33.11 e	9.90c	14.17e
T_1	22.63 e	37.17 d	10.10 bc	17.03 cd

T_2	28.45 b	39.57 c	11.68 a-c	17.30 cd
T_3	29.03 b	39.77 bc	12.90 ab	20.97 ab
T_4	23.57 d	39.13 c	11.57 a-c	18.97 bc
T_5	29.05 b	40.67 b	13.77 a	21.63 a
T_6	30.25 a	44.81 a	13.88 a	21.72 a
T_7	25.28 c	37.83 d	11.96 a-c	18.99 bc
LSD	0.8460	0.8460	2.622	1.916
CV (%)	3.37	2.71	4.00	6.92
Level of Significance	**	**	*	**

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

T_0 –Control
T_1 - 6 ton cowdung ha^{-1}
T_2 - 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}
T_3 - 70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}
T_4 – 4 ton poultry manure ha^{-1}
T_5 - 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}
T_6 - 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}
T_7 - 3 ton cowdung ha^{-1} and 2 ton poultry manure ha^{-1}

4.3 Number of branches plant^{-1}

The data on number of branches plant^{-1} of mungbean at different growth stages as influenced by organic and inorganic fertilizers are presented in Table 2. The average values of the treatments involving cowdung (T_1-T_3) and poultry manure (T_4-T_6) were observed; it was found that both at 30 DAS and at harvest the highest number of branches plant^{-1} was obtained from T_6 treatment (2.67 and 4.97 respectively) that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} which is statistically similar with T_3 (4.83 respectively) and T_5 (4.90 respectively) treatment for harvest time data but for 30 DAS it is statistically similar to T_3 (3.57), T_5 (2.61) and T_7 (2.51) the lowest number of branches plant^{-1} was obtained from T_0 treatment (1.95 and 3.50 respectively) that is control.

Combination of organic and inorganic fertilizers significantly increased among the treatment combination. 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. Aslam *et al.* (2010) reported that combined application of FYM, poultry manure and chemical fertilizer recorded higher number of pod bearing branches plant $^{-1}$ in mungbean.

Table 2. Effect of various combinations of organic and inorganic fertilizer on number of branches plant^{-1} (at 30 DAS and at harvest)

Treatment	Number of branches plant^{-1}	
	30 DAS	At harvest
T_0	1.95 g	3.50h
T_1	2.33 ef	4.17 efg
T_2	2.40 c-f	4.27 ef
T_3	2.57 a-c	4.83 ab
T_4	2.47 b-f	4.47 cd
T_5	2.61 ab	4.90 ab
T_6	2.67 a	4.97 a
T_7	2.51 a-d	4.79 b
LSD	0.1755	0.18
CV (%)	5.46	3.45
Level of Significance	**	**

