EFFECT OF VERMICOMPOST AND INORGANIC FERTILIZERS ON THE GROWTH AND YIELD OF MUNGBEAN (BARI MUNG 6)

MD RIPON HOSEN

DEPARTMENT OF SOIL SCIENCE

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MD RIPON HOSEN

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Approved by:

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

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

Prof. A.T.M. Shamsuddoha
Chairman
Examination Committee

DEPARTMENT OF SOILSCIENCE

Sher-e-Bangla Agricultural University

Sher-e-Bangla Nagar, Dhaka-1207

CERTIFICATE

This is to certify that thesis entitled, “**EFFECT OF VERMICOMPOST AND INORGANIC FERTILIZERS ON THE GROWTH AND YIELD OF MUNGBEAN (BARI MUNG 6)”**submitted to the Department of soil science, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in SOIL SCIENCE**, embodies the result of a piece of bona fide research work carried out by **MD RIPON HOSEN, Registration no. 19-10224** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Prof. Mst. Afrose Jahan
Supervisor
Department of soil science
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

Dated:

Dhaka, Bangladesh

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

A field experiment was conducted at the experimental field of Sher-e-Bangla Agricultural University, Dhaka-1207 during the period of Kharif-1 season from March, 2020 to May, 2020 to study the effect of vermicompost and inorganic fertilizer on growth and yield of mungbean (BARI mung 6) using RCBD (Randomized Completely Block Design) with three replications. Theexperimental soil was silty clay loam in texture having pH 6.3. There were 8 treatments where, T_0 = control condition, T_1 = 100% recommended chemical fertilizer + 0 t ha^{-1}vermicompost, T_2 = 80% recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_3 = 80% recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_4 = 80% recommended chemical fertilizer + 6 t ha^{-1}vermicompost, T_5 = 60% recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_6 = 60% recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_7 = 60% recommended chemical fertilizer + 6 t ha^{-1}vermicompost. Different plant growth and yield parameters were significantly influenced by different vermicompost and inorganic levels of fertilizer. The maximum plant height at 30 DAS, 40 DAS and harvest time (29.84 cm, 41.14 cm, 55.19 cm respectively) , number of leaves $plant^{-1}$at 30 DAS, 40 DAS and harvest time (6.76, 6.90, 8.14 respectively) , number of branches $plant^{-1}$(4.46) , number of pods $plant^{-1}$ (16.90) , number of seeds pod^{-1} (10.40), pod length (8.03 cm), 1000 grain weight (44.70 g) and grain yield (1.41 t ha^{-1}) were recorded by T_4 and the lowest plant height at 30 DAS, 40 DAS and harvest time (22.79cm, 32.49 cm, 46.92 cm respectively), number of leaves $plant^{-1}$ at 30 DAS, 40 DAS and harvest time (3.13, 3.03, 4.36 respectively) , of branches number $plant^{-1}$ (2.03), number of $podsplant^{-1}$ (9.23), number of seeds pod^{-1} (6.63), pod length (6.86), 1000 grain weight (37.65 g) and grain yield (0.97 t ha^{-1}) were recorded by T_0 where control condition was used. The maximum grain yield (1.41 t ha^{-1}) was obtained in T_4 (80% Recommendation chemical fertilizer + 6 t ha^{-1}vermicompost). The minimum grain yield (0.37 t ha^{-1}) was observed in the T_0 treatment where control condition was applied.

CHAPTER 1

INTRODUCTION

Mungbean (*Vigna radiate* L.) is an important pulse crop in Bangladesh that is grown mostly in rotation with cereal crops such as rice, wheat etc. For cultivating this crop, the agro-ecological conditions in Bangladesh are more favorable. Mungbean retains first in market values, the 3rd in protein content and 5th in both acreage and production (BBS, 2008). It maintains 2nd ranking to drought resistance after soybean (Ali *et al.*,2001). Mungbean is primarily grown for human consumption because of its edible seeds, which are distinguished by their high protein content, good digestion, taste, and lack of any flatulence-inducing qualities (Ahmed *et al.*, 2001). Whether they are aware of it or not, Bangladeshi consume pulse as an additional source of animal protein. Mungbean seed contains 24.7% protein, 0.6% fat, 0.9% fiber and 3.7% ash (Potter and Hotchkis, 1997) as well as sufficient amounts of calcium, phosphorus and influential vitamins.It comprises exalted quality of lysine (4600 mg/g N) and tryptophan (60 mg/g N). Mungbean can be interplanted with jute, sugarcane, or cereal crops to act as a cover crop, feed, or manure. On an average, it fixes aerial N @ 300 kg ha^{-1} annually (Sharar*et al.*, 2001). On the nutritional point of view, this legume is one of the best among pulses (Khan, 1981 and Kaul, 1982). According to FAO (2013) recommendation, per capita intake of pulse should be 80 $gday^{-1}$where as it is 10.92 g day^{-1} in Bangladesh.In Bangladesh almost 291 thousands Mt pulses was imported, in 2006-2007 fiscal year by virtue of deficit of production (BBS, 2010).

With a total grain production of 134.4 thousand tons and an estimated yield of 482.63 kg ha^{-1}mungbean is grown over a surface area of 261.4 thousand hectares (Anonymous, 2003). Chemical or organic fertilizers have a strong reaction on mungbean.Due to its leguminous nature, mungbean requires less nitrogen but still needs the suggested maximum amounts of other important plant nutrients. The total nutritional content of our food may be increased in a developing country like Bangladesh by including pulses.Unfortunately, the production of grain legumes is severely lacking in the nation. In Bangladesh, just 10 grams of pulses are consumed daily per person, compared to 45 grams in India (FAO, 1984).

To decrease imports and fulfill the need for pulse consumption, there is an urgent need to increase pulse production. Because the entire plant or its byproducts may be utilized as high-quality animal feed, it can help reduce the shortage of fodder. Pulses can be grown to boost soil fertility by biologically fixing nitrogen, as well as the physical, chemical, and biological aspects of the soil.

The majority of the teeming millions of people in Bangladesh get their plant protein from grain legumes, and the most well-liked grain legume that is frequently grown as a pulse crop in this nation is mungbean. Carbohydrates are present at 46.8%, Protein 21.2%, Barimung-6 seed has a little amount of vitamins and minerals as well (BARI, 2003). Only one-fourth of the nation's required supply of pulses is now produced. When compared to other pulses, the production of mungbean is great species of earthworm is vermicompost. A natural fertilizer and soil conditioner that is rich in nutrients is vermicompost..Mungbean is a significant crop that can be produced on flood-free soils almost all year long.The final result of the decomposition of organic materials by some

Vermicomposting is the practice of creating this organic material. Vermiculture is a recent advancement in biotechnology-based products that aids in the resolution of the environmental issues brought on by the usage of inorganic fertilizers. Average mungbean yields in Bangladesh are extremely low, mostly as a result of poor farming practices, poor crop stand, unbalanced nutrition, inadequate plant protection measures, and a lack of good producing cultivars. In addition to other variables, the low yield of mungbean may also be a result of a lack of information about contemporary production techniques and nutrition. Furthermore, the decline in mungbean yields makes it difficult to pay attention to the fertilizer used. By using fertilizers in a balanced manner and controlling the organic manures effectively, mungbean yields and quality may be increased. The mungbean responds very well to fertilizers and manures. Leguminous by nature, mungbean has modest nitrogen requirements but requires the optimum amounts of other essential minerals. The microbial population in the soil may be impacted by soil organic matter, which might also improve crop development and production. The capacity of organic materials to improve soil properties and serve as a source of several nutrients holds considerable promise. In addition to boosting crop output and increasing the amount of readily available major and minor nutrients, this may also increase the effectiveness of chemical fertilizers and their minimal usage in crop production.

