EFFECT OF COWDUNG AND INORGANIC FERTILIZERS ON THE GROWTH AND YIELD OF MUNGBEAN (BARI mung-6)

Md. Mahamudul Hasan

DEPARTMENT OF SOIL SCIENCE

SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA -1207

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By

Name: Md. Mahamudul Hasan
Registration no: 19-10301

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Approved By:

Supervisor
Mst. Afrose jahan
Professor
Department of Soil Science
Sher-e-Bangla Agricultural University
Dhaka-1207

Co-supervisor
Dr. Md. Asaduzzaman Khan
Professor
Department of Soil Science Sher-e-Bangla
Agricultural University
Dhaka-1207

A.T. M. Shamsuddoha (Professor)
Chairman Examination Committee
Department of Soil Science
Sher-e-Bangla Agricultural University
Dhaka-1207

DEPARTMENT OF SOIL SCIENCE
Sher-e-Bangla Aricultural University
Sher-e-Bangla Nagar, Dhaka-1207

CERTIFICATE

This is to certify that the thesis entitled" EFFECT OF COWDUNG AND INORGANIC FERTILIZER 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 Md. Mahamudul Hasan ,Registration NO. 19-10301, 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.

Date:
Dhaka, Bangladesh

____
Professor Mst. Afrose jahan
Supervisor

DEDICATED TO

MY

BELOVED PARENTS

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The Author

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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

ABSTRACT

An experiment was conducted at the experimental field of the farm of Sher-e-Bangla Agricultural University during the period from March to june (kharif season) of 2020 to study the effect of cowdung and inorganic fertilizers on growth and yield of mungbean (BARI Mung 6). The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The 7 treatment combinations of cowdung manure and inorganic fertilizer were T_0 - Control, T_1- 100% Recommended fertilizer dose (RFD), T_2 - 6 ton cowdung ha^{-1} , T_3 - 80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1} T_4 - 60% recommended dose of inorganic fertilizer and 40% cowdung ha^{-1} T_5- 40% recommended dose of inorganic fertilizer and 60% cowdung ha^{-1} , T_6 - 20% recommended dose of inorganic fertilizer and 80% cowdung ha^{-1} . At 30 DAS and at harvest highest plant height (48.22cm), number of leaves $plant^{-1}$ and branches $plant^{-1}$ were found from the combination of 80% cowdung manure and 20% inorganic fertilizer (N, P, K). Maximum numbers of pods $plant^{-1}$ (19.25), seeds pod^{-1} (10.42) and 1000-seed weight (43.44g), seed yield (1.42 t ha^{-1}) were recorded in 20% cowdung manure and 80% inorganic fertilizer. Highest pod $plant^{-1}$ (19.25), 1000-seed weight (43.44g) and seed yield ha^{-1} (1.42 t ha^{-1}) was recorded in 20% cowdung + 80% of optimum dose of inorganic fertilizer and it was statistically disimilar with the treatment of 40% cowdung manure + 60% of optimum dose of inorganic fertilizer. It was observed that, for the above parameters; 80% optimum dose of inorganic fertilizer + 20% of optimum dose of Cowdung showed better results than sole 100% inorganic fertilizer. Lowest values for all of the growth and yield parameters obtained from the treatment using control.

CHAPTER I

INTRODUCTION

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Bangladesh produces a variety of pulse crops, including grass pea (*Lathyrus sativus*), lentil (*Lens culinaris*), mungbean (*Vigna radiata*), blackgram (*Vigna mungo*), chickpea (*Cicer arietinum*), field pea (*Pisum sativum*) and cowpea (*Vigna unguiculata*). Among them Mungbean (*Vigna radiata L.*) belongs to the family Leguminosae and sub-family Papilionaceae is one of the most important pulse crop of Bangladesh. In Bangladesh, among pulses mungbean ranks fourth in acreage, third in production and first in market price (BBS, 2011). Mungbean is one of the important pulse crops grown principally for its protein rich edible seeds. Mungbean is an important food crop because it provides a cheap source of easily digestible dietary protein which complements the staple rice in the country. Its seed contains 24.7% protein, 0.6% fat, 0.9% fiber and 3.7% ash. Pulses, being leguminous crops, are capable of fixing atmospheric nitrogen in the soil and enrich soil fertility and productivity. Thus they are considered as soil fertility development crops. It can also fix atmospheric nitrogen through symbiotic relationship with soil bacteria and improve the soil fertility. The global mungbean growing area has increased during the last 20 years at an annual growth rate of 2.5%. As a legume crop Mungbean has also the ability to improve the physical, chemical, biological nitrogen fixation from the atmosphere. Due to its status as a legume crop, mungbean can also enhance the physical, chemical, and biological nitrogen fixation from the atmosphere. The green plant and hay are utilized as fodder. Therefore, it might be viewed as a necessary part of sustainable agriculture. Mungbean contributed 6.5% of the total pulse production in our country (BBS, 2011). Most of the farmers of Bangladesh were cultivating traditional, local varieties with low yield potential. However, expansion of mungbean cultivation in such nontraditional areas depends largely on its competitive ability with other crops (Hamid, 1996; Islam et al., 2015) as well as its adaptability over a wide range of environmental conditions rather than pesticide residues (Popalghat et al., 2001; Rahman et al., 2018; Rokonuzzamanet al., 2018; Islam et al., 2015). In addition, farmers are becoming disinterested in growing Black gram because to the low return on investment. Therefore, attention should be given to increasing yield through the proper selection of high yielding varieties (Sing et al., 2009). However, other conditions are almost normal for the cultivation of mungbean. The yield and quality of mungbean 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). 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). Because it is a crucial part of essential molecules like ATP, phospholipids, and nucleic acids, plants cannot develop without a consistent supply of this vitamin. P is also necessary for the development of seeds. 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). After phosphorus and nitrogen, potassium (K) is the third macronutrient necessary for plant development (P). K, in contrast to N and P, is not a part of cell structure. Instead, it is mobile and ionic and largely functions 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. In order to produce crops with sustainable crop output, organic fertilizer use has recently gained attention (Tejada et al., 2009). The capacity of organic materials to improve the properties of soil and serve as a source of several nutrients holds considerable promise (Moller, 2009). 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 effects on plants, human being and livestock (Choudhry, 2005). Organic materials have the potential to significantly enhance soil properties and serve as a source of several nutrients. Ecosystems are preserved via organic farming. In order to address the issues with soil fertility and production in Bangladesh, management of soil organic matter has grown to be a critical concern. Increased cropping intensity (now at around 190%), increased use of MVs, soil erosion, sandy soils, and faster organic matter decomposition owing to sub-tropical humid climate are the main causes of the depletion of soil fertility.

Phosphorus is also one of the important essential macro elements for the normal growth and development of plant. The phosphorus requirements vary depending upon the nutrient content the soil (Bose and Som, 1986). Phosphorus shortage restricted the plant growth and remains immature (1-lossain. 1990). Because munghean is a crop with a limited shelf life, easily soluble fertilizers, such as phosphorus, should be used in the field. Contrarily, nutrient availability in a soil is influenced by a number of variables, the most significant of which is fertilizer balance. The right amount of fertilizer helps a crop grow and develop while also ensuring that other crucial nutrients are available to the plant. Again secondary mechanism of interference was the absorption of phosphorus from the soil through luxury consumption, increasing the tissue content without enhancing smooth biomass accumulation (Santos ci al., 2004).

The following objectives of the current study are taken into account in light of the aforementioned facts:

- To observe the effects of cowdung and inorganic fertilizer on growth and yield of mungbean.
- To study the suitable dose of cowdung and inorganic fertilizer on growth and yield of mungbean.
- To study the interaction effect of cowdung and inorganic fertilizer levels on growth, yield and quality of mungbean.

CHAPTER II

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

This chapter presents the literature on the effects of various organic and inorganic manures on growth, seed production and quality characteristics, as well as the effects of chemical and botanical seed treatments on the mungbean seed's ability to store seeds. Analogies from other crops have also been utilized to stress a certain point of view because the knowledge relating to the effect of organic fertilizers on mungbean is insufficient.