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

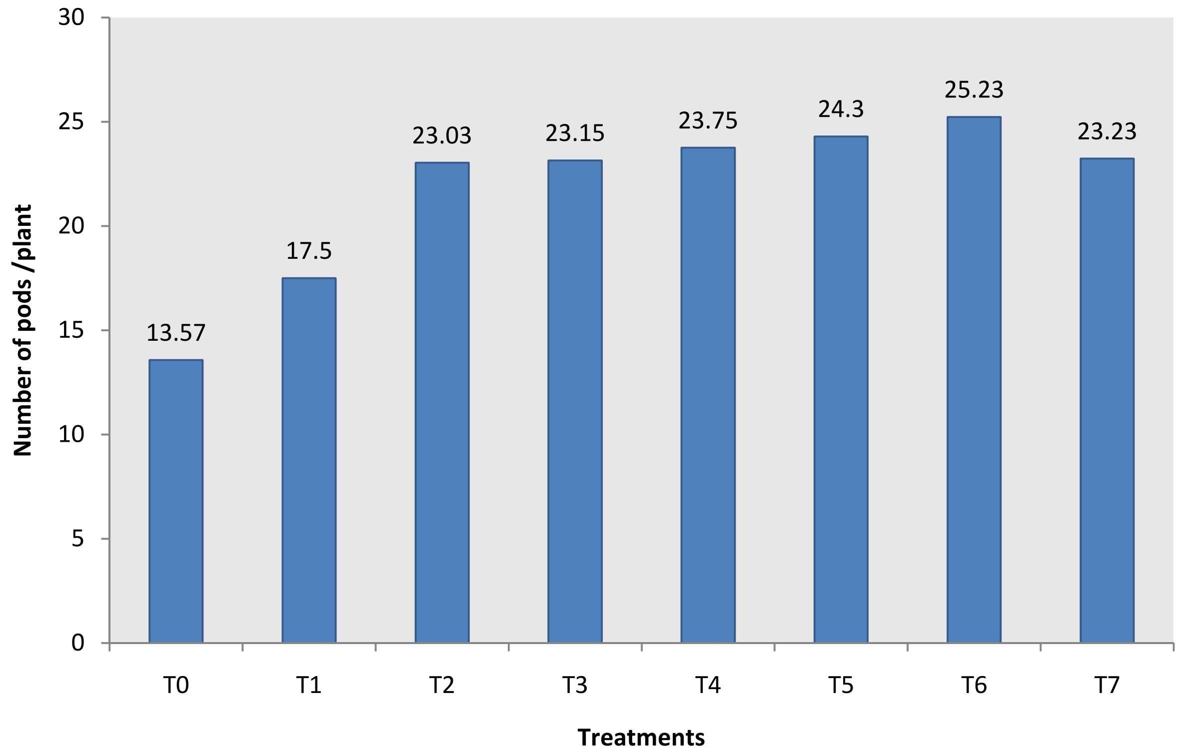
T_0 –Control

T_1 - 6 ton cowdung ha^{-1}
T_2 - 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}
T_3 - 70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}
T_4 – 4 ton poultry manure ha^{-1}
T_5 - 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}
T_6 - 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}
T_7 - 3 ton cowdung ha^{-1} and 2 ton poultry manure ha^{-1}

4.4 Number of pods plant^{-1}

The data on number of pods plant^{-1} of mungbean as influenced by organic and inorganic fertilizers are presented in Figure 1 and Appendix III. The average values of the treatments involving cowdung (T_1-T_3) and poultry manure (T_4-T_6) were observed; it was found that the highest number of pods plant^{-1} was obtained from T_6 treatment (25.23) that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} which is statistically similar with T_2 (23.03), T_3 (23.15), T_4 (23.75), T_5 (24.30) and T_7 (23.23) and the lowest number of pods plant^{-1} was obtained from T_0 treatment (13.57) that is control. 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. 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} in mungbean.

The results showed that application of organic manure along with chemical fertilizers resulted in markedly higher uptake of nutrients. Aslam *et al.* (2010) reported that combined application of FYM, poultry manure and chemical fertilizer recorded higher number of pods plant^{-1} that indicating primacy of integration of the two sources in having improved mungbean productivity.



T_0 –Control
T_1 - 6 ton cowdung ha^{-1}
T_2 - 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}
T_3 - 70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}
T_4 – 4 ton poultry manure ha^{-1}
T_5 - 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}
T_6 - 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}
T_7 - 3 ton cowdung ha^{-1} and 2 ton poultry manure ha^{-1}

Figure 1. Effect of various combinations of organic and inorganic fertilizer on number of pods plant^{-1}

4.5 Number of seeds pod^{-1}

The data on number of seeds pod^{-1} of mungbean as influenced by organic and inorganic fertilizers are presented in Table 3. The average values of the treatments involving cowdung (T_1-T_3) and poultry manure (T_4-T_6) were observed; it was found that the highest number of seeds pod^{-1} was obtained from T_6 treatment (14.89) that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} which is statistically similar with all other except T_0 (10.95) and the lowest number of seeds pod^{-1} was obtained from T_0 treatment (10.95) that is control. 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. 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 seeds pod^{-1} in mungbean.

The results showed that application of organic manure along with chemical fertilizers resulted in markedly higher uptake of nutrients. Aslam *et al.* (2010) reported that combined application of FYM, poultry manure and chemical fertilizer recorded higher number of seeds pod^{-1} that indicating primacy of integration of the two sources in having improved mungbean productivity.