The ecology is protected through organic farming. Symbiotic life forms are cultivated to control weeds and pests and to promote the biological activity of the soil that maintains fertility. For the management of weeds, insects, and pests, organic farming does not call for the use of synthetic fertilizers or dangerous chemicals (pesticides & fungicides). Because inorganic fertilizers primarily contain major nutrients (NPK) in large quantities while neglecting the use of organic manures and biofertilizers, synthetic fertilizers are bad for soil and aerial environments. This has led to the deterioration of soil health, which has negative effects on plants, people, and livestock (Choudhry, 2005).

Most of the nitrogen-based fertilizers that are put to the soil seep below the root zone or into the groundwater, polluting it and mostly causing illnesses. Farmyard manure (FYM), compost, crop rotation, residues, green manuring, vermicompost, bio-fertilizers, and bio-pesticides are all used extensively in organic farming.An essential component that sparked revolutions in numerous nations throughout the world are improved cultivars.A cultivar with a larger potential yield is crucial, much like other elements like high-quality seed, correct fertilizer application, and irrigation.The goal of the current study is to determine how two mungbean cultivars in Faisalabad fare in terms of growth and yield after receiving seed inoculation, organic manures, and inorganic fertilizers. The widespread use of chemical fertilizers significantly contributes to environmental degradation by depleting fossil fuels, generating carbon dioxide (CO_2), and contaminating water supplies. Environmental degradation is a big danger facing the entire planet.Due to an unbalanced application of fertilizers, it results in soil deterioration and a loss of soil fertility, which negatively affects agricultural output. The adoption of ecological and sustainable agricultural methods is now being seen as the only way to stop the downward trend in global production and environmental preservation (Aveyard 1988, Wani and Lee 1992, Wani*et al*. 1995). In order to produce crops with sustainable crop output, organic fertilizer use has recently gained attention (Tejada *et al.,* 2009). In terms of providing a variety of nutrients and enhancing soil properties, organic materials are very promising (Moller, 2009).

Considering the above facts, the present experiment has been undertaken to study the following objectives:

1. To study the effect of vermicompost and inorganic fertilizer on the growth and yield of mungbean.
2. To observe the combined effect of vermicompost and inorganic fertilizer on growth andyield of mungbean.

CHAPTER 2

REVIEW OF LITERATURE

Some of the published reports relevant to research topic are reviewed under the following heading:

2.1 Effect of inorganic fertilizers on mungbean

2.1.1 Effect of Nitrogen on mungbean

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}.

Achakzai *et al.* (2012) conducted an experiment at the experiment field to evaluate the effect of nitrogen and irrigation managements on dry matter accumulation and yield of mungbean (*Vigna radiate* L.) cv. BARI mung-5 during the period from March to May 2006. The trial comprised of ten treatments such as T_1 = No fertilizer and irrigation (control), T_2 = 20 kg N ha^{-1} as basal, T_3 = 20 kg N ha^{-1} as basal + one irrigation at flower initiation stage, T_4 = 30 kg N ha^{-1}as basal, T_5 =30 kg N ha^{-1} as basal + one irrigation at flower initiation stage, T_6 = 40 kg N ha^{-1} as basal, T_7 = 40 kg N ha^{-1}as basal + one irrigation at flower initiation stage, T_8 = 10 kg N ha^{-1}as basal and 10 kg N ha^{-1}as split + one irrigation at first flowering stage, T_9 = 15 kg N ha^{-1}as basal and 15 kg N ha^{-1}as split +one irrigation at flower initiation stage and T_{10} = 20 kg N ha^{-1} as basal and 20 kg as sp N ha^{-1}lit + one irrigation at flower initiation stage. Irrespective of treatment differences the mungbean plant as a pulse crop showed a lag phase for slow dry matter production in early growth stage (up to 40 DAS) that increase up to harvest. Application of 30 kg N ha^{-1}as basal with one irrigation at flower initiation stage (35 DAS) significantly improved dry matter accumulation. This greater dry matter production eventually partitioned to pods per plant, seeds per plant and 1000-seed weight which is get her resulted with maximum seed yield per plant (5.53 g) or per hectare (1.65 t). A functional positive relationship was observed in with pods per plant and seeds per plant.

Jahan *et al.* (2020) conducted an experiment during Kharif season 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 intreatment $N_{20}P_{40}K_{40}$ + 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.

Bhuiyan *et al.* (2008) conducted the study to determine the effect of varying levels of nitrogen (0, 25 and 50 kg ha^{-1}) and phosphorus (0, 50, 75 and 100 kg/ha) on the yield and quality of mungbean(*Vigna radiate* L.) cultivar NM-98 during the year 2001. Although plant population was not affected significantly but various growth and yield components were significantly affected by varying levels of nitrogen and phosphorus. A fertilizer combination of 25-75 kg NP ha^{-1} resulted in maximum seed yield (1112.96 kg ha^{-1}). Maximum protein content (25.6%) were obtained from plots fertilized @ 50-75 kg NP ha^{-1} followed by protein content of 25.1% obtained from plots fertilized @ 25-75 kg NP ha^{-1}. Highest net income (Rs. 21374.9) was also obtained by applying N and P @ 25 and 75 kg NP ha^{-1} respectively.

Ali *et al.* (2010) observed an experimentat the research field of the Horticulture Research Center at Labukhali, Patuakhali 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 (V_1) and BARI mung–6 (V_2) and five levels of N fertilizer including control viz. 0 kg N ha^{-1} (N_0), 30 kg N ha^{-1} (N_{30}), 45 kg N ha^{-1} (N_{45}), 60 kg N ha^{-1} (N_{60}), and 75 kg N ha^{-1} (N_{75}) 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}, higherweight 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^{-1} for seed yield was found under the regional condition of Patuakhali (AEZ-13).

Biswash *et al.* (2014) conducted the study to evaluate the growth respose of mungbean [*Vigna radiate* (L.) Wilczek] cultivars subjected to different levels of applied N fertilizer. To achieve the aim, an experiment conducted in the experimental field of Agricultural Research Institute (ARI), Quetta. The soil of the study area was basic in reaction, salt free, medium textured having low organic matter & total N contents. Four different cultivars of mungbean viz., NM-92, NM-98, M-1, and NCM-209 grown in kharif season for two consecutive years i.e., 2007 and 2008. Six different levels of N fertilizer applied @ zero, 20, 40, 60, 80 and 100 kg ha^{-1}. While, a constant dose of P_2O_5 and K_2O also applied to each N level (except control, zero). Urea fertilizer used as a source of N, while TSP and SOP as sources of P & K, respectively. The plot size kept as 2.40m^2 (4x4x0.15), and arranged in a randomized complete block design (RCBD). Results showed that different fertilizer levels did significantly ($p<0.05$) influenced most of the growth attributes of the mungbean. Maximum days to flowering (48.25) and number of branches plant-1 (3.83) recorded for plants subjected to highest dose of applied N fertilizer viz., 100 kg ha^{-1}.
Similar responses toward added N fertilizer also noted for various cultivars of mungbean. Maximum days to flowering (47.72) and number of leaves plant^{-1} (5.86) recorded for NCM-209. Whereas, the maximum plant height (38.52 cm) number of branches plant^{-1} (3.72) obtained for mungbean cultivar M^{-1}. The correlation coefficient (r) studies exibited that plant height (0.593), number of leaves plant^{-1} (r=0.325), number of branches plant^{-1} (r=0.187) and leaf area (r=0.342) significantly ($p<0.05$) and positively correlated with their grain yield (kg ha^{-1}). However, days to 50% flowering (r = 0.265) are also significantly but negatively associated with their grain yield (kg ha^{-1}). Thus based on correlation studies it could revealedthat cultivars under cultivation displayed a wide range of variation for most of the mentioned growth traits and could be exploited in breeding programme to enrich the mungbean genetic treasure.