2.1 Effect of NPK on mungbean

2.1.1 Effect of Nitrogen on mungbean

Tickoo et al. (2006) carried out an experiment on mungbean and cultivars Pusa 105 and Pusa Vishal which were sown at 22.5 and 30 m spacing and was supplied with 36-46 and 5 8-46 kg NP ha^{-1} in a field experiment conducted in Delhi, India during the kharif season of 2000. Cultivar Pusa Vishal recorded higher biological and grain yield (3.66 and 1.63 t ha^{-1}, respectively) compared to cv. Pusa 105. 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.

Manpreet et al. (2005) conducted a field experiment to assess the response of different mnungbean genotypes in terms of nutrient uptake and quality to incremental levels of phosphorus application. Genotypes showed significant differences for straw and grain N content and grain P content while straw P content, N and P uptake differed non-significantly. Phosphorus resulted in significant increase in N and P content and their uptake.

Oad and Buriro (2005) conducted a field experiment 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) on the growth and yield of mung bean cv. AEM 96 in Tandojam. Pakistan. during the spring season. The different NPK levels significantly affected the crop parameters. The 10-30-30 kg NPK/ ha was the best treatment, recording plant height of 56.25, germination of 90.50%, satisfactory plant population of 162.00, prolonged days taken to maturity of

55.50, long pods of 5.02 cm, seed weight per plant of 10.53 g, seed index of 3.52 g and the highest seed yield of 1205.2 kg/ha. There was no significant change in the crop parameters beyond this level.

Mahboob and Asghar (2002) studied the effect of seed inoculation at different nitrogen levels on mungbean at the agronomic research station in Pakistan. They revealed that various yield components like 1000 grain weight was affected significantly with 50-50-0 NPK kg ha^{-1} application. Again they revealed that seed inoculation with 50-50-0 NPK kg ha^{-1} exhibited superior performance in respect of seed yield (955 kg hi). Nita et. al. (2002) carried out a field experiment on mungbean and showed that seed yield, protein content and net production value increased with increasing rates of K and S. Similarly, the status of N and P in soil decreased with increasing rates of K and S.

Singh et al. (1993) conducted a pot experiment on mung bean (*Vigna radiata*). Results showed that compared with untreated controls, P and Zn application increased the seed protein. N and P contents, but decreased the Mg and Ca contents. Ardeshana et al. (1993) conducted a field experiment on clay soil during the rainy season to study the response of mungbean to nitrogen. They observed that seed yield increased with application of nitrogen fertilizer up to 20 kg N ha^{-1} in combination with phosphorus fertilizer up to 40 kg P 20 kg ton/ ha.

Patel et at (1992) conducted a field trial to evaluate the response of mungbean to sulphur fertilization under different levels of nitrogen and phosphorus. Greengram cv. Gujrarat 2 and K 85 were given 10kg N + 20 kg P ha^{-1}. 20 kg N + 40 kg P ha^{-1} and 0, 10, 20 or 30 kg S ha^{-1} as gypsum. Seed yield was 1.2 and 1.24 ton ha^{-1} in Gujrarat 2 K 85, respectively 20 kg N + 40 kg per hectare.

Suhartatik (1991) in a study observed that increased application of NPK fertilizers significantly increased the plant height of mungbean. Bali et at (1991) conducted a field trail on mungbean in kharif seasons on silty clay loam soil. They revealed that 1000-seed weight increased with 40 kg N ha^{-1} and 60 kg P 20 kg ha^{-1} Arya and Kalra (1988) reported that application of N at the rate of 50 kg ha^{-1} along with 50 kg P ha^{-1} increased mungbean yield.

Salimullah el at (1987) reported that the number of pods per plant was highest with the application of 50 kg N ha^{-1} along with 75 kg P_2O_5 and 60 kg K_2O ha^{-1} in summer mungbean. Patel and Parmer (1986) conducted an experiment of the response of green gram to varying levels of nitrogen and phosphorus. They observed that increasing N application to rainfed mungbean (cv. Gujrat- I) from 0 to 50 kg N ha^{-1} increased the number or pods per plant.

An experiment was conducted by Trung and Yoshida (1983) using 0-100 ppm N as treatment in the form of ammonium nitrate or 10 or 100 ppm N as urea, sodium nitrate, ammonium nitrate or ammonium sulphate. They found that seed yield of mungbean increased with the increase in N up to 50 ppm.

A study was conducted by Nigainananda and Elamathi (2007) in Uttar Pradesh. India to evaluate the effect of N application time as basal and as DAP (diammonium phosphate) or urea spray and plant growth regulator (NAA at 40 ppm) on the yield and yield components of green gram cv. K-85 1. The recommended rate of N:P:K (20:50:20 kg/ha) as basal was used as a control. Treatments included: 1/2 basal N + foliar N as urea or DAP at 25 or 35 days after sowing (DAS); 1/2 basal N + 1/4 at 25 DAS ± 1/4 at 35 DAS as urea or DAP and 1/2 basal N + 1/2 foliar spraying as urea or DAP + 40 ppm NAA. Results showed that 2% foliar spray as DAP and NAA, applied at 35 DAS. resulted in the highest values for number of pods $plant^{-1}$ (38.3). seeds pod^{-1}, test weight, flower number, fertility coefficient, grain yield (9.66 q ha^{-1}).

Nadeem et al. (2004) studied the response of mungbean cv. NM-98 to seed inoculation and different levels of fertilizer (0-0, 15-30, 30-60 and 45-90 kg NP205 ha^{-1} under field conditions. Application of fertilizer significantly increased the yield and the maximum seed yield was obtained when 30 kg N ha^{-1} was applied along with 60 kg P 25 ha^{-1},

Srinivas et al. (2002) conducted an experiment on the performance of mungbean at different levels of nitrogen and phosphorus. Different rates of N (0. 25 and 60 kg ha^{-1}) and p (0, 25, 50 and 60 kg ha^{-1}) were tested. They observed that the number of pods per plant was increased with the increasing rates of N up to 40 kg ha^{-1} followed by a decrease with further increase in N. They also observed that 1000-seed weight was increased with increasing rates of N up to 40 kg ha^{-1} along with increasing rates of P which was then followed by a decrease with increase in N.

Tank et al. (1992) found that mungbean fertilized with 20 kg N along with level of 40 kg P205 ha1 increased seed yield significantly over the unfertilized control. They also reported that mungbean fertilized with 20 kg N ha^{-1} along with 75 kg $P_2 0_5$ ha^{-1} significantly increased the number of pods per plant.

An experiment was conducted by Trung and Yoshida (1983) using 0-100 ppm N as treatment in the form of ammonium nitrate or 10 or 100 ppm N as urea, sodium nitrate, ammonium nitrate or ammonium sulphate. They found that seed yield of mungbean increased with the increase in N up to 50 ppm.

Sultana (2006) observed that plant height of mungbean showed superiority at 30 kg N ha^{-1} followed by 40 kg N ha^{-1}. Nitrogen fertilizer significantly influenced plant height at all growth stages of Mungbean. At 20, 35, 50, 65 DAS and harvest the maximum heights were observed in the plants treated with 30 kg N ha^{-1}.

A field experiment was conducted during Kharif season 2014 at the Research farm of Soil Science, Allahabad School of Agriculture, laid out in randomized block design, consisted nine treatments and three replications, it was observed that growth and yield of green gram in treatment N20 P40 K40 + FYM @10 t ha^{-1} and Rhizobium was maximum. Maximum plant height 50.66 cm, number of leaves plant^{-1} 33.00, number of branches plant^{-1} 4.66 at 60, number of cluster plant^{-1} 9.33, number of pods plant^{-1} 37.33 and total seed yield 12.10 q ha^{-1} were found to be significant over all other treatment. Adequate plant nutrient supply holds the key for improving the growth and food grain production of crop.

