EFFECTS OF ORGANIC MANURES AND INORGANIC FERTILIZERS ON THE PERFORMANCE OF MUNGBEAN (*Vigna radiate L.*)

A Thesis

By

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MASTER OF SCIENCE (M.S.)

IN

CROP PHYSIOLOGY AND ECOLOGY

DEPARTMENT OF CROP PHYSIOLOGY AND ECOLOGY

HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY

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DEDICATED

TO MY

BELOVED PARENTS

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ABSTRACT

The experiment was conducted at the research field of Crop Physiology and Ecology Department, Hajee Mohammad Danesh Science and Technology University, Dinajpur, during the period of mid- April to mid- July, 2012 to evaluate the effect of organic manures and inorganic fertilizers on the performance of mungbean. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The experimental plots were first divided into three blocks each representing a replication. Each block then divided into six-unit plots of 3m x 2m sizes. The distance between block to block was 0.5m and plot to plot was 0.75m. The experiment comprised of two sets of factors such as two varietirs; V_1 = BINA Mug- 5 and V_2 = BARI Mug- 6 and four fertilizer treatments: T_0 = control, T_1 = Recommended dose of fertilizer, T_2 = 10 ton cowdung manure ha^{-1} + inorganic fertilizer and T_3 = 5 ton ha^{-1} poultry manure + inorganic fertilizer. Significant variation in plant height at 35 DAS, 42 DAS, 49 DAS, 56 DAS, 63 DAS, 70 DAS and 77 DAS were found among the varieties. The highest number of pod $plant^{-1}$ (25.33) was found in BINA Mug- 5 and the lowest number of pod $plant^{-1}$ (11.67) was recorded in BARI Mug- 6 variety. Among all fertilizer treatments the maximum yield of mungbean (1365 kg ha^{-1}) was recorded in T_1 and the minimum (1255 kg ha^{-1}) was in the T_0 treatment of BINA Mug- 5. Maximum yield of mungbean (1310 kg ha^{-1}) was recorded in T_3 and the minimum (1210 kg ha^{-1}) was in the T_0 treatment of BARI Mug- 6. Finally, it might be concluded that the application of organic manures with chemical fertilizers is the best way for further mungbean production in economic point of view. But the degree of benefits obtained from different organic manures were as cow dung manure>poultry manure.

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CHAPTER I

INTRODUCTION

Mungbean (*Vigna radiata* L.Wilczek) under the family Leguminosae and sub-family Papilionaceae is an important pulse crop of Bangladesh. It is a rich source of protein. It is mainly a day neutral warm season crop commonly grown in semiarid to subhumid tropics and subtropics. It is cultivated most extensively in India, Myanmer, Thailand, Bangladesh, Iran, Pakistan, Vietnam, China, Japan, Philippines, Korea, Indonesia, Srilanka and Islands in the south pacific (FAO, 2003).

Mungbean contributes 6.5% of the total pulse production in our country. It contains 51% carbohydrate, 26% protein, 10% moisture, 4% mineral and 3% vitamin. Mungbean is the best of all pulses for its high digestibility, good flavor, high protein content and absence of any flatulence effects which are common to many pulses (Ahmed *et al.* 1978). In Bangladesh, the main form of protein readily available to the bulk of the population is plant protein. As the population has increased and the cost of production of animal protein has increased, it has become out of reach for the bulk of' the population in both rural and urban areas.

In developing countries like Bangladesh, pulse can improve the overall nutritional value of cereal-based diet. Unfortunately there is an actual shortage of grain legumes production in the country. The production has been steadily decreased due to reduced acreage. The main causes are, expansion of rice cultivation area especially Boro rice, poor management and low yielding local cultivars. The daily consumption of pulse in Bangladesh is only 12 grams per head. But according to WHO, each person requires 45 grams of pulses per day. Increase of pulse production is urgently needed to meet up the demand of proteinous part in our daily diet and also to increase pulse consumption.

Experiment was conducted with BARI indicated summer pulses that are more economic than low yielding Aus rice. According to the BBS (2009) mungbean covered an area of 55,100.00 hectares and production was about 36,000 metric tons. The average production of mungbean in the country is about 570 kg ha^{-1}, which is much lower than India and some other countries of the world.

Organic manures helps in better utilization of all the nutrients in the soil, increases soil water holding capacity which meeting up the need of irrigation and thus increases yield. In the production of crops, soil always serves as the basic ingredient to be exploited fully to produce more.

Organic manure stimulates microbial activity in soil through the improvement of soil physical properties, so that organic matter content is increased. Considering these points organic manures can also help in less use of N-fertilizer. Organic manures help in retaining moisture in the soil and sometimes even substitute soil and can lessen the need of inorganic fertilizer (Donato *et al.,* 1972).

The role of organic manures in the growth and productivity of plants is well recognized, it protects the plant from temperature injury, moisture loss by wind and soil evaporation structure, drainage and fertility. The encouraging results were reported by Frazier, 1957.

Plenty of research work showed that organic manures has a beneficial effect on conservation of soil moisture. Organic manures can increase water holding capacity of soil, also increases soil aeration, microbial activities, organic matter content of surface soil. This means better utilization soil resources by the plants. Organic manures can also be used to alleviate the negative effects of a problem soil. Considering the above mentioned facts this study was under taken for the following objectives-

1. To find out the suitable type and dose of organic manure with inorganic fertilizers for the growth of mungbean.
2. To determine the influence of different organic manures with inorganic fertilizers on yield and yield contributing characters of mungbean.

CHAPTER II

REVIEW OF LITERATURE

A number of investigations have been done on the effect of different organic and inorganic fertilizers on the performance of mungbean in different parts of the world. But in Bangladesh research in this line is very limited. Because in Bangladesh pulse crops are generally grown without application of any fertilizers and manures. Recently the Pulse Research Center,Ishwardi of Bangladesh Agriculture Research Institute (BARI) and Bangladesh Institute of Nuclear Agriculture (BINA) have started research work for improvement of this crop. Available information pertinent to present study are reviewed and presented in this chapter.

Rahman *et al. (*2012) reported that the effect of inorganic fertilizers along with organic manure and mungbean residue on soil properties and yield of crops. For the first crop (maize), there were five treatments. After harvest of maize, mungbean and dhaincha *(Sesbania)* seeds were sown as per treatments. For T. Aman rice (third crop), each of the treatments (T_2 and T_3 plots) were subdivided into six, so there were altogether 15 treatments. Integrated use of manure and inorganic fertilizers (IPNS basis) produced comparable seed yield of maize with the chemical fertilizers alone irrespective of moderate or high yield goal basis (MYG or HYG). The highest maize yield of 10.02 t/ha was obtained from the treatment T5, which produced significantly highest yield over all other treatments. During the growing period of mungbean, temperature coupled with rainfall encouraged vegetative growth of mungbean and as a result, pod formation was low. The incorporation of *Sesbania* biomass and mungbean residue along with inorganic fertilizers for MYG produced identical grain yields of T. Aman rice with the fertilizers alone for HYG. The highest grain yield 4.31 t/ha was found in IPNS dhaincha along with fertilizers for HYG treatment. There was no remarkable change in post harvest soil status during the growing period. It may be concluded that addition of mungbean residues or *Sesbania* biomass before T. Aman rice may ensure higher crop productivity and sustain soil fertility.

Rahman (2007) reported that Mungbean *(Vigna radiata)* can be a good option as a legume crop since it is a high value pulse so that seeds can be harvested and residue can be incorporated into soil as manure. Growing of mungbean after maize harvest would supply 14 kg N/ha to the subsequent T. Aman rice.

Samanta *et al.* (1999) reported that temperature had tremendous influence on mungbean growth and observed high temperature favoured vegetative growth and consequently increased the stover yield. Incorporation of legume residues had supplied PKSZn nutrients from the same plot, so it is a recycling process but N was taken up from the soil as well as from atmosphere through biological N fixation by legume-rhizobium symbiosis. Zaman *et al.* (1995) reported that 60-day old dhaincha *(Sesbania)* plants produced 5.2 t/ha dry matter which yielded 135 kg N/ha.

Quayyum (1994) reported that a build up of S in soil in the legume based cropping pattern was noted. There was a build up of available Zn status of soils in all the treatments with fertilizer or fertilizer plus manure or crop residues application compared with initial soil. Qiao-lan *et al.* (2007) reported that the residual effect of Zn fertilization one year later was similar to a successive Zn fertilization for three years, and the rate of yield increase was quite similar.

Khalequzzaman *et al.* (2005) reported that organic manure resulted in the improvement of organic carbon of the post harvest soil over the control. Total nitrogen was higher in the treatments where organic manure and crop residues were added. Islam *et al.* 2006 obtained that nitrogen content slightly increased in residue management treatment but decreased in unincorporated plots.

Sarker (2005) obtained the highest grain yield from 100% fertilizer application which was comparable with 75% inorganic fertilizer along with legume residue incorporation.

Ghulam Abbas, (2011) reported that the effects of organic and inorganic fertilizers on mungbean (*Vigna radiata*. (L.) yield under arid climate were studied 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 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.

Tejada (2009) reported that the use of organic materials as fertilizers for crop production has received attention for sustainable crop productivity. Moller (2009) reported that Organic materials hold great promise as a source of multiple nutrients and ability to improve soil characteristics.

Choudhury (2005) repoted that 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.

Naeem (2006) observed the maximum number of grains pod-1 (12.54) with the application of NPK in variety NM-98 and (11.38) in variety M-1 and the maximum 1000-grain weight (40.86g) in treatment NPK in variety NM-98 and (40.55g) in the same variety NM-98 which was however statistically at par with variety M-1 in NPK treatment.

Becker (2008) reported that economic reasons, farmers increasingly diversify their cropping system by replacing the dry season rice by high-value horticultural crops grown under upland conditions. However, upland cropping is likely to further exacerbate the soil-related problems. Organic substrates from decentralized waste and waste water management are widely available and may help to alleviate the reported soil problems.

Naeem *et al.*(2006) reported that 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.

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

Yadav and Jakhar (2001) found that grain and straw yields of mungbean increased up to 60 kg P_2O_5 application ha^{-1}.