2.1.2 Effect of Phosphorus on mungbean

Hossen *et al.* (2015) conducted an experiment in Jobner, Rajasthan, India during the rainy season to investigate the effect of P fertilizers (at 0, 15, 30, 45 and 60 kg $P_2O_5ha^{-1}$) and biofertilizers (Rhizobium sp.; phosphate solubilizing bacteria, PSB; and combination of of Rhizobium + PSB) on the growth and yield of mung bean cv. RMG 62. All biofertilizer treatments increased growth and yield characters, except pod length and test weight. The highest values for all the parameters studied were obtained with Rhizobium + PSB: dry matter accumulation/m row at 50 days after sowing and at harvest; branches plant^{-1} at harvest; number of nodules plant^{-1}; pods plant^{-1}; and seed yield ha^{-1}. The dry matter accumulation, pods plant^{-1}, number of seeds plant^{-1}, test weight and seed yield were highest with P at 45 kg $P_2O_5ha^{-1}$ than the other P rates.

Malik *et al.* (2003) conducted a field experiment to study the effect of phosphorus and rhizobium inoculum on the yield and yield components of Mungbean cv. NM-92 under the rainfed conditions at Arid Zone Research Institute. D.I. Khan. Phosphorus at the rate of 0, 20, 35, 50, 65, and 80 kg P_2O_5 ha^{-1} along with basal dose of 20 kg N ha^{-1} was applied with and without inoculum according to split-plot arrangement in Randomized Complete Block (RCB) Design with three replications. The results showed that plant height and number of branches plat^{-1} were significantly affected with both inoculum and P application. The highest plant height (72.6 cm) was recorded in the plot receiving 35 kg P_2O_5 with rhizobium inoculum while the highest number of branches per plant (4.2) was recorded at 65 kg P_2O_5 + inoculum. The impact of inoculum and P was also significant on the number of pods per plant. The maximum number of pods (17.0) were recorded at 80 kg P_2O_5 + inoculum. However, it was found that the number of grains pod^{-1} increased only with increase of P levels. The maximum grains pod^{-1} (10.9) were recorded at 80 kg P_2O_5 followed by 10.83 at 65 kg P_2O_5. Both inoculum and P equally contributed in the increase of 1000-grainweight. The highest 1000-grain weight (52.3 g) was recorded in treatments receiving 65 and 80 kg P_2O_5 + inoculum. Similarly both phosphorus and inoculum significantly affected the grain yield. The highest grain yield (1018 kg ha^{-1}) was obtained in treatment receiving 65 kg P_2O_5 + in.

Meena *et al.* (2015) conducted the study to find out the optimum phosphorus levels required for obtaining high yield of mungbean under conditions prevailing in D.I.Khan. The effect of various phosphorus levels on two mungbean cultivars NM-92 and NM-54 revealed that all the yield and yield contributing factors were significantly affected by the application P_2O_5. However, no statistical difference between the cultivars was detected. Similarly, the interaction of phosphorus levels with the cultivars was also non-significant. The application of P_2O_5 from 60-90 kg ha^{-1} is recommended for realizing better yield of mungbean.

Al-shaheen *et al.* (2016) conducted a field experiment 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_1 (control), T_2 (42.5 kg P ha−1), T_3 (85 kg P ha^{-1}), T_4 (127.5 kg P ha^{-1}), and T_5 (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 owing to the interactive effect of phosphorus dose and mungbean variety.

Dhakal *et al.* (2016) carried out an experiment 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.

Khan *et al.* (1999) conducted a field experiments under Adaptive Research Station, to evaluate the influence of three levels of phosphatic fertilizer on mung at Mianwali. The experiment comprised of four treatments viz, control, Phosphatic fertilizer @ 30 Kg ha^{-1} with started dose of nitrogen, Phosphatic fertilizer @ 57 Kg ha^{-1}and Phosphatic fertilizer @ 84 Kg ha^{-1}. Experiments were laid in randomized complete block design with three replications. The results revealed that all the levels of phosphatic fertilizer showed significant impact on mung compared to that of control plots, However, treatment of Phosphatic fertilizer @ 84 Kg ha^{-1} out yielded rest of the treatments giving the maximum yield components and grain yield during both years.

Asaduzzaman *et al.* (2008) conducted a pot experiment was during Kharif, at the Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. There were four levels of phosphorus (P) (0, 20, 40, 60 kg ha^{-1}) and 2 levels of molybdenum (Mo) (1.0 and 1.5 kg ha^{-1}) having a common Rhizobium inoculant, one control with no Rhizobium or fertilization and a Rhizobium inoculation only were applied. The performance of Rhizobium inoculant alone was superior to control in almost all parameters of the crop studied. Rhizobium inoculation along with P and Mo significantly increased the growth of plants, number of nodules, dry matter production as well as grain yield of mungbean significantly compared to uninoculated control. Nodulation (nodule number plant^{-1}) was the highest with 20 kg P ha^{-1} and 1.0 kg Mo ha^{-1}. However, P and Mo application at the rate of 40 kg P ha^{-1} and 1.0 kg Mo ha^{-1} progressively and significantly increased dry matter content of shoot and root of mungbean. Seed yield plant^{-1} was positively correlated with the number of nodules plant^{-1}. From this point of view, nodule number plant^{-1} with 20 kg P ha^{-1}and 1.0 kg Mo ha^{-1}, and yield and attributes of mungbean combined application of Rhizobium inoculant with 40 kg P ha^{-1} and 1.0 kg Mo ha^{-1} was considered to be the balanced and suitable combination of fertilizer nutrients for achieving the maximum output through cultivation of mungbean.

Kumawat *et al.* (2009) conducted a pot experiment in wire house, during spring season in the institute of soil and environmental sciences at University of Agriculture, Faisalabad to study the influence of phosphorus fertilization and rhizobium inoculation on growth and yield parameters of mungbean (*Vigna radiata*). A composite soil sample was collected for analysis of soil for physical and chemical properties. Phosphorus application along with rhizobium inoculation increased the dry weight of nodules, roots, shoots and grains significantly. Maximum dry weights were observed where recommended and 150% of the recommended dose of phosphorus along with rhizobium inoculation was applied. So it is concluded that mungbean crop should preferably be grown with @150% of the recommended dose of phosphorus along with rhizobium inoculation under agro-ecological conditions of Faisalabad for obtaining higher yield.