An experiment was conducted at the research field of the Horticulture Research Center at Labukhali, Patuakhali during the period from January to March 2014 to find out the most suitable BARI mungbean variety and optimum rates of N concerning higher seed yield under the regional condition of Patuakhali (AEZ–13). Two BARI mungbean varieties namely BARI mung–5 (V1) and BARI mung–6 (V2) and five levels of N fertilizer including control viz. 0 kg N ha^{-1} (N0), 30 kg N ha^{-1} (N30), 45 kg N ha^{-1} (N45), 60 kg N ha^{-1} (N60), and 75 kg N ha^{-1} (N75) were used for the present study as level factor A and B, respectively. In case of variety, BARI mung–6 produced significantly longest pod (7.56 cm), maximum pods (9.14) plant^{-1}, maximum seeds (9.14) pod^{-1} , higher weight of 100–seed (4.48 g), highest seed weight (4.33 g plant^{-1}) and highest seed yield (1.56 t ha^{-1}) than BARI mung–5 at harvest. In case of N fertilizer, longest pod (7.96 cm), maximum pods plant^{-1} (10.45), maximum seeds pod^{-1} (9.70), higher weight of 100–seed (4.52 g), higher weight of seed (5.73 g plant^{-1}) and greater seed yield (1.85 t ha^{-1}) were also obtained in 45 kg N ha^{-1} compare other N levels. The BARI mung–6 × 45 kg N ha for seed yield was found under the regional condition of Patuakhali (AEZ-13).

2.1.2 Effect of Phosphorus on mungbean

A field experiment was carried out by Bhat ci al. (2011) during the summer season to study the influence of biofertilizers and phosphorus levels on yield and P uptake of Mung bean. The experiment was laid out in factorial randomized block design. The treatments comprised four phosphorus levels (0. 30. 60 and 90 kg P_20_5 ha^{-1}) and three biofertilizcrs. The seed and straw yield increased significantly with the application of biofertilizers and phosphorus levels: however, their interaction had non-significant effect. Quadratic response of munghean seed yield to bio fertilizers was recorded and YAM was found more efficient among biofertilizers with minimum physical, maximum and optimum economic doses; 60 kg P_20_5 ha^{-1} was found optimum along with biofertilizers with respect to yield. Among all the treatments YAM along with 60 kg P205/ha was found to be better in registering seed yield, straw yield and P uptake.

Malik et al. (2006) conducted a field experiments in Faisalabad, Pakistan to evaluate the interactive effects of irrigation and phosphorus on green gram Available K (ppm). Five phosphorus doses (0, 20. 40. 60 and 80 kg P ha^{-1}) were arranged in a split plot design with four replications. Phosphorus application at 40 kg P_20_5 had affected the crop positively, while below and above this rate resulted in non-significant effects. Interactive effects of two irrigations and 40 kg P_20_5 ha^{-1} were the most effective. The rest of the combinations remained statistically non-significant to each other. It may he concluded that green gram can he successfiully grown with phosphorus at 40 kg P_20_5 ha^{-1}.

Bhat et al. (2005) conducted a study during the summer in Uttar Pradesh, India. to examine the effects of phosphorus levels on green gram. Four phosphorus rates (0, 30. 60 and 90 kg/ha) were used. All the phosphorus rates increased the seed yield significantly over the control. The highest seed yield was observed with 90 kg P ha^{-1}. which was at per with 60 kg ha^{-1}, and both were significantly superior to 30 kg ha^{-1}.

Likewise, 60 kg ha^{-1} significantly improved the yield attributes except test weight compared to the control. For the phosphorus rates, the Stover yield followed the trend observed in seed yield.

A field experiment was conducted by Vikrant et at (2005) on a sandy loam soil in Hisar. Haryana, India, during kharif season to study the effects of p (0, 20,40 and 60 kg P 205 kg ha^{-1}) applications to green gram cv. Asha. Application of 60 kg P. being at par with 40 kg P. was significantly superior to 0 and 20 kg P ha^{-1} in respect of grain, stover and protein yields of green gram.

Khan et al. (2004) conducted a study to determine the effect of different levels of phosphorus on the yield components of mung bean cv. NM-98 in D.I. Khan, Pakistan. Treatments comprised: 0. 20, 40, 60, 80, and 100 kg P ha^{-1}. The increase in phosphorus levels decreased the days to flowering and increased the branches per plant, number of pods per plant, 1000-grain weight and grain yield. The highest yield of 1022 kg ha^{-1} was obtained at the phosphorus level of 100 kg ha^{-1} compared to a 774-kg ha^{-1} yield in the control. The most economical phosphorus level was 40 kg ha^{-1}, because it produced a grain yield statistically comparable to 100 kg P ha^{-1}.

A field experiment was conducted comprising two varieties of mungbean, BARI Mung 5 (V1) and BARI Mung-6 (V2), and five levels of phosphorus fertilizer: triple super phosphate [$Ca(H_2PO_4)$] viz. T_0 (control), T_1 (42.5 kg P ha^{-1}), T_2 (85 kg P ha^{-1}), T_3 (127.5 kg P ha^{-1}), and T_4 (170 kg P ha^{-1}). The experiment was organized in a randomized complete block design with three replications. V_1 produced the highest number of pods per plant (7.65), whereas the maximum 1,000-seed weight (49 g) was produced by V_2. The maximum plant height (30.89cm), number of branches per plant (8.55), number of leaves per plant (19.05), number of pods per plant (10.25), pod length (8.95 cm), number of seeds per pod (9.11), 1,000-seed weight (48.17 g), and yield (1.05 t ha^{-1}) were obtained from the T_4 treatment. The interaction of phosphorus levels and varieties had a considerable effect on the growth, yield, and yield attributes of mungbean. The highest number of leaves (20.44) and number of pods (10.39) were obtained from V_1 when 127.5 kg P ha^{-1} (T_4) was applied, whereas the maximum number of seeds per pod (9.25) and maximum pod length (9.09 cm) were obtained when 85 kg P ha^{-1} and 42.5 kg P ha^{-1}, respectively, were used. The highest number of branches per plant (8.87), 1,000-seed weight (52.83 g), and the maximum seed yield (1.14 t ha^{-1}) were achieved from the treatment V_2T_4 sowing to the interactive effect of phosphorus dose and mungbean variety.

2.1.3 Effect of Potassium on mungbean

Prasad et al (2000) conducted a pot experiment to study the effect of potassium on yield and K-uptake by summer mungbean (cv. 1-44) and showed that the grain yield increased with potassium application but result was statistically non-significant. Increasing potassium levels significantly increased potassium uptake. Available K in soil after harvest of crop increased with increasing levels of K.

Potassium is the key element for mungbean (*Vigna radiata L.*) productivity. The study was carried out to understand the effects of potassium (K) on mungbean productivity, quality, nutrient content and nutrient uptake and how this element can help to manage soil fertility. Therefore, an experiment was conducted during two consecutive years 2016 and 2017. The experiment was laid out in randomized complete block design considering six treatments with thrice replicates. The treatments were T_1 = Control, T_2 = 30 kg K ha^{-1} , T_3= 40 kg K ha^{-1}, T_4= 50 kg K ha^{-1}, T_5= 60 kg K ha^{-1} and T_6= 70 kg K ha^{-1} along with the blanket dose of N15 P20 S10 Zn2 B1.5 kg ha^{-1}. Results revealed that application of different levels of potassium showed significant effects on the plant height, number of pods per plant, number of seeds per pod and thousand seed weight which were influenced to obtain higher yield of mungbean. The highest average seed yield (1476 kg ha^{-1}) and highest yield increment (39.5%) of mungbean were produced from the treatment T_5. Most of the cases the highest nutrient (N, P, K, S, Zn and B) content was obtained in T_5 treatment. The highest K uptake by mungbean, maximum nodulation, the highest protein content in seed and maximum apparent K recovery efficiency (54.8%) were, however, recorded from the treatment receiving of 60 kg K ha^{-1}. It was concluded that proper use of K with other nutrients facilitated to improve the productivity and quality of mungbean and also K played a significant role in maintaining soil fertility.

Potassium application is directly related to growth, plant biomass and yield in crops. While the deficiency of Potassium is in Pakistan is becoming nutritional limiting factor in most of areas. A study was carried out at experimental area of Department of Agronomy, University of Agriculture, Faisalabad during summer 2005. The objective was to find out the best level of potash fertilizer on growth and yield response of two mungbean (*Vigna radiata L.*) cultivars (BARI Mung-5 and BARI Mung-06) to different levels of potassium. The experiment was laid out in Randomized Complete Block Design with factorial arrangements and replicated thrice. Treatments were comprised of five levels of potash fertilizer (0, 30, 60, 90,120 Kg ha^{-1}). Different potassium levels significantly affected the seed yield and yield contributing parameters except number of plants per plot. Maximum seed yield (753 Kg ha^{-1}) was obtained with the application of 90 Kg potash per hectare. Genotype M-06 produced higher seed yield than that of NM-92. The interactive effect of Mungbean varieties and Potassium level was found significant in parameter of protein contents (%). Maximum protein contents were observed in case of Mung-06 with application of 90 Kg potash per hectare. It is concluded that the application of Potash fertilizer gave higher yield of mungbean cultivars under agro-climatic conditions of Faisalabad.