4.6 Seeds yield plant^{-1} (g)

The data on seed yield plant^{-1}(g) of mungbean as influenced by organic and inorganic fertilizers are presented in Table 3. The average values of the treatments involving cowdung (T_1-T_3) and poultry manure (T_4-T_7) were observed; it was found that the highest seed yield plant^{-1} was obtained from T_6 treatment (15.24 g) that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} which is statistically similar with T_5 (14.74 g) and the lowest number of seeds plant^{-1} was obtained from T_0 treatment (8.55 g) that is control. This may be due to higher pods plant^{-1}, seeds pod^{-1} and seeds plant^{-1}. Similar results were reported by Channaveerswami (2005) in groundnut and Rajkhowa *et al*. (2002) in green gram.

The results showed that application of organic manure along with chemical fertilizers resulted in markedly higher uptake of nutrients. Aslam *et al.* (2010) reported that in mungbean the maximum seeds yield plant^{-1} was recorded with the application of FYM, poultry manure and chemical fertilizer. 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 plant^{-1} in mungbean.

Table 3. Effect of various combinations of organic and inorganic fertilizer on number of seeds pod^{-1} and seed yield plant^{-1}

Treatment	Number of seeds pod^{-1}	Seed yield plant^{-1}(g)
T_0	10.95c	8.55f
T_1	13.49 a-c	10.28 de
T_2	13.35 a-c	11.68 c
T_3	13.99 ab	13.18 b
T_4	13.75 ab	12.68 b
T_5	14.33 ab	14.74 a
T_6	14.89 a	15.24 a
T_7	13.70 ab	12.90 b
LSD	2.684	0.7869

CV (%)	6.55	2.89
Level of Significance	*	**

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

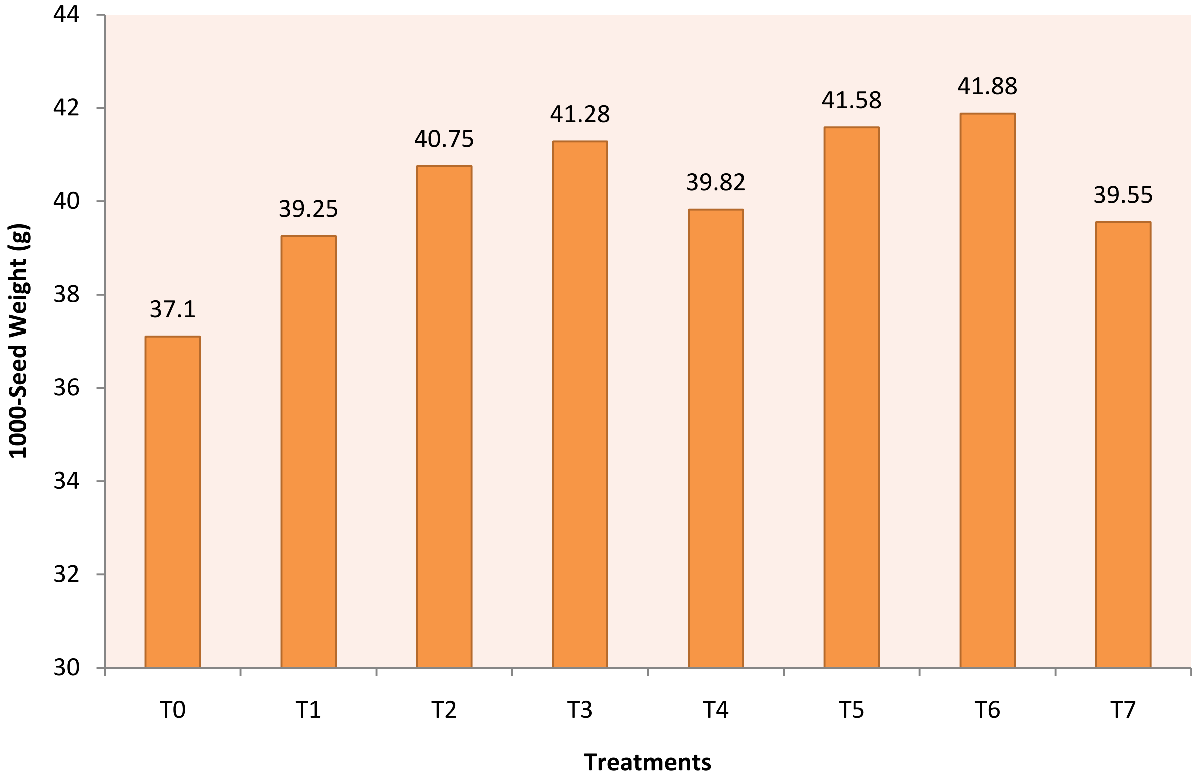
T_0 –Control
T_1 - 6 ton cowdung ha^{-1}
T_2 - 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}
T_3 - 70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}
T_4 – 4 ton poultry manure ha^{-1}
T_5 - 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}
T_6 - 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}
T_7 - 3 ton cowdung ha^{-1} and 2 ton poultry manure ha^{-1}