2.1.3 Effect of Potassium on mungbean

Navsare *et al.* (2018) observed the study indicated that there was significant effect of potassium levels on growth, yield and yield components of both varieties. Compared to Mung-06, the variety NM-92 performed well by displaying maximum seed germination, taller plants with more branches, pods, seeds and biological yield. In addition to the recommended rates of nitrogen and phosphorus, the K applied @ 125 kgha^{-1} significantly increased seed germination, plant height, number of branches per plant, number of pods, seed index and biological yield (kg ha^{-1}) as well. The difference between 125 and 100 kg K ha^{-1} rates for mjority of the growth and yield parameters under study remained non-significant. However, the plants given 75, 50 and 00 kg K ha^{-1} ranked 3rd, 4th and 5th, respectively for all the recorded yield parameters. It is, therefore, concluded that 100 kg K ha^{-1} can be the effective rate for achieving economically higher mungbean yield.

Aslam *et al.* (2010) conducted an 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 Kha^{-1}, T_4= 50 kg Kha^{-1}, T_5= 60 kg K ha^{-1} and T_6= 70 kg Kha^{-1} along with the blanket dose of $N_{15}P_{20}S_{10}Zn_2B_{1.5}$kgha^{-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_5treatment.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 Kha^{-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.

Jat *et al.* (2014) conducted an experiment to study the effect of potassium fertilizer and vermicompost on growth, yield and nutrient contents of mungbean (BARI Mung 5). The two-factorial experiment was conducted by using RCBD (Randomized Completely Block Design) with three replications. During the experiment, following treatments were included: K_0 -Control, K_1-K_2O@ 10 kg ha^{-1}, K_2- K_2O @15 $kgha^{-1}$, K_3 - K_2O @ 20 $kgha^{-1}$ and V_0- No Vermicompost, V_1- Vermicompost @ 4 tha^{-1}, V_2- Vermicompost @ 6 tha^{-1}, V_3 – Vermicompost @ 8 t ha^{-1}. Potassium and vermicompost doses as well as their interactions showed significant effect on growth and yield parameters. At harvest highest plant height, number of leaves and branches per plant, average dry weight per plant, number of pods per plant, number of seeds per pod, number of seeds per plant, 1000-seed weight, seed yield and stover yield were recorded in K_3 (K_2O @ 20 kg ha^{-1}) and it was either closely followed by or statistically similar with the application of K_2O @15 kg ha^{-1} (K_2) and subsequently followed by K_1 (K_2O @ 10 kg $ha^{-1).}$ N, P and K content in seedwere recorded in K_3 (K_2O @ 20 kg ha^{-1}) and it was followed by the application of K_2O @15 kg ha^{-1} (K_2) and then K_1 (K_2O @ 10 kg ha^{-1}). Lowest results for above parameters were found from the treatment using no potassium fertilizer (K_0). Similarly, the highest values for highest plant height, number of leaves and branches $plant^{-1}$, average dry weight $plant^{-1}$, number of $podsplant^{-1}$, number of seeds pod^{-1}, number of seeds $plant^{-1}$, 1000-seed weight, seed yield and stover yield were recorded in V_3 (vermicompost @ 8 t ha^{-1}) which was either closely followed by or statistically similar with vermicompost @ 6 t

ha^{-1} and then followed by vermicompost @ 4 t ha^{-1}. Lowest results were found from the treatment using no vermicompost (V_0).

Kumar *et al.* (2018) conducted a field experiment at experimental farm of Department of Soil Science and Agril. Chemistry, College of Agriculture, Badnapur using mungbean as a test crop to studies on effect of potassium and zinc solubilizing microorganism on growth, yield and quality of mungbean. The experiment was laid out on Vertisols with five treatment combination, replicated four times in randomized block design. The treatment consists of T_1- Absolute control (No fertilizer application), T_{2-} RDF (25:50:00 N, P_2O_5 and K_2O kg ha^{-1}), T_3- (RDF + Rhizobium + PSB + KSB), $T_{4\ -}$ (RDF + Rhizobium + PSB + KSB + ZSB), T_5- (RDF + Rhizobium + PSB + KSB + ZSB). The results emerged out clearly indicated that various growth parameters like, germination percentage, number of pods, number of nodules, dry matter, and seed yield was increased due to application of potassium and zinc solubilizing microorganism. It was inferred from the results that application RDF + Rhizobium + PSB + KSB + ZSB (T_5) found superior over control application. The KSB and ZSB application showed synergistic effects on other nutrients (N, P, K) uptake. Soil fertility was also found to be improved due to application of potassium and zinc solubilizing microorganism to mungbean.

Buriro *et al*. (2015) carried out the studyto find out the best level of potash fertilizer on growth and yield response of two mungbean(*Vigna radiate* L.) cultivars (Niab Mung-92 and Chakwal 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.

Meena *et al*. (2016) conducted a field experiment was held in summer season in the fields to study the effect of two Irrigation period (7-14) days, and three intensities of potassium (0, 50, 100) kg h^{-1} on some of the characteristics of this harvest and the class of the used harvest is the local kind. Results showed superiority the plants were irrigated every 7 days in the highest rate of all the characteristics of study. The results also showed surpass the plants were fertilized by a higher concentration of potassium (100) kg $ha^{-1}$of all the characteristics of study. The search results showed the superiority of irrigated every 7 days and fertilized by the high level of potassium (100) kg \ e in the highest rate for all characteristics of study in a significant difference from other interventions.

2.2 Effect of Vermicomposton mungbean

Barakzai *et al.* (2020) conducted a field experiment was conducted during kharif season in sandy loam soil to find out the effect of organic manures, PSB and phosphorus fertilization on yield and economics of mungbean (*Vigna radiate* L.) Wilczek. Results indicated that response of organic manures, PSB and phosphorus, have markedly influenced the yield and monetary return of kharifmungbean. Effect was found to be significant and higher seed, straw and biological yield could be obtained with application of vermicompost at 2 t ha^{-1}(8.09, 16.24 and 24.33 q ha^{-1}), seed inoculation with PSB (7.39, 15.56 and 22.95 q ha^{-1}) and 40 kg $P_2O_5ha^{-1}$(8.03, 16.29 and 24.33 q ha^{-1}) independently. However, based on economics, treatments FYM at 4 t ha^{-1}, 40 kg P_2O_5 $ha^{-1}$and seed inoculation with PSB were found to be equally effective.