Sharma (1995) carried out a field experiments were carried out to determine the effect of *Sesbania aculeata* L. green manuring and mungbean, *Vigna radiata* (L.) residue incorporation on the response of rice to urea-N and their residual effects on a subsequent spring wheat. Compared with a pre-rice fallow, *Sesbania* green manuring and mungbean residue increased grain yield of rice by 0.4 and 0.3 t ha"^{1}, respectively and of spring wheat by 0.6 and 0.7 t ha"^{1}, respectively when no urea-N was applied to rice and 40 kg urea-N ha~^{I} as a basal starter dose was applied to wheat. *Sesbania* green manure and mungbean residue substituted for 43 and 30 kg urea-N ha~^{I} in rice and subsequently gave a beneficial effect in spring wheat equal to the residual effect of 89 and 112 kg urea-N ha-^{1} applied to rice, respectively. Mungbean residue remaining after the picking of pods, was found to be at par with *Sesbania* green manuring towards N contribution to "rice-wheat" cropping system but had an additional advantage of 0.5 to 1.3 t ha""^{1} seed yield of protein rich mungbeans.

Rashid (2004) reported that The effect of 'on-farm' seed priming – soaking seeds in water before surface-drying and sowing them – was tested for mungbean (*Vigna radiata*) in 15 irrigated on-station trials and four sets of rainfed, paired-plot, farmer-participatory trials over four contrasting years from 1999 to 2002 in the North West Frontier Province of Pakistan. The optimum soaking time was found to be between six and eight hours; eight hours was used in all the trials. Of the 19 trials, priming was significantly better than non-priming in 14 with a mean yield increase of 56%. In the remaining five trials there was no difference between treatments but in no case was priming worse than not priming. In a subset of 11 on-station trials in which management was considered to be optimal, yield declined in a linear fashion as the date of sowing was delayed. The rate of decline of about 30 kg ha^{-1} d^{-1} after 1st June was similar for both non-primed and primed crops, although the latter declined from a higher base. Farmers' yields were proportional to rainfall over the four years and the mean increase in grain yield due to priming in the 39 trials was 30%. Benefits from priming were the result of a combination of faster germination and emergence and more vigorous growth and development, leading to better crop stands and bigger, more productive plants. It was concluded that 'on-farm' seed priming is a low-cost, low-risk technology that has the potential to raise mungbean yields substantially thus making it a more attractive crop for farmers.

Mahmood *et al.* (2010) reported that a field investigation was carried out to evaluate the effect of organic and inorganic sources of phosphorous on the growth and yield of mungbean (*Vigna radiate* 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.

Hussain *et al.* (2008) reported that the availability of P can be increased if it is mixed with FYM. Integrated use of organic and inorganic fertilizers guarantee improved soil health and fertility (Satyanarayana *et al.*, 2002). Ather Nadeem *et al.* (2004). stated that seed yield of mungbean was increased with phosphorus application.

Bending *et al.* (2002) concluded that crop residues and soil organic matter both could affect the diversity of soil microbial community and increase the crop growth and yield. Integrated use of nutrient may be one of the solutions to increase mungbean production as well as reducing cost of production and make the best use of locally available resources like animal dung, urine, crop residues etc. The use of organic matter as a low cost supplement to the artificial fertilizers may help decreasing the cost of production. Therefore, present study was designed to investigate the suitable levels of organic and inorganic sources of phosphorus at constant levels of nitrogen and potassium for obtaining increased growth, yield and quality of mungbean.

Bhuiyan (2011) reported that an experiment was carried out 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, Aeric Haplaquept) 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. There were four treatments for wheat- T1: Control, T2: N, P, K, S, Zn, B (MYG), T3: N, P, K, S, Zn, B (HYG) and T4: N, P, K, S, Zn, B (MYG) + CD. The nutrient rates for four treatments of wheat were N0-P0-K0-S0-Zn0-B0 kg/ha for T1, N80-P20-K50-S10-Zn1-B1 kg/ha for T2, N120-P30-K75-S15-Zn2-B2 kg/ha for T3 and N80-P20-K50-S10-Zn1-B1 kg/ha + CD (5 t/ha) for T4. In T. Aus/Mungbean one-third plot of each treatment was cultivated by T. Aus rice and the rest two-thirds plot by mungbean. The rates of N, P, K, and S for T. Aus rice were, respectively, 60, 12, 32 and 5 kg/ha for MYG, and 90, 18, 48 and 7.5 kg/ha for HYG. The corresponding rates of P, K, and S for mungbean were 10, 13, and 5 kg/ha for average yield goal (AYG). The results showed that grain (3.46 t/ha) and straw yields (5.19 t/ha) of T. Aus rice increased significantly due to application of fertilizers. The highest mean seed yield of 0.56 t/ha and stover yield of 1.99 t/ha in mungbean were obtained from PKS plus inoculums plus residual N, P, K, S, Zn, B for HYG treatment. The N, P, K, S, Zn, and B uptake by T.Aus/Mungbean remarkably increased with increasing supply of nutrients. The highest uptake of N, P, K, S, Zn, and B by the crops was noted in the treatment T3 that received HYG fertilizers in T. Aus rice. The removal of N ranged from 27.3 to 63.2 kg/ha and 29.8 to 48.1 kg/ha, P from 5.62 to 15.80 kg/ha and 2.60 to 4.69 kg/ha, K from 35.8 to 71.8 kg/ha and 21.9 to 37.4 kg/ha, S from 4.08 to 10.26 kg/ha and 2.12 to 4.11 kg/ha, Zn from 44 to 132 g/ha and 56 to 101 g/ha, B from 17 to 70 g/ha and 7 to 16 g/ha by T. Aus rice and mungbean, respectively. Application of cowdung 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.

Saleque *et al* (2004) reported that the application of balanced doses of chemical fertilizers and integrated use of cowdung, ash, and chemical fertilizers gave positive yield trend of rice in long-term experiment at BRRI farm.

Ahlawat *et al.* (1998) reported that the Mungbean is a common grain legume grown in the summer to utilize the gap between winter and rainy season crops. Incorporation of mungbean residues after picking pods has been found as effective as green manuring with other legumes, such as *Sesbania* in increasing the productivity of a rice-wheat system. This study was carried out to find out the effects 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.

Mollah (2011) reported that a field experiment was conducted 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 experiment was designed with five treatments for whole of the cropping pattern in a randomized complete block design with six replications. 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. The highest tuber yield (25.01 t/ha) was obtained from integrated plant nutrient management treatment. 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. Grain and straw yields of T. *Aaman* rice were also significantly influenced by different treatments. The highest grain yield (5.68 t/ha) and straw yield (5.82 t/ha) were also observed in NPKS for high yield goal with residual cowdung treatment. The results also indicated that the residual cowdung had a positive effect on grain and straw yields of T. *Aman* rice. Cost and return analysis of different nutrient management packages for the whole cropping pattern showed that the highest marginal benefit cost ratio (8.64), gross return (Tk. 3,79,960/ha) and gross margin (Tk. 3,43,360/ha) were obtained from integrated plant nutrient management treatment and the lowest from soil test based fertilizers for moderate yield goal treatment. 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.

Mollah *et al.* (2008) reported that Soil fertility is a dynamic property, which varies with inherent status of soil, crops, cropping intensity, and input use. More than 50% of our cultivated soil contains organic matter below the critical level. Annual depletion of plant nutrients in the intensively cropped area ranges from 180- to more than 250 kg/ha.

Miah (1994) reported that High and medium highland comprising 60% of total cultivated land, which in most cases deficient in essential nutrients, such as nitrogen, phosphorus, potassium, and sulphur. The low organic matter content, higher cropping intensity, improper cropping sequence, and faulty management practices are the major causes of depletion of soil fertility. The productivity, particularly the yield per unit area of a wide range of crops in Bangladesh is in a state of stagnating condition due to (1) little or no addition of organic matter to the soil, (2) Intensive cropping throughout the year, (3) Nutrient depletion, (4) Imbalanced fertilization, and (5) poor management practices in crop production.

Bair (1990) reported that it is true that sustainable production of crops cannot be maintained by using only chemical fertilizers and similarly, it was not possible to obtain higher crop yield by using organic manure alone.

Nambiar *et al.* (1998) reported that Sustainable crop production could be possible through the integrated use of organic manure and chemical fertilizers. Fertilization is one of the most important practices for sustained increase of agricultural production. It was estimated that the contribution of fertilization to improvement of crop production accounted for 30-50% of the total increase of the world crop yield. Proper identification and management of soil fertility problems are pre-requisite for boosting crop production and sustaining higher yields over a long period of time. A suitable combination of organic and inorganic sources of nutrients is necessary for a sustainable agriculture that will provide food with good quality and maintain a sound environment. Integrated use of organic manures and chemical NPK fertilizers would be quite promising not only in providing greater stability in production, but also in maintaining higher soil fertility status. The long-term research of BRRI reveals that the addition of cowdung at the rate of 5 t/ha/yr improved the rice productivity as well as prevented the soil resources from degradation.

Singh *and* Hedge (1998) reported that the present system of fertilizer application is mostly based on the nutrient requirement of individual crops ignoring the carry-over effect of the organic or inorganic fertilizer applied to the preceding crop. But it is known that some fertilizers have considerable residual effect on the succeeding crops, which may extend up to two/three crops. Organic or inorganic sources of nutrients applied to preceding crop can benefit the succeeding crop to a great extent and the system productivity may become sustainable through integrated use of organic and inorganic sources of nutrients (Singh and Yadav, 1992). Hence, it is important to develop a cropping system based fertilizer dose for specific agro-ecological zones.

Bhuiya (2010) reported that a Aus rice (mean of three years) was increased significantly by the application of fertilizers. The application of chemical fertilizers, NPKS (HYG) remarkably increased the crop yields. The highest mean mungbean seed yield of 0.56 t ha–1 (mean of three years) and stover yield of 1.99 t ha–1 were obtained from the PKS plus inoculum plus residual N, P, K, S, Zn, B for HYG treatment, while the lowest mean grain yields of 1.48 t ha–1 for T. Aus and 0.42 t ha–1 for mungbean were recorded in the unfertilized control plots.

Ali *et al*. (1997). The need for proper soil organic matter management needs due attention in view of the low organic matter status of the soils. Inclusion of a legume crop in between cereals may contribute to maintaining or increasing soil organic matter.

Ahlawat *et al*. (1998) reported that Mungbean is the most common grain legume grown in the summer to utilize the gap between winter and rainy season crops. It may produce yields ranging from 0.5 to 1.0 t ha–1 and a contribution of an equivalent fertilizer N of 25-40 kg ha–1 to the following rice crop (Ahlawat *et al*., 1998). Further, incorporation of mungbean residues after picking pods has been found as effective as green manuring with other legumes, such as *Sesbania*, in increasing the productivity of a rice-wheat system.