4.7 1000-seed weight

The data on 1000-seed weight (g) of mungbean showed statistically insignificant by organic and inorganic fertilizers are presented in Figure 2 and Appendix III. But numerically maximum 1000-seed weight was observed in the T_6 (41.88g) that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} and the minimum 1000-seed weight was obtained from T_0 (37.10g) that is control. It is revealed from the result that combination of organic and inorganic fertilizers increased the 1000-seed weight than use of inorganic fertilizer alone. This may be because organic fertilizers are known to contain plant nutrients, growth promoting substances and beneficial microflora which in combination with inorganic fertilizers provide 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.

The results showed that application of organic manure along with chemical fertilizers resulted in markedly higher uptake of nutrients. Aslam *et al.* (2010) reported that in mungbean the maximum 1000-seed weight (g) was recorded with the application of FYM, poultry manure and chemical fertilizer. Abbas *et al.* (2011) found that application of DAP at

124 Kg along with 10 tons ha^{-1} of poultry litter yielded maximum1000-seed weight in mungbean.



T_0 –Control
T_1 - 6 ton cowdung ha^{-1}
T_2 - 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}
T_3 - 70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}
T_4 – 4 ton poultry manure ha^{-1}
T_5 - 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}
T_6 - 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}
T_7 - 3 ton cowdung ha^{-1} and 2 ton poultry manure ha^{-1}

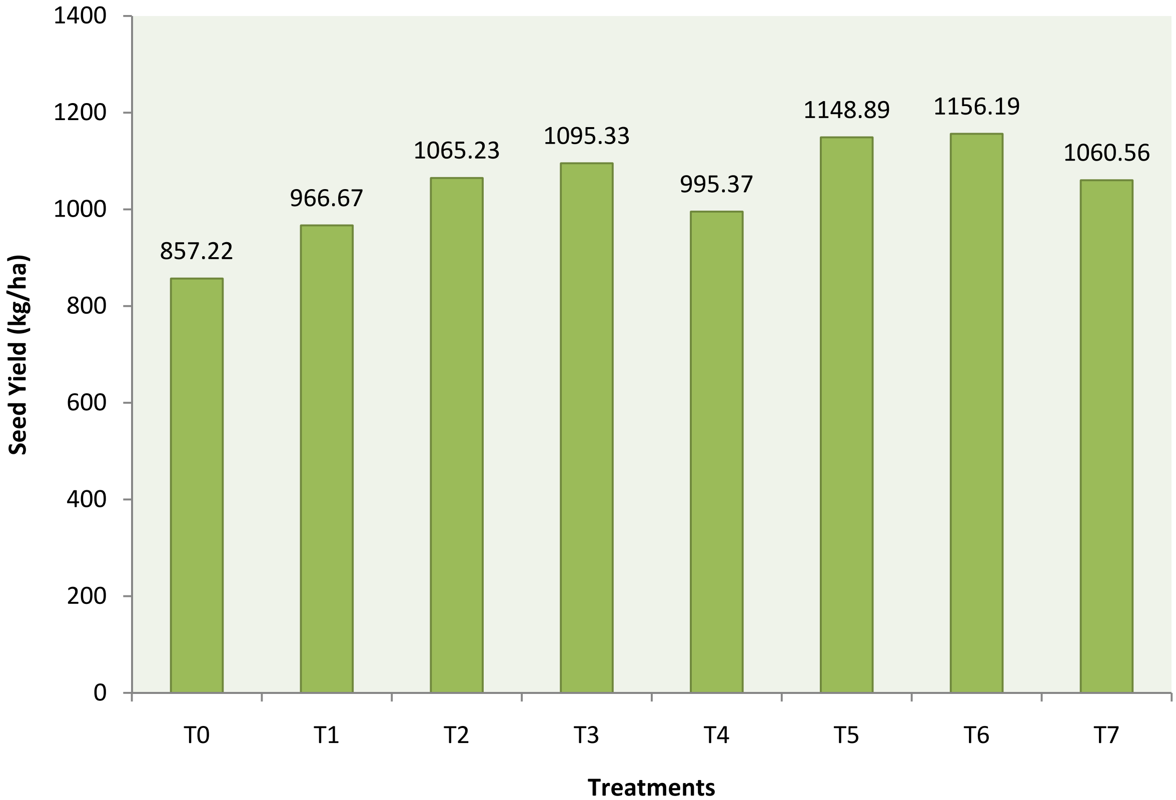
Figure 2. Effect of various combinations of organic and inorganic fertilizer on 1000-seed weight