2.2 Combined effect of cowdung and NPK fertilizer on mungbean

Mollah et al. (2011) was conducted a field experiment at the Multiplication Testing Site (MLT), Joypurhat Sadar upazila with Mugnbean 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, farmer’s practice, and control. Cowdung was applied. The varieties for mungbean were BARI Mung-6, and BR11, respectively. The results demonstrated that 6 the seed yield of mungbean. In mungbean, the highest seed yield (1384 kg ha^{-1}) 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-1 cowdung could be recommended for the Mungbean 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 mungbean 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 ton 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.

Mahabub et al. (2016) was conducted a field experiment to effect of Cow Manure on Growth, Yield and Nutrient Content of Mungbean. The experiment consist of single factor: Cowdung (3 levels); C_0: 0 ton cowdung ha^{-1} (control), C_1: 5 ton cowdung ha^{-1} and C_2: 10 ton cowdung ha^{-1}. The nutrient composition of cowdung is N - 0.5%, P_2O_5 - 0.3%, K_2O - 0.5%, Ca - 0.3%, Mg - 0.1%. The experiment was laid out in Randomized Complete Block Design (RCBD) with five replications. Urea, Triple super phosphate (TSP), Muriate of potash (MoP) and gypsum were used as a source of nitrogen, phosphorous, potassium and Sulphur, respectively. Urea (46% N content), TPS (48% P2O5 content) and MoP (60% K_2O content) were applied at the rate of 45, 50 and 40 kg per hectare, respectively following the Bangladesh Agricultural Research Institute (BARI) recommendation. As organic manure cowdung was applied as per treatment. The size of each unit plot was 4.0 m × 3.0 m. The space between two blocks and two plots were 1.0 m and 0.5 m, respectively. The seeds of mungbean were sown on April 07, 2014 in solid rows in the furrows having a depth of 2-3 cm and row to row distance was 40 cm. Thinning was done two times; first thinning was done at 8 DAS (Days After Sowing) and second was done at 15 DAS (Days After Sowing) to maintain optimum plant population in each plot. Probably cowdung supplied the necessary requirements for the proper vegetative growth that helped in obtaining the highest yield of mungbean. These are in agreement that different levels of organic manure significantly increased grain yield.

CHAPTER III

MATERIALS AND METHODS

CHAPTER III
MATERIALS AND METHODS

The experiment was conducted during the period from March to June 2019 to study the effect of cowdung and inorganic fertilizer on the growth and yield of mungbean. This chapter includes materials and methods that were used in conducting the experiment are presented below under the following headings:

3.1 Experimental site

The experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka. Bangladesh. The experimental site is situated between 230741N latitude and 900351E longitude (Anon., 1989).

3.2 Soil

The soil of the experimental held belongs to the Tejgaon series under the Agro ecological Zone, Madhupur Tract (AEZ- 28) and the General Soil Type is Deep Red Brown Terrace Soils. A composite sample was made by collecting soil from several spots of the field at a depth of 0-15 cm before the initiation of the experiment. The collected soil was air-dried, ground and passed through 2 mm sieve and analyzed for some important physical and chemical properties. The analytical data of the soil sample collected from the experimental area were determined in the Soil Resource Development Institute (SRDI), Soil Testing Laboratory, Khamarhari. Dhaka and presented in Appendix 1.

3.3 Climate

The climate of experimental site is subtropical. characterized by three distinct seasons, the monsoon from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October (Edris ci al., 1979). Meteorological data related to the temperature, relative humidity and rainfalls during the period of the experiment was collected from the Bangladesh Meteorological Department (Climate Division), Sher-c-Bangla Nagar and presented in Appendix II.

3.4 Planting material

The variety BARI mung-6 was used as the test crop. The seeds were collected from the Pulse Seed Division of Bangladesh Agricultural Research Institute, Joydevpur, Gajipur. 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-II, 2020

3.6 Organic Fertilizers

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

Table 1. Chemical compositions of the organic manures (Cowdung) used for the experiment (Oven dry basis)

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

Source : SRDI

3.7 Different treatments:

T_0 - Control

T_1- 100% Recommended fertilizer dose (RFD)

T_2 – 100 % (6 ton) cowdung ha^{-1}

T_3 - 80% inorganic fertilizer (RFD) and 20% from cowdung (1.2) ton ha^{-1}

T_4 - 60% inorganic fertilizer (RFD) and 40% from cowdung (2.4) ton ha^{-1}

T_5- 40% inorganic fertilizer (RFD) and 60% from cowdung (3.6) ton ha^{-1}

T_6 - 20% inorganic fertilizer (RFD) and 80% from cowdung (4.8) ton ha^{-1}

3.8 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.

3.9 Fertilizer application

In this experiment fertilizers were used according to the recommendation of Bangladesh Agricultural Research Institute (BARI) which is mentioned as follows:

Name of Nutrients	Name of Fertilizers	Rate of Application (kg/ha)
Nitrogen (N)	Urea,	45
Phosphorus (P)	Triple Super Phosphate	90
Potash (K)	Muriate of Potash	40
Sulpher (S)	Gypsum	55
Boron (B)	Boric acid	10
Zinc (Zn)	Zinc Oxide	8.5
Organic fertilizer	Cowdung	As per treatment

The amounts of fertilizer as per treatment in the forms of urea, triple super phosphate, muriate of potash, gypsum, boric acid and Zinc Oxide required per plot were calculated. The triple super phosphate, muriate of potash, gypsum and boric acid was applied during final land preparation. The remaining Urea was top dressed in two equal installments- at 25 days after sowing (DAS) and 45 DAS respectively. At the time of sowing of mungbean seed the organic fertilizer was applied.

3.10 Sowing

Mungbean was sown on in 21 March 2020. 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.

3.11 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.

3.12 Harvesting and sampling

The crops were harvested at a time due to synchronous maturity of pods. The seeds were harvest in 20 may 2020. 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. Four plants were randomly selected prior to maturity from each plot for data recording.

3.13 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.

3.14 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, 40 DAS and harvest. The average of four 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 four tagged plants at 30 DAS, 40 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 harvest from four 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 four 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 four 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 four 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 four 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.

3.15 Methods for Soil Analysis

Soil samples were analyzed for both physical and chemical characteristics viz. organic matter, PH, total N and available P and K contents. The soil samples were analyzed by the following standard methods as follows:

3.15.1 Particle size analysis of soil

Particle size analysis of the soil was done by hydrometer method. The textural class was determined by plotting the values of 27.32% sand, 51.75% silt and 20.93% clay using Marshell’s Triangular co-ordinate as designated by USDA.

3.15.2 Organic carbon (%)

Soil organic carbon was estimated by Walkley and Black’s wet oxidation method as outlined by Jackson (1973).

P^H	5.99
Organic Matter(%)	0.84
Total N(N%)	0.17
Available P	12.08
Available S	20.09

3.15.3 C/N ratio

The C/N ratio was calculated from the percentage of organic carbon and total N.

3.15.4 Soil organic matter

Organic carbon in soil sample was determined by wet oxidation method of Walkley and Black (1935). The underlying principle was used to oxidize the organic matter with an excess of 1N $K_2Cr_2O_7$ in presence of conc. H_2SO_4 and conc. H_3PO_4 and to titrate the excess $K_2Cr_2O_7$ solution with 1N $FeSO_4$. To obtain the content of organic matter was calculated by multiplying the percent organic carbon by 1.73 (Van Bemmelen factor) and the results were expressed in percentage (Page et al., 1982). Soil organic matter content was calculated by multiplying the percent value of organic carbon with the Van Bemmelen factor, 1.724.

% organic matter = % organic carbon × 1.724

3.15.5 Soil pH

The pH of the soil was determined with the help of a glass electrode pH meter using Soil: water ratio 1:2.5 (Jackson, 1973).