Bhuiyan *et al.* (2008) found that the plant height of mungbean ranged from 30.13 to 44.95 cm. The highest plant height (44.95 cm) was found with 40 kg P plus 1.0 kg Mo/ha and *Rhizobium* inoculant, which was statistically higher than other treatments.

Muhammad *et al.* (2004) reported that the highest plant height (72.6 cm) was recorded in plot receiving 35 kg P_2O_5/ha + *Rhizobium* inoculum on mungbean.

Sardar (2002) found in a field experiment on *Vigna radiata* and reported that application of phosphorus at the rate of 40 kg ha^{-1} enhanched plant height.

Sukla and Dixit (1996) studied the response of mungbean to *Rhizobium* inoculants and different level of phosphorus. *Rhizobium* inoculation increased the plant height of mungbean. Their study showed that the plant height of mungbean increased with 40 kg P_2O_5/ha , increased from 28.30 to 32.0 cm and 26.91 to 30.80 over the control treatment.

Hussain (1994), and Thakur and Panwar (1995) who reported an increase in plant height of mungbean by seed inoculation and N, P, K application.

Patel and Patel (1991) observed that plant height of mungbean showed superiority at 60 kg P_2O_5/ha followed by 40 kg P_2O_5/ha application rate grown on the soil which was sandy in texture, low in total nitrogen (0.04%), higher in available phosphorus (77.33 P_2O_5/ha) and rich in available potassium (388.15 P_2O_5/ha) with the p^H 7.5. Thus plant height was found to be increased with increasing level of phosphorus from 0 to 60 kg P_2O_5/ha.

Bhuiyan *et al.* (2008) found that the highest root length of mungbean ranges from 6.52 to 11.90 cm when plant receiving P, Mo and *Rhizobium* inoculants. Solaiman (1999) observed that the highest root length was 25.3 cm when mungbean fertilized with 40kg P/ha.

Chowdhury *et al.* (2000) observed that application of phosphorus at the rate of 75 kg P_2O_5/ha to mungbean increased the dry matter accumulation of munbean.

Mitra et al. (1999) reported that the maximum dry matter accumulation of mungbean was found when it was fertilized with 50kg P_2O_5/ha.

Raundal *et al.* (1999) also reported that application of phosphorus 60 kg/ha to mungbean grown in kharif season significantly increase the dry matter yield.

Redddy *et al.* (1990) set up an experiment with three cultivars of mungbean, applying 0 or 50 kg P_2O_5/ha as basal dressing or 50 kg P_2O_5/ha in two equal split dressing at the sowing and flowering. They observed that application of phosphorus increased the dry matter accumulation in mungbean.

Yein (1982) carried out a two year field experiment in Assam, India on mungbean (*Vigna radiata*) and reported that application of phosphorus significantly increase the dry weight of plant.

Khan *et al.* (2002) suggested that the number of pods plant^{-1} increased with increasing phosphorus fertilizer up to a certain limit.

Ashraf *et al.* (2003) reported that in mungbean maximum number of pods (32.9) was recorded in plots where seed was treated with *Rhizobium phaseoli* and fertilized @ 50-50 kg NP ha^{-1}.

Sadeghipour *et al.* (2010) reported that the maximum number of pods plant^{-1} (21.34) of mungbean were obtained from plots receiving 150 kg P_2O_5 ha^{-1}.

Tank *et al.* (1992) found that mungbean fertilized with 20 kg N ha^{-1} along with up to level of 40 kg P ha^{-1} could be assigned to significantly higher number of pods plant^{-1} over the control treatment.

Sardana and Varma (1987) observed that the application of nitrogen, phosphorus and potassium resulted in significant increase in number of pods plant^{-1} of mungbean.

Bayan and Saharia (1996) reported that application of phosphorus affected the number of pods plant^{-1} of mungbean (*Vigna radiata* L.)

Gopala Rao *et al.* (1993) reported that number of pods plant^{-1} increased significantly with increasing phosphorus levels from 0 to 60 kg ha^{-1} where a uniform dose of 20 kg N ha^{-1} was applied as basal dose for all the treatments.

CHAPTER III

MATERIALS AND METHODS

The present research work was conducted at the research field of the Department of Crop Physiology and Ecology, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur during the period from mid April to mid July, 2012 to evaluate the effect of organic manures and inorganic fertilizers on the performance of two mungbean varieties. Materials were used and methodologies followed in the present investigation have been described in this chapter.

3.1 Experimental Location

The experimental site is situated under the Dinajpur Sadar Upazila and located at 25°39′ N latitude and 88°41′ E longitude with an elevation of 37.58 meter above the sea level. The experimental field was a medium high land belonging to the non-calcarious dark gray flood plain soil under the Agro-ecological Zone of Old Himalayan Piedmont Plain (AEZ-1).

3.2 Soil and Climate

The experimental site is situated in the sub-tropical region characterized by heavy rainfall during the months from May to September and scantly rainfall in the rest of the year.

3.3 Experimental design

The experiment was laid out in Randomized Complete Block Design (RCBD) with two factors factorial experiment. There were 8 treatments and each treatment was replicated 3 times.

Factor A: Two Mug bean varieties

a) BINA Mug-5

b) BARI Mug-6

Factor B: Four Fertilizer treatments

T_0 = Control (without any fertilizers)

T_1 = 10 ton cowdung ha^{-1} +Inorganic fertilizers (Recommendation dose of inorganic fertilizers by BARC, 2005).

T_2 = 5 ton poultry manure ha^{-1} +Inorganic fertilizers (Recommendation dose of inorganic fertilizers by BARC, 2005).

T_3 = Recommended doses of inorganic fertilizers (Recommendation dose of inorganic fertilizers by BARC, 2005).

3.4 Layout of the experiment

Initially, the experimental plot was first divided into three blocks each representing a replication. Each block then divided into six-unit plot of 3m x 2m sizes. The distance between block to block was 0.75m and plot to plot was 0.75m.

3.5 Land preparation

The experimental land was ploughed three times by a power tiller followed by laddering to have a good tilth. All the weeds and stubbles were removed from the field and the land was made ready. The soil was considered to be pulverized sufficiently to grow Mungbean. The whole experimental land was divided into the unit plot maintaining the desired spacing. The unit plot was spaded one day before sowing of mungbean seeds.

3.6 Fertilizer application

Recommended doses of cowdung was 10 ton ha^{-1} and poultry manure was 5 ton ha^{-1}. Recommended doses of chemical fertilizers such as Urea, TSP (Triple Super Phosphate), MP (Muriate of Potash), Gypssum, Zinc sulphate and Boric acid at the rate of 52.08, 200, 96, 133.44, 8.37 and 7.05 kg ha^{-1}, respectively were incorporated to the soil before final land preparation.

3 .7 Seed sowing

All the seeds were sown in the experimental plots on 16 April, 2012 following line sowing methods. Line to line distance were 25cm. After sowing, the seeds were covered with a thin layer of loose soil.

3.8 Intercultural operations

3. 8.1 Thinning and weeding

Thinning of seedling was done at 20 days after sowing of mungbean seeds for maintaining uniform plant stands. First weeding was done at the time of thinning, and the field was kept weed free thought the growing period.

3.8.2 Plant protection

The mungbean plants were infested by cutworm and hairy caterpillars. Hand picking of cutworm larvae and Malathion 57 EC were sprayed as control measures.

3.9 Crop sampling and data collection

The first crop sampling was done at 7 DAS and it was continued at an interval of 7 days, viz. 7, 14, 21, 28, 35, 42, 49, 56, 63, 70, 77 DAS. At each harvest three plants were selected randomly from each plot. The selected plants of each plot were uprooted careful by a "Khurpi" and washed in running tap water to remove the soil. The height of the plants was measured with a graduated scale placed on the ground level to top of the leaves. The plants were separated into leaves, stems and roots, number of leaves, flowers, and pods per plant were recorded separately at each harvest.

The components were oven dried at 70° C for 72 hours to record constant dry weights. Total dry matter was determined by recording the dry weight of each portion of the plant. The sampling was done at 7 days interval until maturity and the following characters were studied.

3.10 Growth parameter

1. Plant height (cm)
2. No. of Leafs plant^{-1}
3. Root length
4. Plant dry matter (g)

3.11 Yield contributing characters

1. No. of pods plant^{-1}
2. No. of seeds pod^{-1}
3. 1000- seed weight (g)
4. Grain yield ha^{-1} (kg)
5. Dry biomass plant^{-1} (g)

3.12 Data analysis

All the collected data were statistically analyzed following the ANOVA technique (Gomez and Gomez 1984). The mean differences among the treatments were compared by DMRT method.

CHAPTER IV

RESULTS AND DISCUSSION

The research work was conducted to find out the effects of organic manures and inorganic fertilizers on the performance of Mungbean. The results of the study have been presented in several Tables. Adequate discussion and possible interpretations whenever suitable have been provided in this chapter.

4.1 plant height of mungbean

The effect of organic manures along with inorganic fertilizers on plant height of mungbean throughout the growth period are given in Table 1. Plant height of mungbean was observed at different Days After Sowing (DAS). At 7 Days After Sowing (DAS), in the variety V_1 (BINA Mug- 5) the tallest plant (5.47 cm) height was observed in the treatment T_2 receiving 10 ton cow dung manure ha^{-1} + inorganic fertilizer which was statistically similar with T_0 (control) and T_1 (Recommended dose of fertilizer) and also with treatment T_3 (5 ton ha^{-1} poultry manure + inorganic fertilizer). Whereas, the shortest (4.93 cm) was recorded in T_0 which was the control treatment. In variety V_2 (BARI Mug- 6) the tallest plant height (6.17 cm) was observed in the treatment T_1 receiving recommended dose of fertilizer which was statistically similar with T_0 (control) and T_2 (10 ton cow dung manure ha^{-1} + inorganic fertilizer) and also with treatment T_3 (5 ton ha^{-1} poultry manure + inorganic fertilizer). And the shortest (4.97 cm) plant height was recorded in T_2 which was the 10 ton cowdung manure ha^{-1} + inorganic fertilizer treatment. However, at 7 DAS, 14 DAS, 21 DAS, 28 DAS, 35 DAS, 42 DAS, 49 DAS, 56 DAS, 63 DAS, 70 DAS and 77 DAS in the variety V_1 (BINA Mug- 5) the tallest plant (5.467 cm, 8.47 cm, 12.83 cm, 16.63 cm, 28.23 cm, 35.70 cm, 40.87cm, 46.87cm, 52.67cm, 56.10cm and 57.07 cm) was observed in the treatment T_0,T_1, T_2, T_3 respectively and the shortest plant (4.933 cm, 8.03 cm, 12.10 cm, 15.33 cm, 21.47 cm, 28.20 cm, 36.13 cm, 40.00 cm, 43.90 cm, 45.50 cm and 47.20 cm) was recorded in the treatment T_0, T_1, T_2, T_3 respectively.