4.8 Seed yield (kg ha^{-1})

The data on seed yield kg ha^{-1} of mungbean as influenced by organic and inorganic fertilizers are presented in Figure 3 and Appendix III. The average values of the treatments involving cowdung (T_1-T_3) and poultry manure (T_4-T_7) were observed; it was found that the highest seed yield was obtained from T_6 treatment (1156.19 kg ha^{-1}) that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} which is statistically similar with T_5 (1148.89 kg ha^{-1}) and the lowest seed yield was obtained from T_0 treatment (857.22 kg ha^{-1}) that is control.

This may be because organic fertilizers are known to contain plant nutrients, growth promoting substances and beneficial microflora which in combination with inorganic fertilizers provide 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.

The results showed that application of organic manure along with chemical fertilizers resulted in markedly higher uptake of nutrients. Aslam *et al.* (2010) reported that in mungbean the maximum seed yield Kg ha^{-1} was recorded with the application of FYM, poultry manure and chemical fertilizer. 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} in mungbean. Naeem *et al.* (2006) reported that in mungbean the maximum seed yield Kg ha^{-1} was recorded with the application of poultry manure @ 3.5 t ha^{-1}.



T_0 –Control
T_1 - 6 ton cowdung ha^{-1}
T_2 - 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}
T_3 - 70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}
T_4 – 4 ton poultry manure ha^{-1}
T_5 - 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}
T_6 - 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}
T_7 - 3 ton cowdung ha^{-1} and 2 ton poultry manure ha^{-1}

Figure 3. Effect of various combinations of organic and inorganic fertilizer on seed yield

4.9 Nitrogen content in seeds (%)

The data on nitrogen (N) content in seed of mungbean as influenced by organic and inorganic fertilizers are presented in Table 4. N content of mungbean seed was differed significantly due to the different combinations of organic and inorganic fertilizer doses. Highest N content in seed (4.15 %) was recorded in T_6 that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} and it was statistically similar with the application of 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1} (T_2 : 4.02 %) and closely followed by T_3 (70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1})

(4.09 %), T_5 (50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}) (4.08 %) and T_7 (3 ton cowdung $ha^{-1}$and 2 ton poultry manure ha^{-1}) (4.07 %). Among all the treatments, the lowest N content in seed was found from the treatment using no fertilizer (T_0 : 3.76 %) which is statistically similar with T_1(3.82 %).

4.10 Phosphorus content in seeds (%)

The data on phosphorus (P) content in seed of mungbean as influenced by organic and inorganic fertilizers are presented in Table 4. P content of mungbean seed was differed significantly due to the different combinations of organic and inorganic fertilizer doses. Highest P content in seed (0.523 %) was recorded from T_6 that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} and it was statistically similar with the application of 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}(T_2 : 0.514 %), and followed by T_3 (70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}) (0.499 %), T_4 (4 ton poultry manure ha^{-1}) (0.497 %), T_5 (50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}) (0.511 %) and T_7 (3 ton cowdung $ha^{-1}$and 2 ton poultry manure ha^{-1}) (0.498 %) while the lowest P content in seed was found from the treatment using no fertilizer (T_0 : 0.387 %).