3.15.6 Total nitrogen (%)

Total nitrogen content in soil was determined by Kjeldahl method by digesting the soil sample with conc. H_2SO_4, 30% H_2O_2 and catalyst mixture (K_2SO_4: $CuSO_4$. $5H_2O$: Se = 10:1:0.1) followed by distillation with 40% NaOH and by titration of the distillate trapped in H_3BO_3 with 0.01 N H_2SO_4 (Black, 1965).

The amount of N was calculated using the following formula:

% N = (T-B) × N × 0.014 × 100 / S

Where,

T = Sample titration (ml) value of standard H2SO4

B = Blank titration (ml) value of standard H2SO4

N = Strength of H2SO4

S = Sample weight in gram

3.15.7 Available sulphur (ppm)

Available S in soil was determined by extracting the soil samples with 0.15% $CaCl_2$ solution (Page et al., 1982). The S content in the extract was determined turbid metrically and the intensity of turbid was measured by spectrophotometer at 420 nm wave length.

3.15.8 Available Phosphorus (ppm)

Available phosphorus was extracted from the soil with 0.5 M $NaHCO_3$ solution, pH 8.5 (Olsen et al., 1954). Phosphorus in the extract was measured spectrophotometrically after development of blue color (Black, 1965). It was determined by developing blue color with reduction of phosphomolybdate complex and the color intensity were measured colorimetrically at 660 nm wavelength and readings were calibrated the standard P curve (Page et al. 1982).

3.15.9 Exchangeable Potassium (meq/100 g soil)

Exchangeable potassium (K) content of the soil sample was determined by flame photometer on the NH_4OAc extract (Black, 1965).

3.16 Statistical analysis

The data gathered for different parameters were statistically analyzed the morphology and yield of mungbean as influenced by cowdung and inorganic fertilizer. The mean values of all the recorded parameters were evaluated and analysis of variance was performed by the ‘F’ (variance ratio) test using statistix-10 software. The significance of the difference among the treatment combinations of means was estimated by Duncan’s Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSION

CHAPTER IV
RESULT 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 Effect of cowdung and inorganic fertilizer on growth parameter of mungbean

4.1.1 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 cow dung (T_2-T_6) were observed; it was found that at 30 DAS, 40 DAS, and at harvest the highest plant height was obtained in T_3 treatment (29.98 cm, 39 cm, 48.22 respectively) i.e. 80% recommended dose of inorganic fertilizer and 20% cow dung ha^{-1} and the lowest plant height was obtained from T_0 treatment (22.88 cm, 32.33 cm, and 43.35 cm respectively) that is control.

It seems from the results that the combination of inorganic fertilizers and cow dung significantly increased among the treatment combination. Actually cowdung fertilizers help to increase the organic matter content of the 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 was found by many scientists while experimenting with various crops. A combination of cowdung and inorganic fertilizers was found better by Mollah et al. (2011) in green gram than only inorganic fertilizers.

Table 1. Effect of cow dung and inorganic fertilizer on plant height plant^{-1} (at 30 DAS, 40 DAS, and at harvest)

Treatment	Plant height (cm)		
	30 DAS	40 DAS	At harvest
T_0	22.88f	32.33g	43.35e
T_1	28.97b	39.23b	47.89ab
T_2	24.69e	34.50f	44.62d
T_3	29.98a	39.92a	48.22a
T_4	26.67c	37.82c	46.61b
T_5	26.27cd	36.61d	46.47b
T_6	25.65d	36.06e	45.54c
$LSD_{(0.05)}$	**0.82**	**0.53**	**0.90**
Cv(%)	**1.74**	**0.70**	**1.10**

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here ,
T_0 - Control , T_1- 100% Recommended fertilizer dose (RFD), T_2 – 100 % (6 ton) cowdung ha^{-1}, T_3 - 80% inorganic fertilizer (RFD) and 20% from cowdung (1.2) ton ha^{-1} , T_4 - 60% inorganic fertilizer (RFD) and 40% from cowdung (2.4) ton ha^{-1} , T_5- 40% inorganic fertilizer (RFD) and 60% from cowdung (3.6) ton ha^{-1} , T_6 - 20% inorganic fertilizer (RFD) and 80% from cowdung (4.8) ton ha^{-1}

4.1.2 Number of leaves plant^{-1}

The data on number of leaves plant^{-1} of mungbean at different growth stages as influenced by cow dung and inorganic fertilizers are presented in Table 2. The average values of the treatments involving cow dung (T_2-T_6) and T_1 were observed; it was found that at 30 DAS,40 DAS, and at harvest the highest number of leaves was obtained from T_3 treatment (8.67, 10.33, and 10.33 respectively) that is 80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1}. T_4 (7, 7.67, and 7.33) and T_5 (7, 7.33, and 7.33). The lowest number of leaves was obtained from T0 treatment (3.33,4.67, and 5.33 respectively) that is control.

Results showed that the combination of inorganic fertilizers and cowdung manure 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. Aslam et al. (2010) and Salahin et al. (2011) reported that in mungbean the maximum leaves plant $^{-1}$ was recorded with the application of Cowdung and chemical fertilizer respectively. The results showed that application of cowdung manure along with chemical fertilizers resulted in markedly higher uptake of nutrients.

Table 2. Effect of cow dung and inorganic fertilizer on Number of leaves plant^{-1} (at 30 DAS, 40 DAS, and at harvest)

Treatment	Number of leaves plant^{-1}		
	30 DAS	40 DAS	At harvest
T_0	3.33e	4.67e	5.33c
T_1	7.67b	8.33b	8.33b
T_2	4.67d	5.67de	6.67bc
T_3	8.67a	10.33a	10.33a
T_4	7b	7.67bc	7.33b
T_5	7b	7.33bc	7.33b
T_6	5.67c	6.67cd	6.67bc
$LSD_{(0.05)}$	**0.33**	**1.16**	**1.7**
Cv(%)	**6.34**	**9.04**	**13.03**

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here ,

T_0 - Control, T_1- 100% Recommended fertilizer dose (RFD), T_2 – 100 % (6 ton) cowdung ha^{-1}, T_3 - 80% inorganic fertilizer (RFD) and 20% from cowdung (1.2) ton ha^{-1} , T_4 - 60% inorganic fertilizer (RFD) and 40% from cowdung (2.4) ton ha^{-1} , T_5- 40% inorganic fertilizer (RFD) and 60% from cowdung (3.6) ton ha^{-1} ,T_6 - 20% inorganic fertilizer (RFD) and 80% from cowdung (4.8) ton ha^{-1} .

4.1.3 Number of branches plant^{-1}

The data on number of branches plant^{-1} of mungbean at different growth stages as influenced by inorganic fertilizers and cowdung manure are presented in Table 3. The average values of the treatments involving cowdung (T_2-T_6) and inorganic fertilizer (T_1) were observed; it was found that both at harvest the highest number of branches plant^{-1} was obtained from T_3 treatment (3.86) that is 80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1}. T_3 was statistically similar with T_4 (3.43). The lowest number of branches plant^{-1} was obtained from T_0 treatment (0.4) that is control. Combination of cowdung and inorganic fertilizers significantly increased among the treatment combination. As cowdung 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.

Table 3. Effect of cow dung and inorganic fertilizer on Number of branches plant^{-1} (at harvest)

Treatment	Number of branches plant^{-1}
	At harvest
T_0	0.4f
T_1	3b
T_2	1.23e
T_3	3.86a
T_4	3.43b
T_5	2.6c
T_6	1.7d
LSD$_{(0.05)}$	**0.40**
Cv(%)	**8.04**

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here,
T_0 - Control, T_1- 100% Recommended fertilizer dose (RFD), T_2 – 100 % (6 ton) cowdung ha^{-1}, T_3 - 80% inorganic fertilizer (RFD) and 20% from cowdung (1.2) ton ha^{-1} , T_4 - 60% inorganic fertilizer (RFD) and 40% from cowdung (2.4) ton ha^{-1} , T_5- 40% inorganic fertilizer (RFD) and 60% from cowdung (3.6) ton ha^{-1} ,T_6 - 20% inorganic fertilizer (RFD) and 80% from cowdung (4.8) ton ha^{-1} .