In case of, variety (BARI Mug- 6) it was found that the maximum plant height at different days after sowing (6.167 cm, 8.24 cm, 12.67 cm, 16.53 cm, 25.53 cm, 33.23 cm, 39.90 cm, 46.70 cm, 51.47 cm, 54.53 cm and 56.27 cm) was recorded in the treatment T_0, T_1, T_2, T_3 respectively and the shortest plant height (4.967 cm, 7.97 cm, 11.20 cm, 14.60 cm, 23.60 cm, 29.53 cm, 37.27 cm, 43.63 cm, 48.87 cm, 51.00cm and 51.80 cm) was recorded in the treatment T_0, T_1, T_2, T_3 treatments respectively. The result showed recommended doses of fertilizers has a significant effect for the BINA mug-5 on plant height during the growing period, for the variety BARI Mug-6 10 ton cowdung manure ha^{-1} + inorganic fertilizer has a significant effect on plant height during the growing period. The similar result was found by Muhammad *et al*. (2004).

Table 1. Effect of fertilizer doses and mungbean varieties on the plant height at different days after sowing

Treatments		7DAS	14DAS	21DAS	28DAS	35DAS	42DAS	49DAS	56DAS	63DAS	70DAS	77DAS
V_1	T_0	4.933a	8.467 a	12.43a	15.73 a	22.50ab	29.53bc	36.13b	40.00 d	43.90c	45.50c	47.20a
	T_1	5.300a	8.067 a	12.30a	16.63 a	28.23 a	35.70 a	40.87a	46.87 b	52.67a	56.10a	56.33a
	T_2	5.467a	8.133 a	12.10a	15.33 a	21.47 b	28.20 c	36.17b	42.43 c	47.13b	49.47b	50.53a
	T_3	5.333a	8.033 a	12.83a	16.13 a	24.33ab	31.93 b	39.67a	46.57 a	50.93a	55.07a	57.07a
V_2	T_0	5.767a	8.240 a	11.87a	16.40 a	25.53ab	33.23 a	39.57a	43.63 a	49.20a	53.00a	55.53a
	T_1	6.167a	8.200 a	12.67a	16.53 a	25.20ab	32.80ab	39.57a	46.00ab	49.97a	53.33a	56.00a
	T_2	4.967a	8.167 a	11.20a	14.60 a	23.60ab	33.20 a	39.90a	46.70 a	51.47a	54.53a	56.27a
	T_3	5.300a	7.967 a	11.80a	14.80 a	23.73ab	29.53bc	37.27a	43.67 c	48.87a	51.00b	51.80a
CV(%)		16.17	6.48	11.61	1074	12.05	12.39	13.43	10.41	10.45	10.64	10.89

In a column, figures having the similar letter (s) or without letter (s) do not differ significantly by DMRT at $P \leq 5\%$ level.

4.2 Number of leaves plant^{-1} of mungbean

Number of leaves plant^{-1} found between the varieties is present in table 2. Variety (BINA Mug- 5) and (BARI Mug- 6) showed similar number of leaves plant^{-1} at 7 DAS (2.0), 14 DAS (5.0), 21 DAS (8.0), 28 DAS (11.0). At 63 DAS and at 70 DAS number of leaves plant^{-1} statistically non significant but variation in leaves plant^{-1} are present between the varieties. At 35 DAS highest number of leaves plant^{-1} was recorded in the variety V_2 (BARI Mug- 6) which was significantly different from other treatments and also the variety V_1 (BINA Mug- 5).

At 42 days after sowing (DAS), in the variety V_1 (BINA Mug- 5) the highest number of leaves plant^{-1} (18.0) was observed in the treatment T_1 (Recommended dose of inorganic fertilizers) which was statistically similar with $T_{0,}$ T_2 and $T_{3.}$ Whereas, the lowest (16.33) was recorded in T_0. On the other hand, in variety V_2 (BARI Mug- 6) the highest number of leaves plant^{-1} (19.67) was observed in the treatment T_2 receiving 10 ton cowdung manure ha^{-1} + inorganic fertilizers which was statistically similar with T_0 (control) and T_1 (Recommended dose of inorganic fertilizer) and also with treatment T_3 (5 ton ha^{-1} poultry manure + inorganic fertilizers). And the lowest (17.33) was recorded in T_3 which was the 5 ton ha^{-1} poultry manure + inorganic fertilizers. However, at 49 DAS, 56 DAS, 63 DAS, 70 DAS and 77 DAS in the variety V_1 (BINA Mug- 5) the highest number of leaves plant^{-1} (21.33, 24.0, 23.33, 22.0 and 20.33) was observed in the treatment $T_{0,}$ $T_{1,}$ T_2 and $T_{3,}$ respectively and the lowest number of leaves plant^{-1} (19.67, 21.33, 20.67, 19.33 and 18.0) was recorded in the treatment $T_{0,}$ $T_{1,}$ T_2 and $T_{3,}$ respectively. In case of, variety (BARI mug- 6) it was found that the maximum number of leaves plant^{-1} at different days after sowing (24.0, 25.33, 24.0, 23.33 and 22.33) was recorded in the treatment $T_{0,}$ $T_{1,}$ T_2 and $T_{3,}$ respectively and the lowest number of leaves plant^{-1} (20.67, 22.67, 21.33, 20.33 and 19.67) was recorded in the treatment T_1 and T_3 treatment, respectively.

Table 2. Effect of fertilizer doses and mungbean varieties on the number of leaves plant^{-1} at different days after sowing

Treatments		7DAS	14DAS	21 DAS	28 DAS	35DAS	42DAS	49 DAS	56DAS	63DAS	70 DAS	77DAS
V_1	T_0	2.0 a	5.0 a	8.0a	11.0 a	14.0 b	16.3b	19.7 b	21.3 c	20.7 a	19.3 a	18.0 b
	T_1	2.0 a	5.0 a	8.0 a	11.0 a	14.0 b	18.0ab	21.3ab	24.0ab	23.3 a	22.0 a	20.3 ab
	T_2	2.0 a	5.0 a	8.0a	11.0 a	14.0 b	17.3ab	20.3ab	21.7 c	21.3 a	20.3 a	19.7 ab
	T_3	2.0 a	5.0 a	8.0 a	11.0 a	14.0 b	17.0ab	21.0 ab	23.3 b	22.7 a	21.7 a	20.3 ab
V_2	T_0	2.0 a	5.0 a	8.0 a	11.0 a	14.0 b	18.7ab	21.7 ab	22.7 b	22.3 a	22.0 a	20.3 ab
	T_1	2.0 a	5.0 a	8.0 a	11.0 a	14.0 b	18.0ab	20.7 ab	22.7 b	22.0 a	21.3 a	20.7 ab
	T_2	2.0 a	5.0 a	8.0 a	11.0 a	15.0 a	19.7 a	24.0 a	25.3 a	24.0 a	23.3 a	22.3 a
	T_3	2.0 a	5.0 a	8.0 a	11.0 a	14.0 b	17.3ab	21.3 ab	22.7 a	21.3 a	20.3 a	19.7 ab
CV (%)		6.75	7.25	6.95	7.45	5.87	7.91	10.04	9.06	9.45	9.96	9.86

In a column, figures having the similar letter (s) or without letter (s) do not differ significantly by DMRT at $P \leq 5\%$ level.

Here, it is found that number of leaves/plant is significantly higher in variety V_2 (BARI Mug-6). This was happened due to their genetically variation. Variety (BARI Mug-6) with different organic manures with inorganic fertilizers performed better for number of leaves/plant over control and other treatment combinations, respectively.

4.3 Root length of mungbean

The effect of organic manures along with inorganic fertilizers on the root length of mungbean variation during the growth period presents in Table 3. Root length of mungbean was recorded at different Days after sowing (DAS). At 10 Days After Sowing (DAS), in the variety V_1 (BINA Mug- 5) the maximum root length (6.52 cm) was recorded in the treatment T_0 receiving no fertilizer which was statistically similar with T_1 (Recommended dose of inorganic fertilizers) and T_2 (10 ton cow dung manure ha^{-1} + inorganic fertilizer) and also with treatment T_3 (5 ton ha^{-1} poultry manure + inorganic fertilizer). Minimum root length (5.30 cm) was recorded in T_2 which was the 10 ton cowdung manure ha^{-1} + inorganic fertilizer treatment. In case of, variety V_2 (BARI Mug- 6) the maximum root length (6.87 cm) was recorded in the treatment T_3 receiving 10 ton cow dung manure/ ha + inorganic fertilizer which was statistically significant with T_0(control) and T_2 (10 ton cow dung manure ha^{-1} + inorganic fertilizers) and also with treatment T_1. While, the minimum root length (5.09 cm) was recorded in T_0 which was the control treatment. However, at 20 DAS, 30 DAS, 40 DAS, 50 DAS, 60 DAS and 70 DAS in the variety V_1 (BINA Mug- 5) the maximum root length (10.69 cm, 12.33 cm, 16.98 cm, 20.45 cm, 29.38 cm and 34.36 cm) was observed in the treatment T_0, T_1, T_2 and T_3 respectively and the minimum root length (9.05 cm, 11.70 cm, 14.51 cm, 18.57 cm, 23.96 cm and 29.68 cm) was recorded in the treatment T_0, T_1, T_2 and T_3, respectively. Again for the variety (BARI Mug- 6) it was found that the maximum root length at different days after sowing (12.22 cm, 12.20 cm, 18.25 cm, 20.63 cm, 31.53 cm and 34.87 cm) was recorded in the treatment T_0, T_1, T_2 and T_3, respectively and the minimum root length (10.56 cm, 10.60 cm, 15.68 cm, 19.45 cm, 25.80 cm and 42.10 cm) was recorded in the treatment T_0, T_1, T_2 and T_3 treatment, respectively.