4.11 Potassium content in seeds (%)

The data on potassium (K) content in seed of mungbean as influenced by organic and inorganic fertilizers are presented in Table 4. K content of mungbean seed was differed non-significantly due to the different combinations of organic and inorganic fertilizer doses. Although, numerically the highest K content in seed (1.39%) was recorded in T_6 treatment that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}. Among all the treatments, the lowest K content in seed was found from the treatment using no fertilizer (T_0 : 1.19%).

Table 4: Effect of various combinations of organic and inorganic fertilizer on N, P and K content in seeds (%)

Treatment	N content in seeds (%)	P content in seeds (%)	K content in seeds (%)
T_0	3.76 c	0.387 d	1.19
T_1	3.82 c	0.473 c	1.24
T_2	4.02 ab	0.514 ab	1.26
T_3	4.09 ab	0.499 a-c	1.3
T_4	3.94 bc	0.497 a-c	1.33
T_5	4.08 ab	0.511 a-c	1.36
T_6	4.15 a	0.523 a	1.39
T_7	4.07 ab	0.498 a-c	1.35
LSD	0.1755	0.03528	0.2502
CV (%)	3.26	5.97	9.23
Level of Significance	**	**	NS

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

T_0 –Control
T_1 - 6 ton cowdung ha^{-1}
T_2 - 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}
T_3 - 70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}
T_4 – 4 ton poultry manure ha^{-1}

T_5 - 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}
T_6 - 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}
T_7 - 3 ton cowdung ha^{-1} and 2 ton poultry manure ha^{-1}

CHAPTER 5

SUMMARY AND CONCLUSION

A field experiment was carried out during Kharif-I season of 2014 at Sher-e-Bangla Agricultural University (SAU) Farm under the Madhupur Tract (AEZ 28, Paleaustult) of Bangladesh with an objective of finding out effect of different combinations of organic and inorganic fertilizers on growth and yield of a selected mungbean cultivar. A summary of methodology and results of this study is given below.

The soil of the experimental field initially had a pH of 6.9, organic carbon 1.05%, total N 0.08%, available P 12.78 ppm, exchangeable K 43.29 ppm, available S 23.74 ppm. The experiment was designed with 8 treatments, laid out in a randomized complete block design (RCBD) with three replications. Each plot size was 3 m x 2 m. BARI mung-6 was used in the study.

The seeds were sown in 27 February 2014. At first 50% of early matured pods were harvested by hand picking at 60 days after sowing. Finally 4 days after first harvesting, all plants were harvested plot-wise. All recommended cultural practices were followed to grow the crop. Frequent samplings were done at 30 days after sowing (DAS) for counting plant height, number of leaves plant^{-1}, number of branches plant^{-1}. The crop was harvested at maturity. Seed yields were recorded at 12% moisture content. The seed samples were chemically analyzed 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 variation was found in plant height, number of leaves and branches plant^{-1} of BARI mung-6 at 30 DAS and at harvest due to the various combinations of organic and inorganic fertilizers. At 30 DAS and at harvest highest plant height were observed in T_6 (70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}). Lowest plant height at 30 DAS and at harvest was found from the treatment using no fertilizer (T_0). Numbers of leaves $plant^{-1}$ (both at 30 DAS and at harvest) were also highest inT_6 and it was statistically similar withT_3 and T_5. Lowest number of leaves $plant^{-1}$ at 30 DAS and at harvest was found from the treatment using no fertilizer (T_0). Numbers of branches $plant^{-1}$ (both at 30 DAS and at harvest) were also highest inT_6 and it was closely followed by T_5. Lowest numbers of branches $plant^{-1}$ at 30 DAS and at harvest were found from the treatment using no fertilizer (T_0). For the above parameters; T_6 (70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}) showed better results than other treatments.

Number of pods $plant^{-1}$, seeds pod^{-1} and seed yield $plant^{-1}$ showed significant variation due to the different combinations of organic and inorganic fertilizer doses. Maximum numbers of pods $plant^{-1}$, seeds pod^{-1} and seed yield $plant^{-1}$ were recorded in T_6 and it was closely followed by T_5. Minimum numbers of pods $plant^{-1}$, seeds pod^{-1} and seed yield $plant^{-1}$ was found from the treatment using no fertilizer (T_0). It was observed that, for the above parameters; T_6 (70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}) showed better results which is statistically similar with T_5 (50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}) than other treatments.