4.1.3 Pod Length (cm)

The data on pod length of mungbean as influenced by cow dung and inorganic fertilizers are presented in Table 5. The average values of the treatments involving cowdung (T_2-T_6) and inorganic fertilizer (T_1) were observed; it was found that the highest number of pod length was obtained from T_3 treatment (7.9) that is - 80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1} which is statistically similar with all other except T_1(7.7) and the lowest number of pod length was obtained from T_0 treatment (6.91) that is control. This may be because combination of cow dung and inorganic fertilizers improves soil physical properties, which provide health and favorable soil conditions to enhance nutrient use efficiency. Similar results were reported by Salahin et al. (2011) and Mahabub et al. (2016) in mungbean.

The results showed that application of cowdung manure along with chemical fertilizers resulted in markedly higher uptake of nutrients.

Table 4. Effect of cow dung and inorganic fertilizer on pod length (at harvest)

Treatment	Pod length(cm)
T_0	6.91g
T_1	7.7b
T_2	7f
T_3	7.9a
T_4	7.5c
T_5	7.32d
T_6	7.2e
$LSD_{(0.05)}$	0.08
CV(%)	0.58

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Different treatments: Here,

T_0 - Control, T_1- 100% Recommended fertilizer dose (RFD), T_2 – 100 % (6 ton) cowdung ha^{-1}, T_3 - 80% inorganic fertilizer (RFD) and 20% from cowdung (1.2) ton ha^{-1} , T_4 - 60% inorganic fertilizer (RFD) and 40% from cowdung (2.4) ton ha^{-1} , T_5- 40% inorganic fertilizer (RFD) and 60% from cowdung (3.6) ton ha^{-1} ,T_6 - 20% inorganic fertilizer (RFD) and 80% from cowdung (4.8) ton ha^{-1}

4.2 Effect of cowdung and inorganic fertilizer (NPK) on the yield and yield attributes of mungbean

4.2.1 Number of pods plant^{-1}

The data on number of pods plant^{-1} of mungbean as influenced by cowdung and inorganic fertilizers are presented in Figure 1 and Appendix III. The average values of the treatments involving cowdung (T_2), combination of cowdung and inorganic fertilizer (T_3-T_6) were observed; it was found that the highest number of pods plant^{-1} was obtained from T_3 treatment (19.25) that is 80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1}. The average value was observed from (T_4-T_5) and the lowest number of pods plant^{-1} was obtained from T_0 treatment (9.25) that is control. This may be because combination of organic and inorganic fertilizers improves soil physical properties, which provide health and favorable soil conditions to enhance nutrient use efficiency. Similar results were reported by Mahabub et al. (2016) in mungbean.

The results showed that application of organic manure along with chemical fertilizers resulted in markedly higher uptake of nutrients.

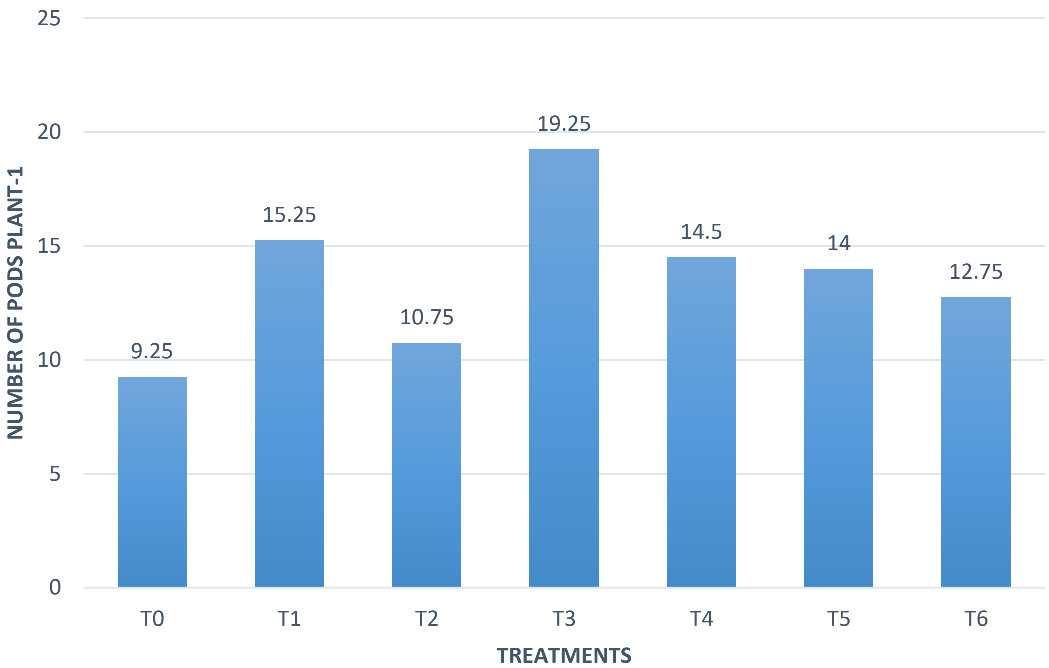

Figure 1. Effect of cow dung and inorganic fertilizer on Number of pod plant^{-1}

4.2.2 Number of seeds pod^{-1}

The data on number of seeds pod^{-1} of mungbean as influenced by cow dung and inorganic fertilizers are presented in Table 4. The average values of the treatments involving cowdung (T_2-T_6) and inorganic fertilizer (T_1) were observed; it was found that the highest number of seeds pod^{-1} was obtained from T_3 treatment (10.42) that is - 80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1} which is statistically disimilar with all other except T_1 and the lowest number of seeds pod^{-1} was obtained from T_0 treatment (6.67) that is control. This may be because combination of cow dung and inorganic fertilizers improves soil physical properties, which provide health and favorable soil conditions to enhance nutrient use efficiency. Combination of organic and inorganic fertilizers was found better by Mahabub et al. in mungbean than only inorganic fertilizers. The results showed that application of organic manure along with chemical fertilizers resulted in markedly higher uptake of nutrients.

Table 5. Effect of cow dung and inorganic fertilizer on Number of seeds pod^{-1} (at harvest)

Treatment	Number of seeds pod^{-1}
T_0	6.67f
T_1	9b
T_2	7.58e
T_3	10.42a
T_4	8.7bc
T_5	8.42c
T_6	8d
LSD(0.05)	**0.33**
CV(%)	**2.23**

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here ,
T_0 - Control , T_1- 100% Recommended fertilizer dose (RFD), T_2 – 100 % (6 ton) cowdung ha^{-1}, T_3 - 80% inorganic fertilizer (RFD) and 20% from cowdung (1.2) ton ha^{-1} , T_4 - 60% inorganic fertilizer (RFD) and 40% from cowdung (2.4) ton ha^{-1} , T_5- 40% inorganic fertilizer (RFD) and 60% from cowdung (3.6) ton ha^{-1} , T_6 - 20% inorganic fertilizer (RFD) and 80% from cowdung (4.8) ton ha^{-1}

4.2.3 1000-seed weight (g)

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_3 (43.44g) that is 80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1} and the minimum 1000-seed weight was obtained from T_0 (38.57g) that is control. It is revealed from the result that combination of cowdung 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 favorable soil conditions to enhance nutrient use efficiency.

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 Cowdung and chemical fertilizer.