In the effect of manure and inorganic fertilizers on the root length of the mungbean, variety V_2 (BARI Mug- 6) shows the better performance than the variety V_1 (BARI Mug- 5). The results obtained from the treatment T_3 and T_1 were statistically similar. Similar results were observed by Solaiman (1999).

Table 3. Effect of fertilizer doses and mungbean varieties on the root length at different days after sowing

Treatments		10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS	70 DAS
V_1	T_0	6.520 a	9.052a	12.13 a	14.51 b	18.57 b	23.96 b	29.68 a
	T_1	6.063 a	9.73 a	12.20 a	16.98 ab	20.00ab	28.89ab	32.24 a
	T_2	5.303 a	10.30 a	12.33 a	16.98 ab	20.12ab	27.59ab	31.96 a
	T_3	5.650 a	10.69 a	11.70 a	15.90 ab	20.45 a	29.38ab	34.36 a
V_2	T_0	5.093 a	8.967 a	11.40 a	15.68 ab	19.73ab	30.06ab	33.13 a
	T_1	5.763 a	12.22 a	12.20 a	18.16 a	19.52ab	28.87ab	32.10 a
	T_2	5.373 a	11.67 a	10.60 a	18.25 a	20.63 a	31.53 a	33.00 a
	T_3	6.873 a	10.56 a	10.97 a	17.03 ab	19.45ab	25.80ab	34.87 a
CV (%)		18.67	17.43	9.60	11.93	6.66	12.56	8.71

In a column, figures having the similar letter (s) or without letter (s) do not differ significantly by DMRT at $P \leq 5\%$ level.

4.4 Plant dry weight (g) of mungbean

The effect of organic manures along with inorganic fertilizers on plant dry weight of mungbean variation throughout the growth period is given in Table 4. Plant dry weight of mungbean was recorded at different Days after sowing (DAS). At 10 Days After Sowing (DAS), in the variety V_1 (BINA Mug- 5) the maximum plant dry weight (0.0267g) was recorded in the treatment T_3 receiving 5 ton ha^{-1} poultry manure + inorganic fertilizers which was statistically similar with T_0(control) and T_1 (Recommended dose of fertilizer) and also with treatment T_2 (10 ton cow dung manure ha^{-1} + inorganic fertilizers). And the minimum plant dry matter (0.0233g) was recorded in T_1 which was the recommended dose of fertilizer treatment. In variety V_2 (BARI Mug- 6) the maximum plant dry matter (0.0333g) was recorded in the treatment T_1 receiving recommended dose of fertilizers which was statistically similar with T_0 (control) and T_2 (10 ton cow dung manure ha^{-1} + inorganic fertilizers) and also with treatment T_3 (5 ton ha^{-1} poultry manure + inorganic fertilizers). While, the minimum plant dry weight (0.0267g) was recorded in T_2 which was the10 ton cowdung manure ha^{-1} + inorganic fertilizers treatment. However, at 20 DAS, 30 DAS, 40 DAS, 50 DAS, 60DAS and 70 DAS in the variety V_1 (BINA Mug- 5) the maximum plant dry weight (0.1200g, 4.820g,7.357g, 8.960g, 19.89g and 21.01g) was recorded in the treatment T_0, T_1, T_2 and T_3 respectively and the minimum plant dry weight (0.0633g, 3.553g, 3.220g, 7.380g, 11.91g and 13.01g) was recorded in the treatment T_0, T_1, T_2 and T_3 respectively. In case of, variety (BARI Mug- 6) it was found that the maximum plant dry weight at different days after sowing (0.1167g, 4.993g, 6.027g, 9.863g and 23.71g) was recorded in the treatment T_0, T_1, T_2 and T_3 respectively and the minimum plant dry matter (0.0733g, 3.154g, 4.180g, 7.840g, 14.69g and 15.77g) was recorded in the treatment T_0, T_1, T_2 and T_3 treatment respectively.

Table 4. Effect of fertilizer doses and mungbean varieties on the plant dry weight at different days after sowing

Treatments		10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS	70 DAS
V_1	T_0	0.02667a	0.1200a	4.707a	3.220a	7.380 b	11.91 b	13.01 b
	T_1	0.02333a	0.06333a	4.747a	7.357a	8.487ab	18.97 ab	20.39ab
	T_2	0.02333a	0.1067a	3.553a	6.240a	7.777 b	18.11 ab	19.05ab
	T_3	0.02667a	0.1133a	4.820a	5.923a	8.960ab	19.89 ab	21.01ab
V_2	T_0	0.03333a	0.1100a	4.820a	4.717a	9.227ab	20.72 ab	21.41ab
	T_1	0.03333a	0.1000a	4.490a	5.310a	9.863 a	22.78 a	23.71 a
	T_2	0.02667a	0.07333a	4.993a	6.027a	8.083ab	19.75 ab	20.34ab
	T_3	0.02667a	0.1167a	3.154a	4.180a	7.840ab	14.69 ab	15.77ab
CV (%)		12.29	11.29	14.71	14.22	13.95	12.35	11.50

In a column, figures having the similar letter (s) or without letter (s) do not differ significantly by DMRT at $P \leq 5\%$ level.

In the effect of manure and inorganic fertilizer on the root length of the mungbean, variety V_2 (BARI Mug- 6) shows the better performance than the variety V_1 (BINA Mug- 5).

4.5 Yield characteristics

4.5.1 Number of pods plant^{-1}

Number of pods plant^{-1} of mungbean varied significantly with variation in organic manures and inorganic fertilizers application. In variety V_1 (BINA Mug-5) the maximum number of pods plant^{-1} was recorded in treatment T_1 receiving recommended dose of fertilizer produced the maximum number of pods plant^{-1} (25.33). Minimum number of pods plant^{-1} (16.00) was recorded in T_0 which was statically identical with T_2 and T_3. This might be due to the application of various manures and chemical fertilizers. For the variety V_2 (BARI Mug- 6) the maximum number of pods plant^{-1} was recorded in treatment T_1 receiving recommended dose of fertilizer produced the maximum number of pods plant^{-1} (20.53). And minimum number of pods plant^{-1} (11.67) was recorded in T_0 which was statically different with T_2 and T_3. This might be due to the application of various manures and chemical fertilizers. In case of number of pods plant^{-1} of mungbean variety V_1 (BINA Mug- 5) shows the better performance than the variety V_2 (BARI Mug- 6). The results were supported by Sarker *et al.* (2005).

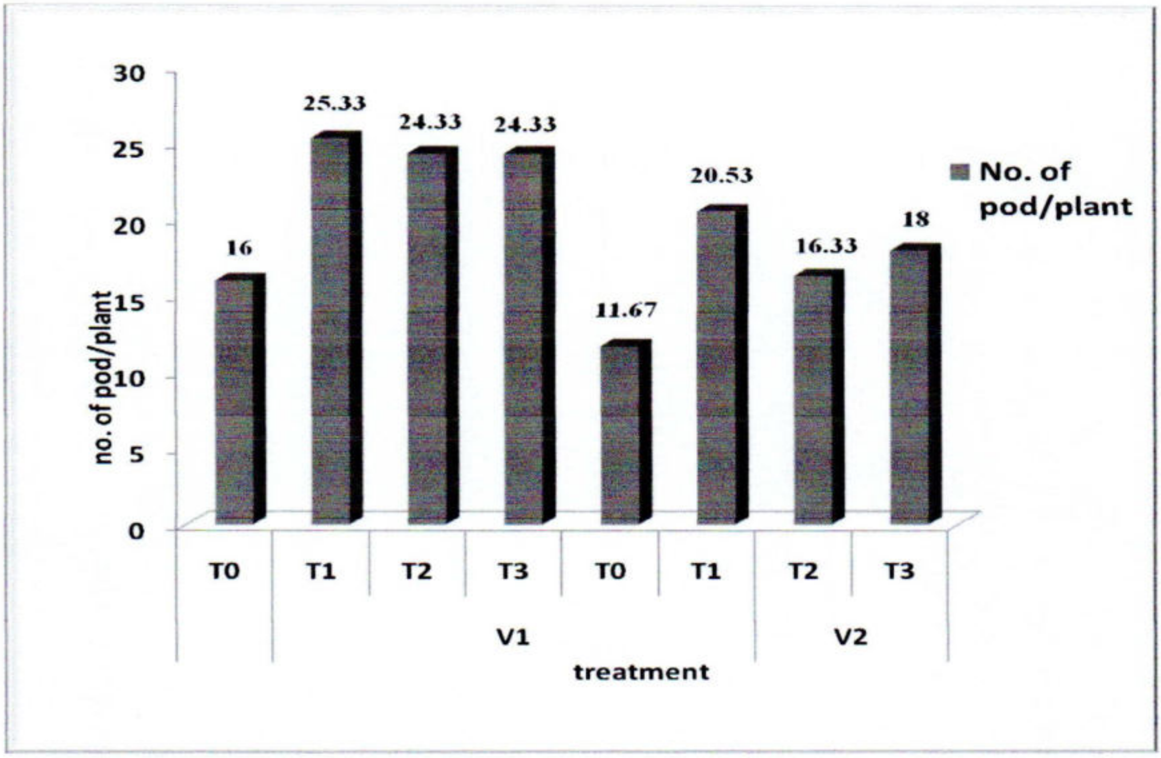

Fig 1: Showing no. of pod/ plant of two mungbean variety, BINA Mug-5 and BARI Mug-6

4.5.2 Number of seeds pod^{-1}

Number of seeds pod^{-1} of mungbean varied significantly with variation in organic manures and inorganic fertilizer application. In case of variety V_1 (BINA Mug- 5) the maximum number of seeds pod^{-1} was recorded in treatment T_1 receiving recommended dose of fertilizer produced the maximum number of seeds pod^{-1} (12.00). On the other hand, minimum number of seeds pod^{-1} (9.667) was recorded in T_0 which was statically identical with T_2 and $T_{3.}$ This might be due to the application of various manures and chemical fertilizers. While variety V_2 (BARI Mug- 6) the maximum number of seeds pod^{-1} was recorded in treatment T_1 receiving recommended dose of fertilizer produced the maximum number of seeds pod^{-1} (10.33). On the other hand, minimum number of seeds pod^{-1} (9.00) was recorded in T_0 which was statically identical with T_2 and $T_{3.}$ This might be due to the application of various manures and chemical fertilizers. The number of seeds pod^{-1} of mungbean variety V_1 (BINA Mug- 5) shows the better performance than the variety V_2 (BARI Mug- 6). Sardar (2002) found in a field experiment on mugbean that application of phosphorus at the rate of 40 kg ha^{-1} enhanced the number of seeds pod^{-1}.