1000-seed weight showed insignificant variation due to the different combinations of organic and inorganic fertilizer doses. Numerically highest 1000-seed weight was recorded in T_6 (70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}). Highest seed yield ha^{-1} was recorded in T_6 (70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}) and it was statistically identical with the application of 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1} (T_5). Lowest 1000-seed weight and seed yield ha^{-1} was found from the treatment using no fertilizer (T_0). For these yield related parameters; T_6 (70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}) showed better results than other treatments. This improvement in seed yield components may be due to improved vegetative growth. The overall improvement in growth and yield components maybe due to synergistic effect of combined use of organic and inorganic manures.

N, P and K contents of mungbean seed were differed significantly due to the different combinations of organic and inorganic fertilizer doses. Highest N and P contents in seed were recorded in T_6 (70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}) and it was followed by T_2, $T_{3,}$ T_5 and T_7.

K content of mungbean seed was differed non-significantly due to the different combinations of organic and inorganic fertilizer doses. Although, numerically the highest K content in seed was recorded in T_6 treatment that is 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}. Lowest N, P and K contents of mungbean seed were found from the treatment using no fertilizer (T_0).

From the above results it can be concluded that combination of organic and inorganic fertilizer is more productive compare to sole use of inorganic fertilizers. By combining the both, we may be able to reduce the doses of inorganic fertilizers. It is evident from the results that, in case of BARI mung-6, 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} gave statistically same yield with 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}. So, if we use 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1} it will allow us to reduce the use of 30% inorganic fertilizer at least.

Recommendations for further researches :

1. Studies with different doses of organics should be performed.

2. Such studies should be conducted under different AEZs.

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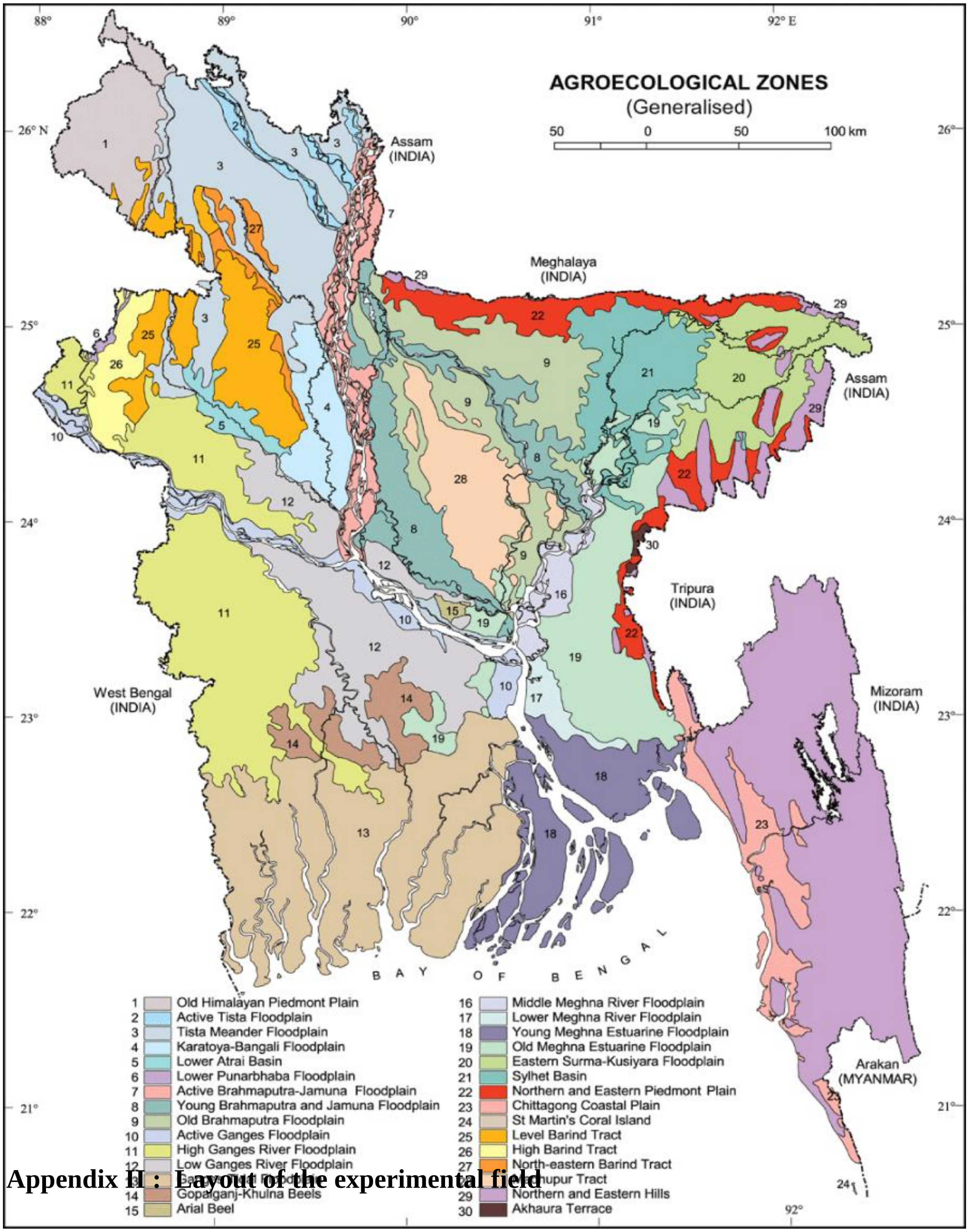
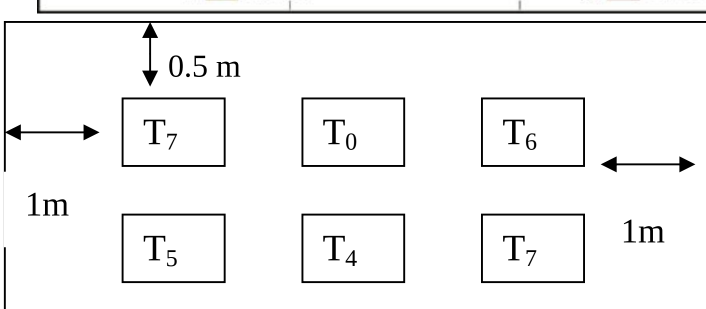
APPENDICES