Muhammad *et al.* (2004) conducted a field study during rainy (kharif) season to find out the effect of bioinorganic nutrient combinations on yield, quality and economics of mungbean [*Vigna radiate* (L.) Wilczek]. The twelve treatments comprised one control, three levels of inorganic sources (75, 50 and 100% NPK of recommended dose) and other eight in combination viz. 50% RDF+ Rhizobium + Phosphorus solublizingbacteria (PSB), 50% RDF + 2.5 t ha^{-1}vermicompost, 50% RDF+2.5 t ha^{-1}vermicompostha^{-1} + Rhizobium + PSB, 75% RDF+ Rhizobium + PSB, 75% RDF + 2.5 tha^{-1}vermicompost, 75% RDF + 2.5 t ha^{-1}vermicompost + Rhizobium +PSB, 100%RDF+ Rhizobium+ PSB and 100% RDF + 2.5 t ha^{-1}vermicompost were laid out in randomized block design with three replications. Amongst combinations, significant improvement in plant height at harvest, yield attributes, yield, protein per cent, nutrient content and uptake were recorded with application of nutrients through 75% RDF + 2.5 t ha^{-1}vermicompost + Rhizobium + PSB as compared to other combinations, followed by treatments 100% RDF + 2.5 tha^{-1}vermicompost and 100% RDF + Rhizobium + PSB. The highest and comparable net returns were obtained with the application of 100% RDF + Rhizobium + PSB (INR 52894.73) followed by 75% RDF + 2.5 t ha^{-1}vermicompost + Rhizobium + PSB (INR 51582.60) and 75% RDF + + Rhizobium + PSB (INR 50664.74). The above studies show that bioinorganic combinations have their own roles play to higher productivity, not only solely supply all the nutrients to the soils but also create favorable conditions for betters growth to producing crop.

Bray *et al*. (1945) conducted a field experiment during rainy seasons to study the effect of organic manures, PSB and phosphorus fertilization on growth and yield of kharifmungbean. The results revealed that application of organic manures, PSB and phosphorus fertilization markedly influenced the growth and yield of mungbean. Results showed that application of vermicompost, seed inoculation with PSB and 40 kg $P_2O_5ha^{-1}$ significantly increased the growth attributes i.e. plant height, number of branches per plant, dry matter accumulation per meter row length, chlorophyll content, effective nodules, dry weight of nodules per plant, total nodules and finally seed yield (8.09 q ha^{-1}) of mungbean.

Sing *et al* .(2003) conducted a field experiment was conducted at agriculture farm of Sri Karan Narendra Agriculture University. The treatment consisted 20 combinations of phosphorus (0, 20, 40 and 60 kg ha^{-1}) and bio-organics (Control, PSB, VAM, vermicompost at 2t ha^{-1} and vermicompost at 2t ha^{-1} + VAM). Results showed that every increase in level of phosphorus up to 40 kg ha^{-1} significantly increased the growth and yield attributing characters viz., plant height, no. of branches $plant^{-1}$, dry matter accumulation, number and weight of root nodules $plant^{-1}$, number of pods $plant^{-1}$, number of grains pod^{-1} and test weight and grain, straw and biological yield and nutrient content in grain and straw of mungbean. However, it was found at par with 60 kg P_2O_5 ha^{-1}, wherein the maximum values were obtained. Application of bio-organics as vermicompost at 2t ha^{-1} + VAM significantly increased the observed growth and yield attributing characters viz. plant height, no. of branches $plant^{-1}$, dry matter accumulation, number and weight of root nodules plant^{-1}, number of pods plant^{-1}, number of grains pod^{-1} and test weight and yields and nutrient content in grain and straw of mungbean as compared to vermicompost, VAM, PSB and control.

2.3 Combined effect of vermicompost and inorganic fertilizers on mungbean

Murphy *et al.* (1962) conducted a field experiment was conducted during spring-summer seasons at Tarnak Research Farm, ANASTU, Kandahar, Afghanistan to investigate the effect of sources of nutrient and biofertilizers on growth, yield and economics of Mungbean. The experiment laid out in Split Plot Design (SPD) with by assigning 4 levels of nutrients sources (control, 30:60:40 kg N:P:K ha^{-1}, 10 t FYM ha^{-1}, and 15:30:20 kg N:P:K ha^{-1} + 5t FYM ha^{-1}) in main plot and 4 levels of biofertilizers [No Biofertilizer, Rhizobium, Phosphate solubilizing bacteria (PSB) + Vesicular ArbuscularMycorrhiza (VAM), and Rhizobium + PSB + VAM] in subplot, thus sixteen treatment combinations were tested in three replications. Results of the study revealed that significantly superior plant growth parameters like plant height, number of branches, trifoliate leaves, leaf area and dry matter accumulation were recorded from RDF 0.5+ FYM 5 t ha^{-1}. Similarly, these parameters were superior with the application of Rhizobium+ PSB+VAM at most of the growing stages. Among different nutrient sources and biofertilizer the interaction effect was significant at different stages and found best with the combination of RDF 0.5+ FYM 5 t ha^{-1} and Rhizobium+PSB+VAM for most of the growth parameters. Root parameters like root length and root nodules (7.7 plant^{-1}) were significantly higher with the application of RDF0.5+FYM 5 t ha^{-1} and Rhizobium+PSB+VAM over control at 25, 50 and at harvest stages. Highest growth and yield can be obtained with the application of 15:30:20 kg N: P: K ha^{-1}+ 5 t FYM ha^{-1} along with Rhizobium + PSB + VAM in the Kandahar province of Afghanistan.

Russel *et al*. (1986) conducted a field experiment to study the effect of different nutrient combination and sources on mungbean (*Vigna radiate* L. Wilczek) in sandy loam soil at Crop Research Centre of SardarVallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.), during kharifseason of 2012. The experiment was laid out in Randomized Block Design with ten treatments, three replications and variety was SML-668. Among all the treatment application of 50 kg phosphorus through SSP, 8 kg N through urea as basal along with 1.0 ton of vermicompost ha^{-1} gave maximum plant height, number of green try foliate, dry matter accumulation, number of active nodules, number of pods plant $^{-1}$, number of grains pod^{-1}, strawand biological yield, which was significantly more than the other treatments. An increase of 84.4 percent in grain yield were recorded due to integration of nutrient sources and also to be found significantly higher gross return and net return compare to control treatments.

Hussain *et al* .(2011) conducted a field experiment at Agricultural Research Farm, School of Agriculture, Lovely Professional University, Phagwara, Punjab, during Rabi season. The soil texture was sandy loam, with pH 7.83 to 7.98 and $0.4dSm^{-1}$. The study was conducted to evaluate the performance of mung bean, by growing in different nutrients and sowing methods. In this experiment cultivar used was SML 668. The experiment was conducted using Two Factorial Random Block Design with three sowing patterns (flat sowing, raised bed sowing, ridge sowing) and 6 treatments T_0 (control), T_1 (Compost), T_2 (NPK), T_3 (Micronutrients), T_4 (NPK + Micronutrients), T_5 (NPK + Micronutrients + Compost) and were replicated three times. It was found that Ridge sowing shows. T_5 showed better results in growth and yield parameters (NPK + Micronutrients + Compost). However ridge sowing and T_5 interaction performed better results in higher plant height, number of leaves, number of branches and grain yield whereas interaction between flat sowing and T_5 sowing shows better results in pod length, number of grains per pod, pods per plant and 1000 grains weight. Mungbean is an important dietary protein source among the pulses. It is an extraordinary source of vitamin C and antioxidants when used in sprouted form. But this crop is generally grown on marginally fertile lands which results in low productivity, poor quality and less remuneration. Therefore, the present study was intended to find out the ways and means to solve the nutrient management issues with an integrated approach to improve the yield, quality and net returns of mungbean crop. The field experiment was conducted on clay loam soil taking four levels of fertility [75% Recommended Dose of Fertilizers (RDF), 75% RDF+ Vermicompost (VC) @ 2 t ha^{-1}, 100% RDF and 100% RDF+VC @ 2 t ha^{-1}) and four levels of biofertiliizers (control, Rhizobium, Phosphate Solubilizing Bacteria (PSB) and Rhizobium + PSB). These treatments were evaluated in factorial randomized block design with three replications taking mungbean as test crop. The application of fertility level significantly increased the dry matter accumulation, number of pods per plant, number of seeds per pod, seed and haulm yield and net returns up to 75% RDF+VC @ 2 t ha^{-1}. Seed inoculation with Rhizobium + PSB significantly increased the dry matter accumulation, number of pods per plant, number of seeds per pod, seed yield and net returns. The interactive effect of fertility levels and biofertilizers significantly influenced the seed and haulm yield and net returns and maximum reported with the application of 100% RDF+VC @ 2 t ha^{-1} and Rhizobium + PSB combination, which was at par with 75%RDF+VC @ 2 t ha^{-1} and Rhizobium + PSB combination.