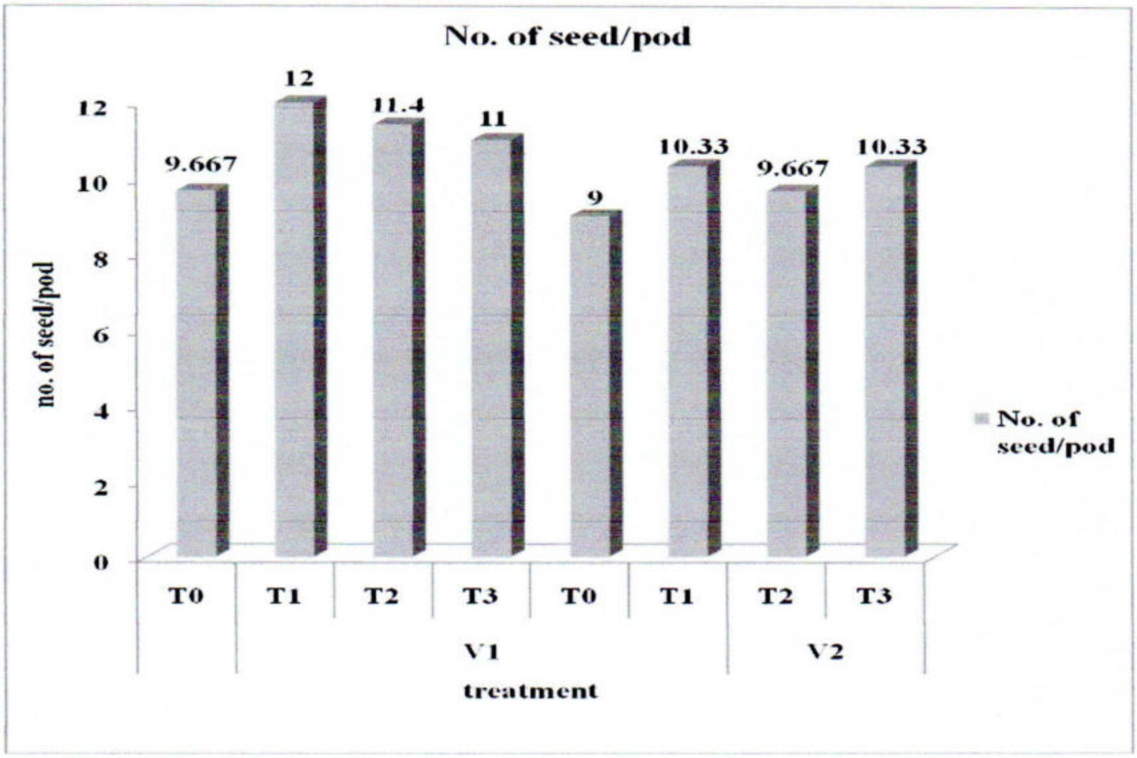

Fig 2: Showing no. of seed/ pod of two mungbean variety, BINA Mug-5 and BARI Mug-6

4.5.3 1000- seed weight (g) of mungbean

Thousand seed weight of mungbean varieties showed significant varied significantly with the variation in organic manures and inorganic fertilizer application. In variety V_1 (BINA Mug- 5) the maximum 1000 seed weight was recorded in treatment T_3 receiving 5 ton ha^{-1} poultry manure + inorganic fertilizers produced the maximum number of 1000 seed weight(53.17g). And minimum 1000 seed weight (52.33g) was recorded in T_0 which was statically identical with T_1 and T_2. This might be due to the application of various organic manures and inorganic fertilizers. In variety V_2 (BARI Mug- 6) the maximum 1000 seed weight (53.33 g) was recorded in treatment T_2 receiving 10 ton cowdung manure ha^{-1} + inorganic fertilizer. And minimum 1000 seed weight (52.38 g) was recorded in T_1 which was statically identical with T_0 and T_3. The results were supported by several researchers (Patel *et al.*, 1984; Abbas *et al.*, 2010).

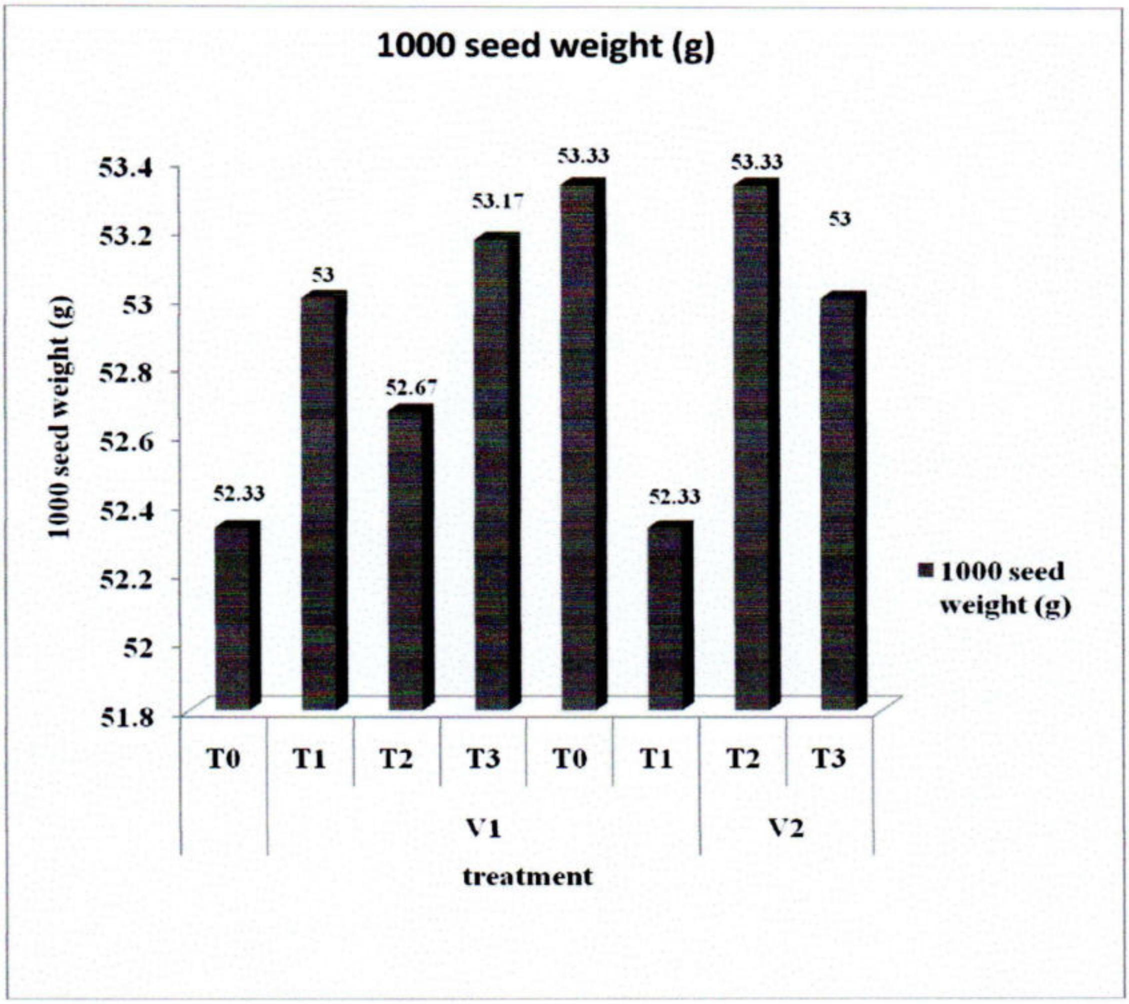

Fig 3: Showing 1000 seed weight (g) of two mungbean variety, BINA Mug-5 and BARI Mug-6

4.5.4 Dry biomass plot^{-1} (kg/ha)

Dry biomass plot^{-1} (kg/ha) of mungbean varied significantly with variation in organic manures and inorganic fertilizers application. In variety V_1 (BINA Mug-5) the maximum dry biomass plot^{-1} (kg/ha) was recorded in treatment T_1 receiving recommended dose of fertilizer produced the maximum dry biomass plot^{-1} (kg/ha) (0.27 kg/ha). And minimum dry biomass plot^{-1} (kg/ha) (0.17 kg/ha) was recorded in T_0 which was statically identical with T_2 and T_3. This might be due to the application of various organic manures and inorganic fertilizers. While variety V_2 (BARI Mug- 6) the maximum dry biomass plot^{-1} (kg/ha) was recorded in treatment T_0 receiving no fertilizer produced the maximum dry biomass plot^{-1} (kg/ha) (0.31 kg/ha). And minimum dry biomass plot^{-1} (kg/ha) (0.18 kg/ha) was recorded in T_2 which was statically identical with T_0, $T_1$and T_3 treatment. This might be due to the application of various organic manures and inorganic fertilizers. Finally it might be concluded that dry biomass plot^{-1} (kg/ha) of mungbean variety V_2 (BARI Mug- 6) shows the better performance than the variety V_1 (BINA Mug- 5).