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



Appendix II : Layout of the experimental field



T_0 –Control
T_1 - 6 ton cowdung ha^{-1}
T_2 - 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}
T_3 - 70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}
T_4 – 4 ton poultry manure ha^{-1}
T_5 - 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}
T_6 - 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}
T_7 - 3 ton cowdung ha^{-1} and 2 ton poultry manure ha^{-1}

Appendix III : Effect of various combinations of organic and inorganic fertilizer on number of pods plant^{-1}, 1000-seed weight (g) and seed yield (kg ha^{-1})

Treatment	Number of pods plant^{-1}	1000-seed weight (g)	Seed yield (kg ha^{-1})
T_0	13.57 f	37.10	857.22 f
T_1	17.50 e	39.25	966.67 e
T_2	23.03 a-d	40.75	1065.23 c
T_3	23.15 a-d	41.28	1095.33 b
T_4	23.75 a-c	39.82	995.37 d
T_5	24.30 ab	41.58	1148.89 a
T_6	25.23 a	41.88	1156.19 a
T_7	23.23 a-c	39.55	1060.56 c
LSD	2.503	6.31	18.42
CV (%)	9.82	6.85	5.98
Level of Significance	**	NS	**

** = Significant at 1% level,   NS = Non significant

T_0 –Control
T_1 - 6 ton cowdung ha^{-1}
T_2 - 50% recommended dose of inorganic fertilizer and 3 ton cowdung ha^{-1}
T_3 - 70% recommended dose of inorganic fertilizer and 2 ton cowdung ha^{-1}
T_4 – 4 ton poultry manure ha^{-1}

T_5 - 50% recommended dose of inorganic fertilizer and 2 ton poultry manure ha^{-1}
T_6 - 70% recommended dose of inorganic fertilizer and 1.2 ton poultry manure ha^{-1}
T_7 - 3 ton cowdung ha^{-1} and 2 ton poultry manure ha^{-1}