Quddus *et al*. (2019) conducted an experiment to find out the growth performance and development attributes of mungbean (*Vigna radiate* L.) as influenced by organic manure and inorganic fertilizer. The experiment consisted of two factors: factor A: five levels of manures and inorganic fertilizers [T_0 = Control (no fertilizer or manure), T_1 = Recommended dose of fertilizer (R) (45 kg urea ha^{-1} + 100 kg TSP ha^{-1} + 58 kg MoP ha^{-1}), T_2 = R + cow dung (3 t ha^{-1}), T_3 = R + poultry manure (2 t ha^{-1}), T_4 = R + vermicompost (2.5 t ha^{-1})] and factor B: two mungbean varieties; (V_1 = BARI Mung 5 and V_2 = BARI Mung 6). The experiment was laid out in split- plot design with three replications. The growth performance and development attributes of mungbean varieties were found significant with the combined effect of different organic manures and recommended doses of inorganic fertilizers. The largest plant height, number of leaves $plant^{-1}$, number of branches $plant^{-1}$, dry weight of plant, minimum days to first emergence, 80% emergence, 80% flowering and 80% pod maturity (46.05 cm at 55 DAS, 24.16 at 55 DAS, 7.92 at 55 DAS, 40.68 g at 55 DAS, 1.80 days, 3.16 days, 32.21 days and 46.56 days, respectively) were found from the combined effect of V_2 varieties with T_4 treatment. Among the different treatment combination T_4 [(recommended doses of fertilizer + vermicompost (2.5 t ha^{-1})] showed the best results. So, BARI Mung 6 performed the best performance with the application of vermicompost @ 2.5 t ha^{-1} with the recommended dose of fertilizer.

CHAPTER 3

MATERIALS AND METHODS

This chapter includes a brief description of the experimental soil, mungbean variety, land preparation, experimental design, treatments, cultural operations, collection of soil and plant samples etc. and analytical methods followed in the experiment to study the effect of vermicompost and inorganic fertilizer on the yield of mungbean.

3.1 Experimental site

The experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka - 1207 during kharif season of 2020.The location of the site is 90°33´ E longitude and 23°77´ N latitude with an elevation of 8.2 m from the sea level.

3.2 Description of soil

The general soil type of the experimental field is deep red brown terrace soils, and it is a part of the Tejgaon series under the Madhupur Tract (AEZ-28) of the Agroecological Zone. Before the experiment began, dirt was collected from several locations in the field at a depth of 0–15 cm to create a composite sample. The obtained soil was crushed, air-dried, and put through a 2 mm screen before being examined for a number of significant physical and chemical characteristics.

3.3 Description of the mungbean variety

This experiment employed the high producing mungbean cultivar BARI Mung-6 as the test crop. The variety was released by Bangladesh Agricultural Research Institute, Joydebpur, Gazipur in 2002. Its life cycle ranges from 55 to 60 days. It is resistant to pests, insects and disease.

3.4 Climate

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

3.5 Preparation of the field

The field was disclosed by power tillar on the 20 March, 2020. Then the land was ploughed many times then laddering was done for mungbean seed sowing. Weeds and stubbles were separate from the field and big size clods were broken down for desirable size .Finally, working field was equal in size and the field was divided into unite plot.

3.6 Treatments

The experiment consists 8 treatment combination are given below:

Treatment combinations:

T_0= Control condition

T_1= 100% Recommended chemical fertilizer + 0 t ha^{-1}vermicompost.

T_2=80% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost

T_3= 80% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost

T_4= 80% Recommended chemical fertilizer + 6 t ha^{-1}vermicomost

T_5= 60% Recommended chemical fertilizer +2 t ha^{-1}vermicompost

T_6=60% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost

T_7= 60% Recommended chemical fertilizer +6 t ha^{-1}vermicompost

3.7 Nutrient status of vermicompost

An ideal vermicompost contain 1% nitrogen, 1% phosphorus, 1%potassium, 18%carbon and 15-25% moisture.

3.8 Layout of the experiment

The working field was two factor and RCBD design with 3 replication. The amount of plots was 24, each measuring $4m^2$ .In the field contained 3 replication with each at 8 plots. The distance maintained between two plots was 50 cm.The layout of the experiment is shown in Appendix II.

3.9 Fertilization

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

NameofNutrients	NameofFertilizers	RateofApplication (kg/ha)
Nitrogen(N)	Urea,	45
Phosphorus(P)	TripleSuperPhosph ate	90
Potash(K)	MuriateofPotash	40
Sulpher(S)	Gypsum	55
Boron(B)	Boricacid	10
Organic fertilizer	Vermicompost	As per treatment

The amounts of fertilizer as per treatment in the forms of urea, triple super phosphate, muriate of potash, gypsum, boric acidandZincOxide 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 Seed sowing

Mungbean seeds were sown on the 21th March, 2020 in lines following the recommended line to line distance of 30 cm and plant to plant distance of 10 cm.

3.11 Cultural and management practices

Various cultural techniques such as plant thinning, weeding, and pesticide spraying, were carried out as needed. Purching was made sure to occur at the moment of germination in order to safeguard the bug. After seeding, the field received two irrigation treatments: one at 15 days and the other at 30 days.

3.12 Harvesting

Harvesting time of the mungbean crops was 20th May, 2020. Crops are bunched up plotwise after harvest. The yields of grain and straw were put down in a plot since statistical analysis required those data.

3.13 Collection of samples

3.13.1 Soil sample

Dirt from a depth of 0 to 15 cm was collected before the area was planted in order to collect data.Soil samples for composite samples were taken after the earth had been fully mixed. A little amount of soil was collected on 25th May, 2020, after the crop had been harvested, at a depth of around 0–15 cm. Before the samples were sieved with a 2 mm (10 mesh) sieve for the next analysis, they were allowed to air dry.

3.13.2 Plant sample

Plant samples were purposefully collected at the point of maturity for additional analysis. They were positioned for additional analysis after being cut above the surface. They are then rinsed with tap water first, followed by distilled water. For 45 hours, the plant samples were dried in an electric oven set at 70°C. The sample was then collected and placed for additional investigation in an electric grinding machine. No plant samples were taken from the border region.

3.14 Collection of data

Data collection were done on the following paramerers –

3.14.1 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.

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3.14.2 Number of leaves plant^{-1}

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.

3.14.3 Number of branches plant^{-1}

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.

3.14.4 Number of pods plant^{-1}

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

.3.14.5 Pod length (cm)

From each plot around 4 plants pods were counted and averaged.

3.14.6 Number of seeds pod^{-1}

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}.