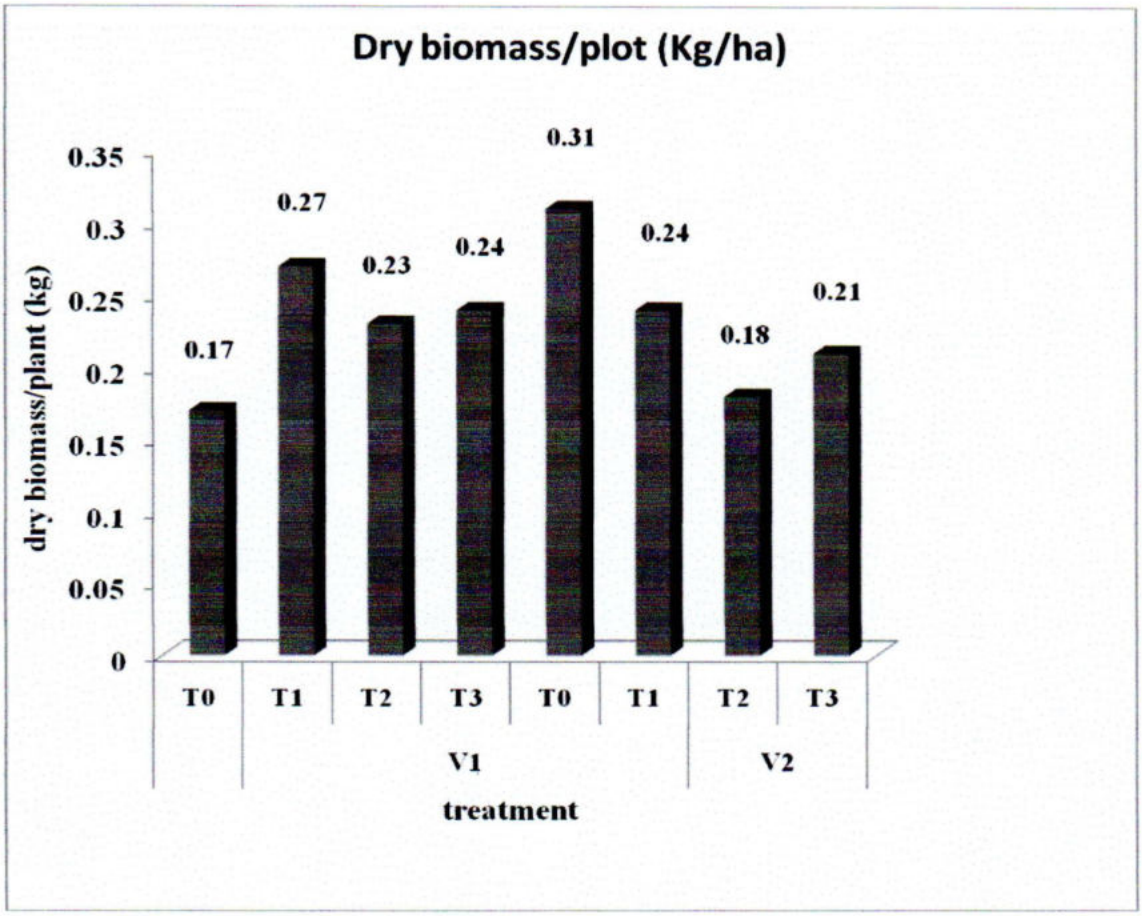

Fig 4: Showing dry biomass/ plot of two mungbean variety, BINA Mug-5 and BARI Mug-6

4.5.5 Grain yield ha^{-1} (kg)

Grain yield ha^{-1} (kg) of mungbean varied significantly with variation in organic manures and inorganic fertilizer application. In variety V_1 (BINA Mug- 5) the maximum grain yield ha^{-1} (kg) was recorded in treatment T_1 receiving recommended dose of fertilizers produced the maximum grain yield ha^{-1} (1365 kg). And minimum Grain yield/ ha (1255 kg) was recorded in T_0 which was statically identical with T_2 and T_3. This might be due to the application of various organic manures and inorganic fertilizers. While variety V_2 (BARI Mug- 6) the maximum grain yield ha^{-1} (kg) was recorded in treatment T_3 receiving 5 ton ha^{-1} poultry manure + inorganic fertilizers produced the maximum grain yield ha^{-1} (1310 kg). And minimum grain yield ha^{-1} (1210 kg) was recorded in T_0 which was statically identical with T_1 and T_2 treatment. This might be due to the application of various organic manures and inorganic fertilizers. Sarker *et al.* (2005) assessed the effect of plant spacing and phosphorus on seed yield of mungbean and observed that the highest seed yield was found in the 30 cm × 10cm with 40 kg P_2O_5 ha^{-1}. Ather Nadeem *et al.* (2004) stated that seed yield of mungbean was increased with phosphorus application. Yadav and Jakhar (2001) reported that in mungbean, the highest seed yield (14.00g) per plant was found with 40 kg ha^{-1}, which was significantly higher than others. In the present study we found that the grain yield of mungbean was increased to a certain level of phosphorus and then decreased with the increasing phosphorus rate in mungbean plant.

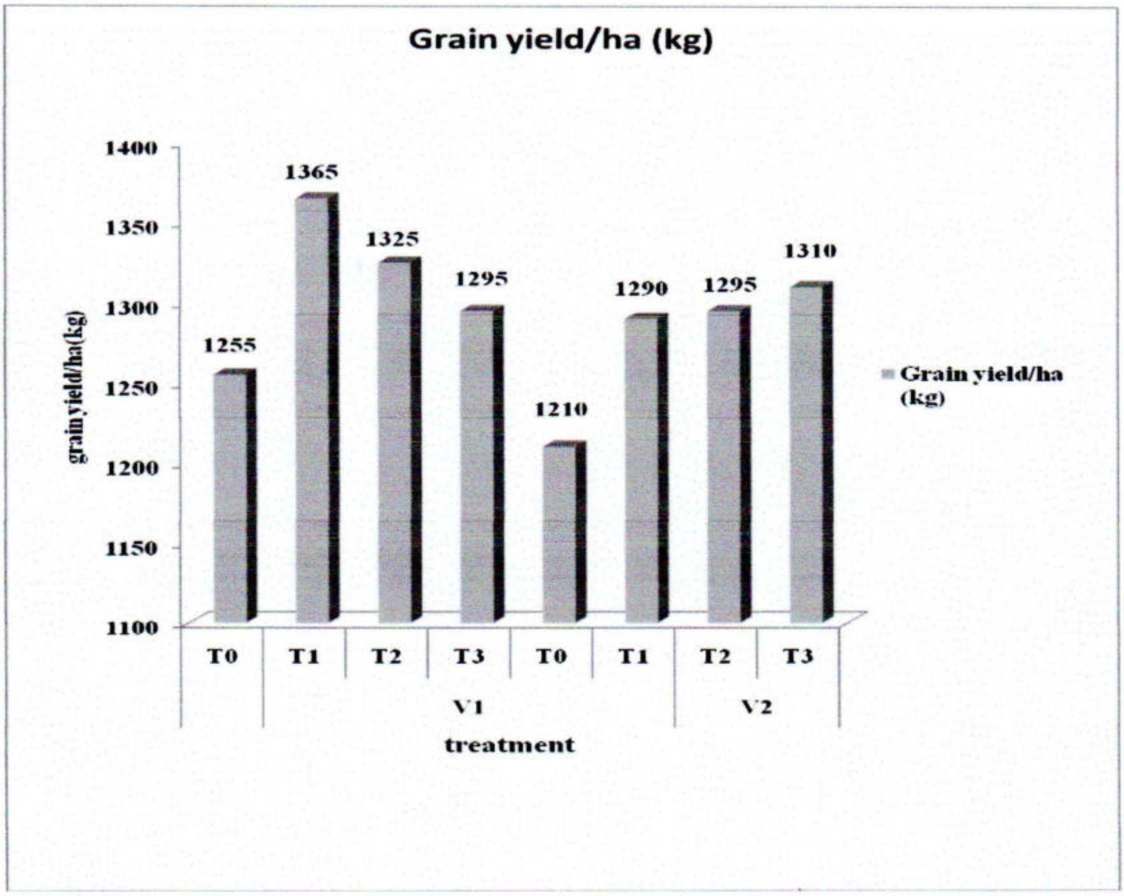

Fig 5: Showing grain yield/ ha (kg)of two mungbean variety, BINA Mug-5 and BARI Mug-6

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted at the Research Field of Department of Crop Physiology and Ecology, Hajee Mohammad Danesh Science and Technology University, Dinajpur, during the period of mid April to mid July, 2012 to evaluate the effect of organic manures and inorganic fertilizers on the performance of mungbean. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The experimental plot was first divided into three blocks each representing a replication. Each block then divided into six-unit plot of 3m x 2m sizes. The distance between block to block was 0.75m and plot to plot was 0.75m. The experiment comprised of two sets of factors such as Variety; V_1 = BINA Mug- 5 and V_2 = BARI Mug- 6; Four fertilizer treatments: T_0 = control, T_1 = Recommended doses of inorganic fertilizers, T_2 = 10 ton cowdung manure ha^{-1} + inorganic fertilizers and T_3 = 5 ton ha^{-1} poultry manure + inorganic fertilizers.

The effect of organic manures along with inorganic fertilizers on plant height of mungbean was significant throughout the growth period. Plant height of mungbean was observed at different days after sowing (DAS). At 7 days after sowing (DAS), in the variety V_1 (BINA Mug- 5) the tallest plant (5.47 cm) was observed in the treatment T_2 receiving 10 ton cow dung manure ha^{-1} + inorganic fertilizer. The shortest plant height (4.93 cm) was recorded in T_0 which was the control in treatment. In variety V_2 (BARI Mug- 6) the tallest plant (6.17 cm) was observed in the treatment T_1 receiving recommended doses of inorganic fertilizers and the shortest (4.97 cm) was recorded in T_2 which was the10 ton cowdung manure ha^{-1} + inorganic fertilizer treatments.

Number of leaves $plant^{-1}$ of mungbean was observed at different days after sowing (DAS). At 42 day's after sowing (DAS), in the variety V_1 (BINA Mug- 5) the highest number of leaves $plant^{-1}$ (18.0) was observed in the treatment

T_1receiving recommended dose of fertilizer and the lowest (16.33) was recorded in T_0 which was the control treatment. In case of variety V_2 (BARI Mug- 6) the highest number of leafs plant^{-1} (19.67) was observed in the treatment T_2 receiving 10 ton cowdung manure ha^{-1} + inorganic fertilizers. Again, the lowest (17.33) was recorded in T_3 which was the 5 ton ha^{-1} poultry manure + inorganic fertilizers. Root length of mungbean was recorded at different days after sowing (DAS). At 10 days after sowing (DAS), in the variety V_1 (BINA Mug- 5) the maximum root length (6.52 cm) was recorded in the treatment T_0 receiving no fertilizer. And the minimum root length (5.30 cm) was recorded in T_2 which was the 10 ton cow dung manure ha^{-1} + inorganic fertilizer treatments. And in variety V_2 (BARI Mug- 6) the maximum root length (6.87 cm) was recorded in the treatment T_3 receiving 10 ton cowdung manure ha^{-1} + inorganic fertilizers. While the minimum root length (5.09 cm) was recorded in T_0 which was the control treatment.