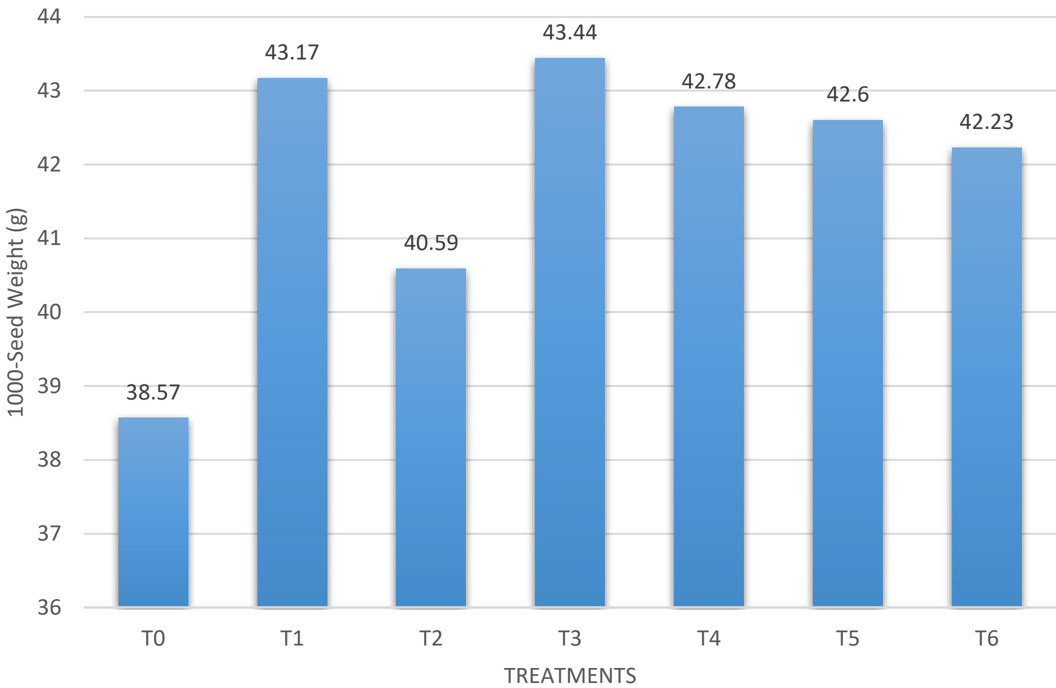

Figure 2. Effect of cow dung and inorganic fertilizer on 1000-seed weight (g)

4.2.4 Seed yield (ton ha^{-1})

The data on seed yield kg ha^{-1} of mungbean as influenced by cowdung and inorganic fertilizers are presented in Figure 3 and Appendix III. The average values of the treatments involving cowdung (T_2-T_6) and inorganic fertilizer (T_1) were observed; it was found that the highest seed yield was obtained from T_3 treatment (1.42-ton ha^{-1}) that is - 80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1} and the lowest seed yield was obtained from T_0 treatment (0.82 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 favorable soil conditions to enhance nutrient use efficiency. Similar results were reported by Mahabub et al. (2016) and Mollah et al. (2011) in green gram. The results showed that application of cowdung along with chemical fertilizers resulted in marked higher uptake of nutrients.

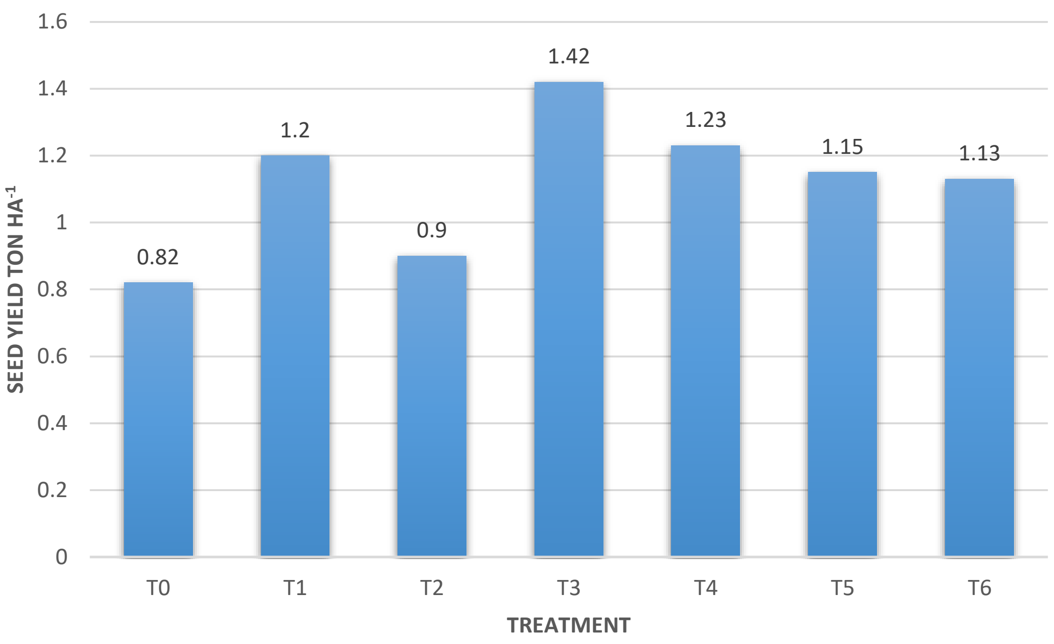

Figure 3. Effect of cow dung and inorganic fertilizer on seed yield ton ha^{-1}

Here ,

T_0- Control, T_1- 100% Recommended fertilizer dose (RFD), T_2 -100 % (6 ton) cowdung ha^{-1}, T_3 - 80% inorganic fertilizer (RFD) and 20% from cowdung (1.2) ton ha^{-1} , T_4 - 60% inorganic fertilizer (RFD) and 40% from cowdung (2.4) ton ha^{-1} , T_5- 40% inorganic fertilizer (RFD) and 60% from cowdung (3.6) ton ha^{-1} ,T_6 - 20% inorganic fertilizer (RFD) and 80% from cowdung (4.8) ton ha^{-1} .

CHAPTER V

SUMMARY AND CONCLUSION

CHAPTER V

SUMMARY

The experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from March to June 2020 to study the effects of combination of cowdung and recommended inorganic fertilizer on the growth, yield of mungbean. The variety BARI mung-6 was used as the test crops. A summary of methodology and results of this study is given below.

The experiment was designed with 7 treatments [T_0 - Control, T_1- 100% Recommended fertilizer dose (RFD), T_2 – 100 % (6 ton) cowdung ha^{-1}, T_3 - 80% inorganic fertilizer (RFD) and 20% from cowdung (1.2) ton ha^{-1} , T_4 - 60% inorganic fertilizer (RFD) and 40% from cowdung (2.4) ton ha^{-1} , T_5- 40% inorganic fertilizer (RFD) and 60% from cowdung (3.6) ton ha^{-1} ,T_6 - 20% inorganic fertilizer (RFD) and 80% from cowdung (4.8) ton ha^{-1}], laid out in a randomized complete block design (RCBD) with three replications. Each plot size was 2 m x 2 m. BARI mung-6 was used in the study. The seeds were sown in 21 March 2020. 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.

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 cowdung and inorganic fertilizers. At 30 DAS and at harvest highest plant height (48.22cm) were observed in T_3 (80% recommended dose of inorganic fertilizer and 20% cowdung 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_3 (80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1}). 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 in T_3 (80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1}). 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_3 (80%

recommended dose of inorganic fertilizer and 20% cowdung 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 cowdung and inorganic fertilizer doses. Maximum numbers of pods $plant^{-1}$, seeds pod^{-1} and seed yield $plant^{-1}$ (1.42 ton/ha) were recorded in T_3(80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1}). 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_3 (80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1}) showed better results. 1000-seed weight showed insignificant variation due to the different combinations of cowdung and inorganic fertilizer doses. Numerically highest 1000-seed weight was recorded (43.44 gm) in T_3 (80% recommended dose of inorganic fertilizer and 20% cowdung ha^{-1}). 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_3 (80% recommended dose of inorganic fertilizer and 20% cowdung 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 cowdung and recommended inorganic fertilizer.

CHAPTER VI

CONCLUSION

From the above results it can be concluded that combination of cowdung and recommended 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. Therefore, the present experimental results suggest that the combined use of cowdung and recommended inorganic fertilizer were applied together, the mungbean crop's grain production dramatically increased. The maximum grain yield (1.42 ton ha^{-1}) was obtained in T_3 (80% Recommendation chemical fertilizer + 20% cowdung) of BARI Mung-6 under the climatic and edaphic condition of Sher-e-Bangla Agricultural University, Dhaka and similar environment elsewhere in Bangladesh.

Considering the situation of the present experiment, further studies in the following areas may be suggested:

- Such study is needed in different agro-ecological zones (AEZ) of Bangladesh to investigate regional adaptability and other performance.
- It needs to conduct more researches of cowdung and recommended inorganic fertilizer to investigate the growth and yield BARI Mung6.It needs to conduct more advanced and related experiments with other varieties of mungbean and also in different climate and soil condition.