3.14.7 Thousand seed weight

Thousand seeds of mungbean were counted randomly and then weighed plot wise.

3.14.8 Grain yield

The grain yield obtained from the net plot area of each treatment was added with the yield obtained for four tagged and harvested plants. The grainwere 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, P^H, 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).

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 totitrate 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 P^H

The P^H of the soil was determined with the help of a glass electrode P^Hmeter 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:

$\% N = (T-B) \times N \times 0.014 \times 100 / S$

Where,

T = Sample titration (ml) value of standard H_2SO_4

B = Blank titration (ml) value of standard H_2SO_4

N = Strength of H_2SO_4

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. The mean values of all the recorded parameters were evaluated and analysis of variance was performed by the 'F' (variance ratio) test using MSTAT-C 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 4

RESULT AND DISCUSSION

This chapter includes the experimental results along with discussions. Effects ofvermicompost and inorganic fertilizer on growth, yield and yield attributes of mungbean presented in below table and graph are discussed characterwise under the following heads.

4.1 Effect of vermicompost and inorganic fertilizers on the growth parameter of mungbean

4.1.1 Plant height

The effect of different levels of fertilizer on the plant height of mungbean was statistically significant (Table 1).

Interaction betweenvermicompost and inorganic fertilizer had also significant effect on the plant height of mungbean (Table 1). The average values of the treatments were observed; it was found that both at 30 DAS,40 DAS and at harvest the highest plant height was obtained in T_4 treatment (29.84 cm, 41.14 cm and 55.19 cm respectively) i.e. 80% recommended doses of inorganic fertilizer and 6 ton vermicompost ha^{-1} and the lowest plant height was obtained from T_0 treatment (22.79 cm, 32.49 and 46.92 cm respectively) that was control. It is understand from the data that 80% of inorganic fertilizer along with 6 ton ha^{-1}vermicompost resulted the highest plant height of mungbean plants. These are in agreement with those of Yadav and Malik (2005),Reddy *et al.* (1998) and Das *et al.* (2002) who have reported that different levels of vermicompost significantly increased plant height.

Table 1: Effect of vermicompost and inorganic fertilizers on plant height (cm) of mungbean.

Treatment	Plant Height (cm)		
	30 DAS	**40 DAS**	**At Harvest**
T_0	22.79f	32.49e	46.92e
T_1	25.39e	34.23d	47.26e
T_2	28.75b	40.28ab	53.12b
T_3	29.40ab	40.43a	54.22a
T_4	29.84a	41.14a	55.19a
T_5	26.08de	35.23d	49.15d
T_6	26.73cd	37.93c	51.01c
T_7	27.38c	39.11bc	51.29c
$LSD_{(0.05)}$	**0.42**	**0.57**	**0.47**
CV (%)	**1.88**	**1.81**	**1.13**

T_0= control condition, T_1=100% Recommended chemical fertilizer + 0 t ha^{-1}vermicompost,T_2= 80% Recommended chemical fertilizer+2 t ha^{-1}vermicompost,T_3= 80% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost,T_4= 80% Recommended chemical fertilizer+ 6 t ha^{-1}vermicomost,T_5 = 60% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost,T_6=60% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost,T_7= 60% Recommended chemical fertilizer +6 t ha^{-1}vermicompost.

4.1.2 Number of leaves plant^{-1}

Interaction between vermicompost and inorganic fertilizer had also significant effect on the number of leaves per plant of mungbean (Table 2). The average values of the treatments were observed; it was found that both at 30 DAS, 40 DAS and at harvest the highest number of leaves was obtained in T_4 treatment (6.76, 6.90 and 8.14 respectively) i.e. 80% recommended dose of inorganic fertilizer and 6 tonha^{-1} vermicompostand the lowest plant height was obtained from T_0 treatment (3.13, 3.03 and 4.36 respectively)that was control. It is understand from the data that 80% of inorganic fertilizer along with 6 ton ha^{-1}vermicompost resulted the highestplant height of mungbean plants.Tomar*et al*. (1996)found that the highest numbers of leaves were obtained from 60 kg P_2O_5 ha^{-1}.

Table 2: Effect of vermicompost and inorganic fertilizers on number of leaves of mungbean.

Treatment	Number of leaves $plant^{-1}$		
	30 DAS	**40 DAS**	**At Harvest**
T_0	3.13f	3.03g	4.36e
T_1	4.03e	4.10f	5.60d
T_2	6.03b	6.13c	7.35b
T_3	6.53a	6.53b	7.67b
T_4	6.76a	6.90a	8.14a
T_5	5.40d	5.46e	6.49c
T_6	5.66c	5.60de	6.53c
T_7	5.80bc	5.80de	6.56c
$LSD_{(0.05)}$	**0.24**	**0.23**	**0.38**
CV (%)	**2.53**	**2.43**	**3.34**

T_0= control condition, T_1=100% Recommended chemical fertilizer + 0 t ha^{-1}vermicompost, T_2= 80% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_3= 80% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_4= 80% Recommended chemical fertilizer+ 6 t ha^{-1}vermicomost, T_5= 60% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_6=60% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_7= 60% Recommended chemical fertilizer +6 t ha^{-1}vermicompost.

4.1.3 Number of branches $plant^{-1}$

The combined use of vermicompost and different doses of inorganic fertilizer had also significant effect on the number of branches per plant of mungbean (Table 3). The minimum number of branches per plant of mungbean was (2.03) in the T_0 treatment where control condition used. On the other hand, the maximum the number of brances per plant of mungbean in (4.46) was recorded with T_4 (80% Recommendation chemical fertilizer dose+ 6 t ha^{-1}vermicompost) treatment. It is understand from the data that 80% of inorganic fertilizer along with 6 t ha^{-1} of vermicompost resulted the maximum number of branches of mungbean plants. These are in agreement with those of Yadav and Malik (2005), Reddy *et al.* (1998).

Table 3: Effect of vermicompost and inorganic fertilizers on number of brances plant $^{-1}$of mungbean.

Treatment	Number of branches $plant^{-1}$
	At harvest
T_0	2.03g
T_1	3.06f
T_2	4.03c
T_3	4.20b
T_4	4.46a
T_5	3.53e
T_6	3.66e
T_7	3.83d
$LSD_{(0.05)}$	**0.14**
CV (%)	**2.17**