Plant dry weight of mungbean was recorded at different days after sowing (DAS). At 10 days after sowing (DAS), In variety V_1 (BINA mug- 5) the maximum plant dry weight (0.0267g) was recorded in the treatment T_3 receiving 5 ton ha^{-1} poultry manure + inorganic fertilizers. While minimum plant dry weight (0.0233g) was recorded in T_1 which was the recommended dose of fertilizer treatments. And in variety V_2 (BARI Mug- 6) the maximum plant dry weight (0.0333g) was recorded in the treatment T_1 receiving recommended doses of fertilizer. Whereas, the minimum plant dry weight (0.0267g) was recorded in T_2 which was the 10 ton cowdung manure ha^{-1} + inorganic fertilizer treatments.

In variety V_1 (BINA Mug- 5) the maximum number of pods plant^{-1} (25.33) was recorded in treatment T_1. Minimum number of pods plant^{-1} (16.00) was recorded in T_0 (Control) treatment. For the variety V_2 (BARI Mug- 6) the maximum number of pods plant^{-1} (20.53) was recorded in treatment T_1. And minimum number of pods plant^{-1} (11.67) was recorded in T_0 (Control) treatment. Finally it might be concluded that the number of pods plant^{-1} of mungbean variety V_1

(BINA Mug- 5) shows the better performance than the variety V_2 (BARI Mug-6).

In case of variety V_1 (BINA Mug- 5) the maximum number of seeds pod^{-1} (12.00) was recorded in treatment T_1. And the minimum number of seeds pod^{-1} (9.667) was recorded in T_0 (Control) treatment. For the variety V_2 (BARI Mug-6) the maximum number of seeds pod^{-1} was recorded in treatmentT_1 receiving recommended dose of fertilizer produced the maximum number of seeds pod^{-1} (10.33). And the minimum number of seeds pod^{-1} (9.00) was recorded in T_0 (Control) treatment.

Thousand seed weight of mungbean varied with the variation in organic manures and inorganic fertilizer application. In variety V_1 (BINA Mug- 5) the maximum 1000-seed weight (53.17g) was recorded in treatment T_3 treatment. And minimum 1000-seed weight (52.33g) was recorded in T_0. While variety V_2 (BARI Mug- 6) the maximum 1000-seed weight was (53.33g) recorded in treatment$T_{2.}$ And the minimum 1000-seed weight (52.33g) was recorded in T_1.

In variety V_1 (BINA Mug- 5) the maximum dry biomass plot^{-1} (0.27 kg/ha) was recorded in treatment T_1. And the minimum dry biomass plot^{-1} (0.17 kg/ha) was recorded in $T_{0.}$ While variety V_2 (BARI Mug- 6) the maximum dry biomass plot^{-1} (0.31 kg/ha) was recorded in treatmentT_0 and the minimum dry biomass plot^{-1} (0.18 kg/ha) was recorded in T_2. In variety V_1 (BINA Mug- 5) the maximum grain yield ha^{-1} (1365 kg) was recorded in treatment $T_{1.}$ And the minimum grain yield ha^{-1} (1255 kg) was recorded in T_0 (Control) treatment. While, variety V_2 (BARI Mug- 6) the maximum grain yield ha^{-1} (1310 kg) was recorded in treatment$T_{3.}$ And the minimum grain yield ha^{-1} (1210 kg) was recorded in T_0 (Control) treatment.

From the overall results it may be concluded that two different mugbean varieties behave differently when treated by different organic manures with inorganic fertilizers for the yield of mugbean. Among all the treatments the maximum yield of mungbean (1365 kg ha^{-1}) was recorded in T_1 and the minimum was in the T_0 treatment of BINA Mug- 5. In case of, BARI Mug- 6 the maximum yield of mungbean (1310 kg ha^{-1}) was recorded in T_3 and the minimum (1210 kg/ha) was in the T_0 treatment.

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APPENDICES

Appendix I : Chemical properties of the experimental soils

Soil properties	Analytical data
Phosphorus	5.91 µg/g soil
Sulphur	21.44 µg/g soil
Boron	3.39 µg/g soil
Zinc	3.00 µg/g soil
Sodium	0.12 me/100 g soil
Calcium	1.80 me/100 g soil
Magnesium	0.30 me/100 g soil
Potassium	0.15 me/100 g soil
Textural class	Sandy loam

Source: Soil Resource Development Institute (SRDI), Dinajpur

Appendix II : General description of the experimental area

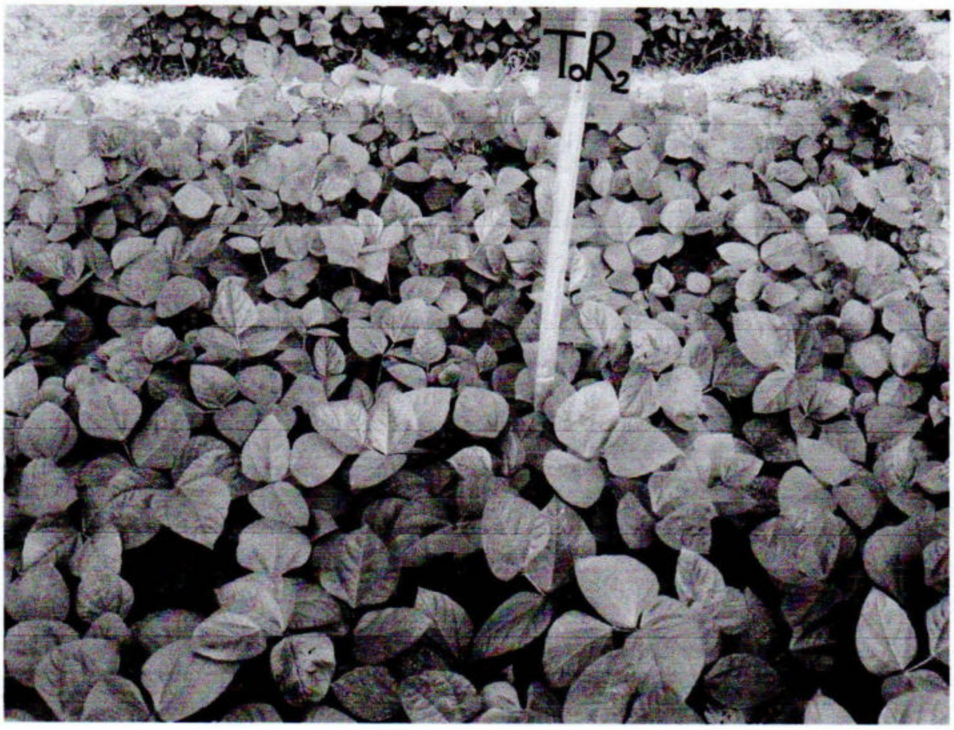
Characters	Description
Location	Crop physiology and ecology, HSTU, Dinajpur
AEZ	Old Himalayan Piedmont Plain (AEZ-1)
General Soil type	Non- Calcareous Brown Floodplain Soil
Parent materials	Piedmont alluvium
Soil series	Ranishankail
Drainage	Moderately well drained
Flood level	Above Flood Level
Topography	High Land

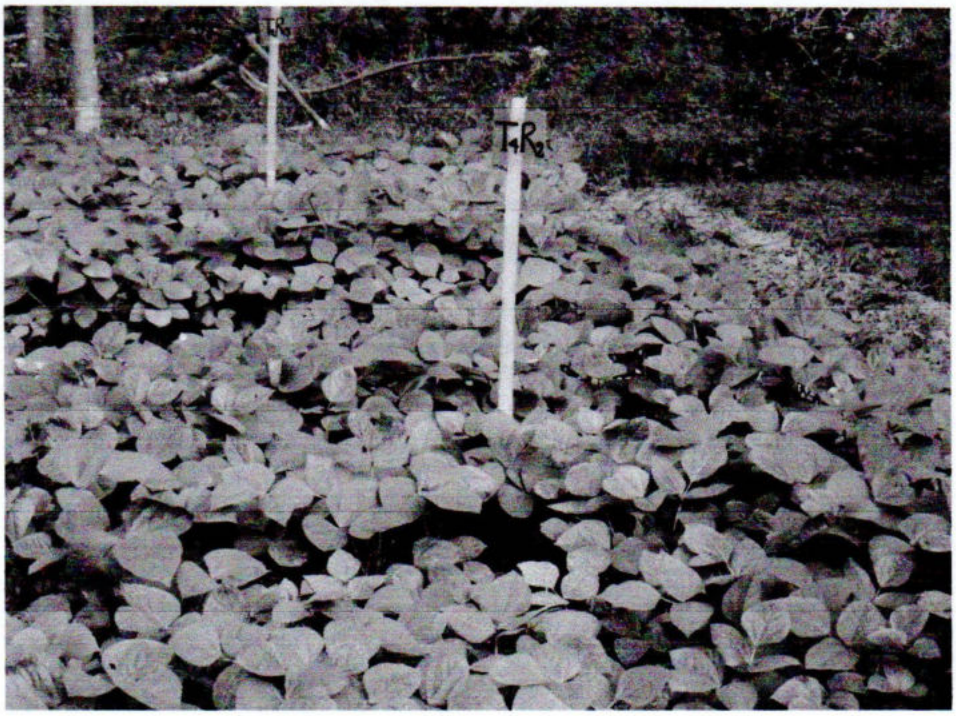
Appendix III : Physical and Chemical characteristics

Characteristics	Value	Interpretation
Physical characteristics		
Particle size (%)		
Sand (2-0.02mm)	60.0	
Silt(0.02-0.002mm)	27.0	Sandy loam
Clay (<0.002mm)	13.0	
Bulk density (g cm-3)	0.86-1.07	Medium
Chemical characteristics		
pH	5.40-5.50	Moderately acidic
Organic matter (%)	1.19	Low
Organic carbon (%)	0.69	Low
CEC (meq/100g soil)	5.60	Low
Total N (%)	0.07	Very Low
Available P (PPM)	16.75	Medium
Exchangeable K (meq/100g soil)	0.17	Medium Low

Source: Analysis of initial soil samples was done in SRDI, Dinajpur, Bangladesh

Appendix-IV: Showing the research field of mungbean (40 DAS).





Appendix-V: Showing the research field of mungbean (65 DAS).