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CHAPTER VII

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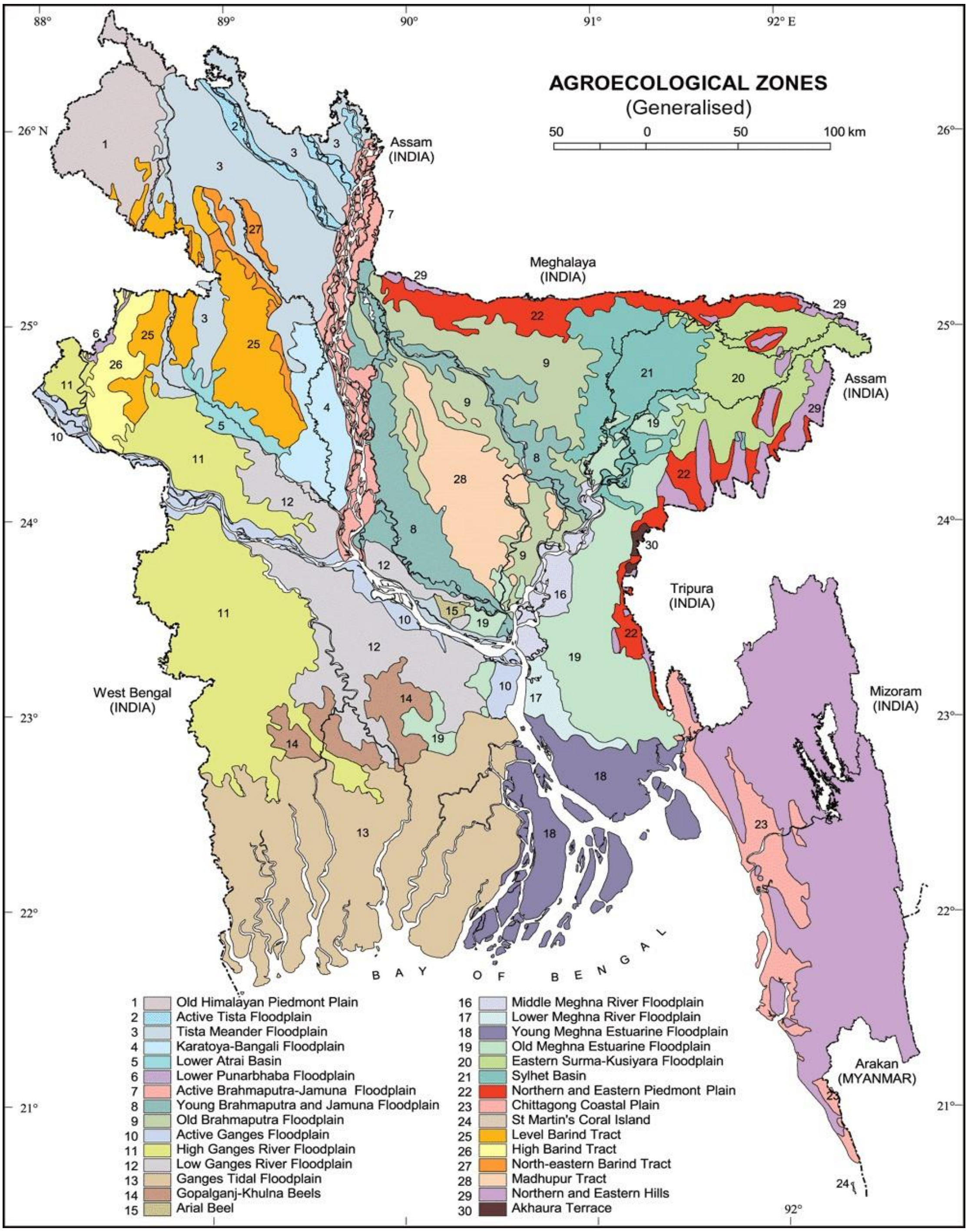
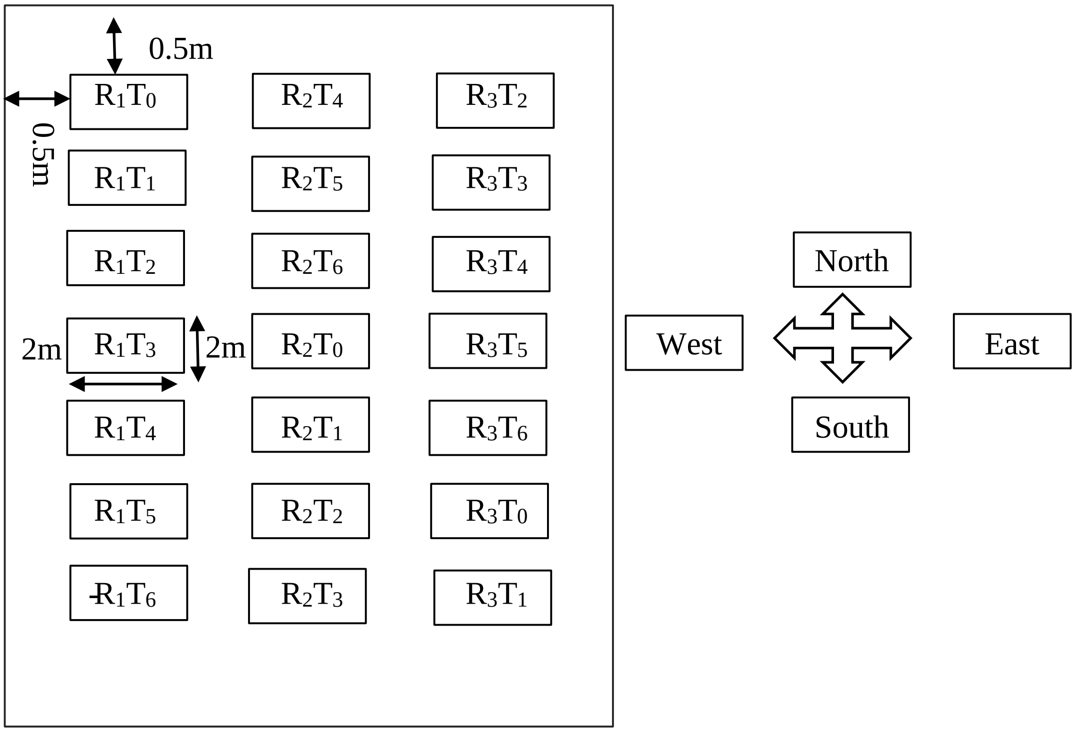
APPENDICES

APPENDICES

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



Appendix II: Layout of the experimental field



Here,

T_0 - Control

T_1- 100% Recommended fertilizer dose (RFD)

T_2 – 100 % (6 ton) cowdung ha^{-1}

T_3 - 80% inorganic fertilizer (RFD) and 20% from cowdung (1.2) ton ha^{-1}

T_4 - 60% inorganic fertilizer (RFD) and 40% from cowdung (2.4) ton ha^{-1}

T_5- 40% inorganic fertilizer (RFD) and 60% from cowdung (3.6) ton ha^{-1}

T_6 - 20% inorganic fertilizer (RFD) and 80% from cowdung (4.8) ton ha^{-1}

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

Treatment	Number of pod plant^{-1}	1000-seed weight(gm)	Seed yield(ton ha^{-1})
T_0	9.25f	38.57f	1.02d
T_1	15.25b	43.17ab	1.2b
T_2	10.75e	40.59e	0.9d
T_3	19.25a	43.44a	1.2a
T_4	14.5c	42.78d	1.23b
T_5	14c	42.6d	1.15c
T_6	12.75d	42.23d	1.13c
$LSD_{(0.05)}$	**0.82**	**0.55**	**0.07**
CV(%)	**3.38**	**0.74**	**3.52**

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here,
T_0 - Control, T_1- 100% Recommended fertilizer dose (RFD), T_2 – 100 % (6 ton) cowdung ha^{-1}, T_3 - 80% inorganic fertilizer (RFD) and 20% from cowdung (1.2) ton ha^{-1} , T_4 - 60% inorganic fertilizer (RFD) and 40% from cowdung (2.4) ton ha^{-1} , T_5- 40% inorganic fertilizer (RFD) and 60% from cowdung (3.6) ton ha^{-1} ,T_6 - 20% inorganic fertilizer (RFD) and 80% from cowdung (4.8) ton ha^{-1}

Appendix III. Morphological characteristics of the experiment field

Locality	SAU, Dhaka
Geograpic position	23^0 77'North Latitude 90^0 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

Appendix IV. 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