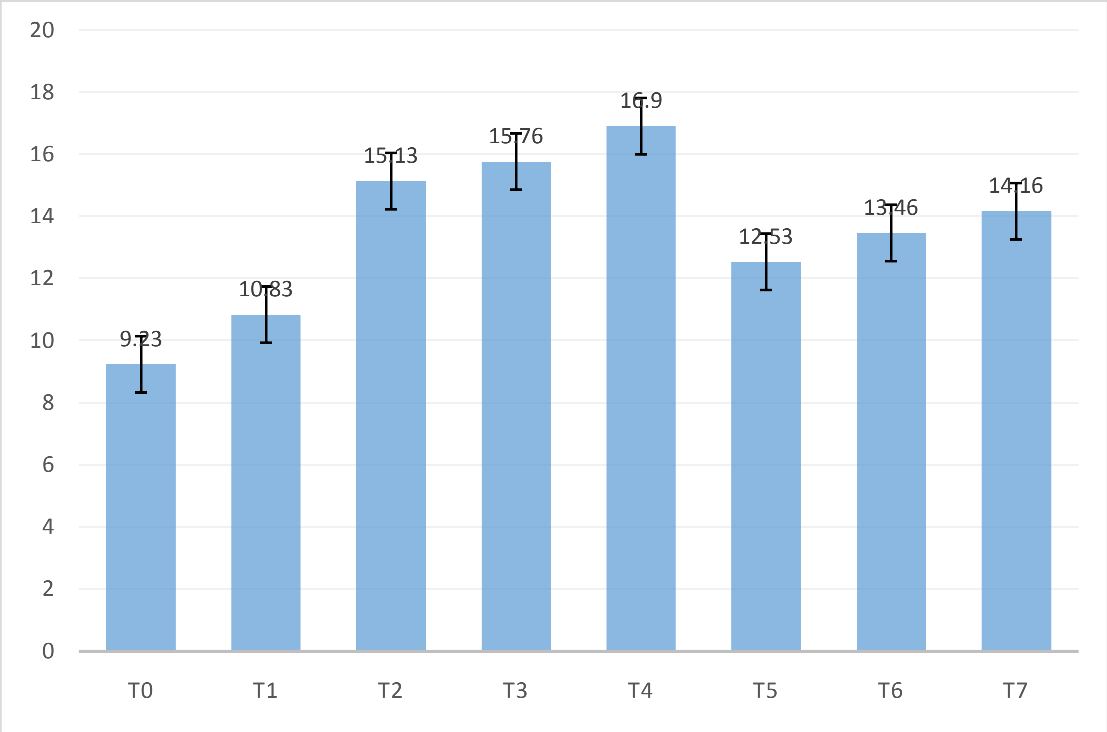
T_0= control condition, T_1=100% Recommended chemical fertilizer + 0 t ha^{-1}vermicompost, T_2= 80% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_3= 80% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_4= 80% Recommended chemical fertilizer+ 6 t ha^{-1}vermicomost, T_5= 60% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_6=60% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_7= 60% Recommended chemical fertilizer +6 t ha^{-1}vermicompost.

4.2 Effect of vermicompost and inorganic fertilizers on the yield and yield attributes of mungbean

4.2.1 Number of pods plant^{-1}

There was statistically significant variation in the effect of fertilizer levels on the number of pods per plant (Figure 1). The number of mungbean pods per plant was significantly impacted by the combined use of vermicompost and various doses of inorganic fertilizer (recommended chemical fertilizer dose) (Figure 1). The minimum number of pods per plant of mungbean was (9.23) in the T_0 treatment where control condition was used. On the other hand, the maximum the number of pods per plant of mungbean (16.90) was recorded with T_4 (80% Recommendation dose + 6 t ha^{-1}vermicompost) treatment. It is understand from the data that 80% of inorganic fertilizer along with 6 t ha^{-1}vermicompost resulted the maximum number of pods of mungbeanplants .These are in agreement with that of Reddy *et al*. (1998) who has reported that different levels of vermicompost significantly increased number of pods per plant of mungbean.

Figure 1: Effect of vermicompost and inorganic fertilizers on number of pods plant $^{-1}$ of mungbean.

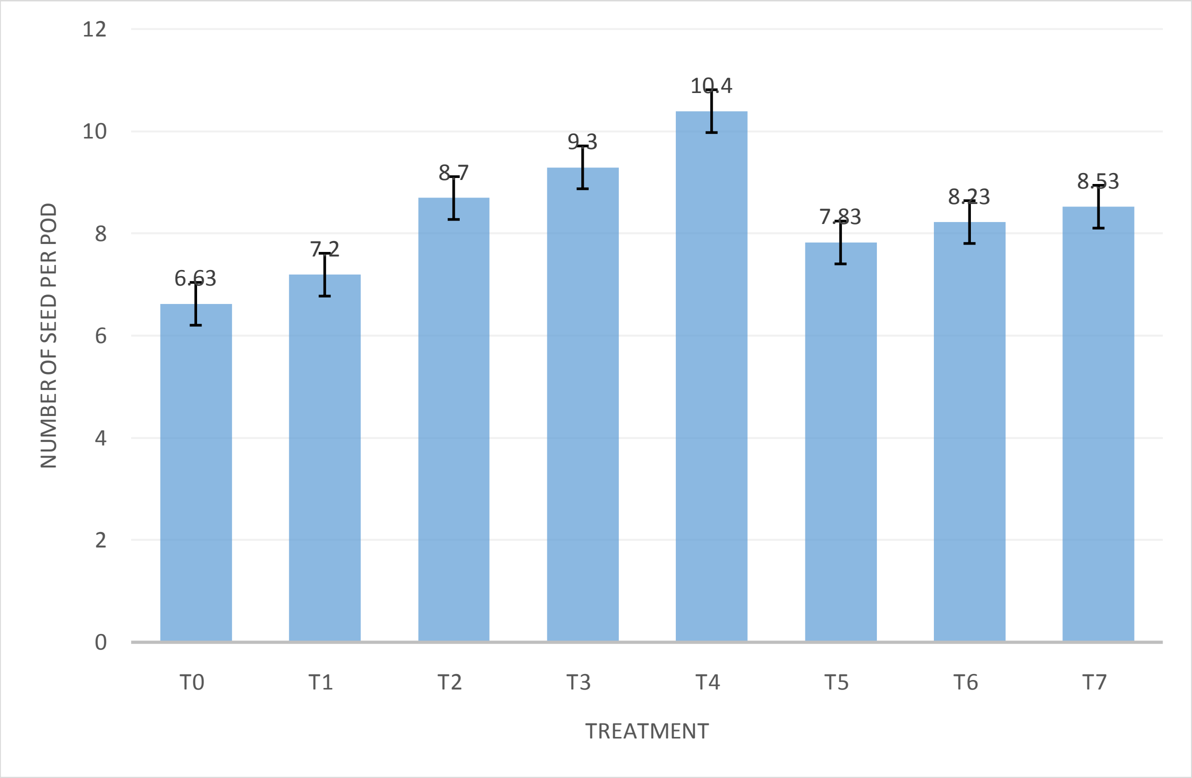


T_0= control condition, T_1=100% Recommended chemical fertilizer + 0 t ha^{-1}vermicompost, T_2= 80% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_3= 80% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_4= 80% Recommended chemical fertilizer+ 6 t ha^{-1}vermicomost, T_5= 60% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_6=60% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_7= 60% Recommended chemical fertilizer +6 t ha^{-1}vermicompost.

4.2.2 Number of seeds pod^{-1}

The quantity of seeds per pod was significantly impacted by the various fertilizer doses (Figure 2) .The amount of seeds per pod was significantly affected by the combined application of vermicompost and various doses of inorganic fertilizer(recommended chemical fertilizer dose) (Figure 2). The minimum number of seeds per pod (6.63) in the T_0 treatment where control condition was used. On the other hand, the maximum number of seeds per pod (10.40) was recorded with T_4 (80% Recommendation dose + 6 t ha^{-1}vermicompost) treatment. It is understand from the data that 80% of inorganic fertilizer along with 6 t ha^{-1} of vermicompost resulted the maximum number of seeds per pod.

Figure 2: Effect of vermicompost and inorganic fertilizers on number of seeds pod^{-1} of mungbean.

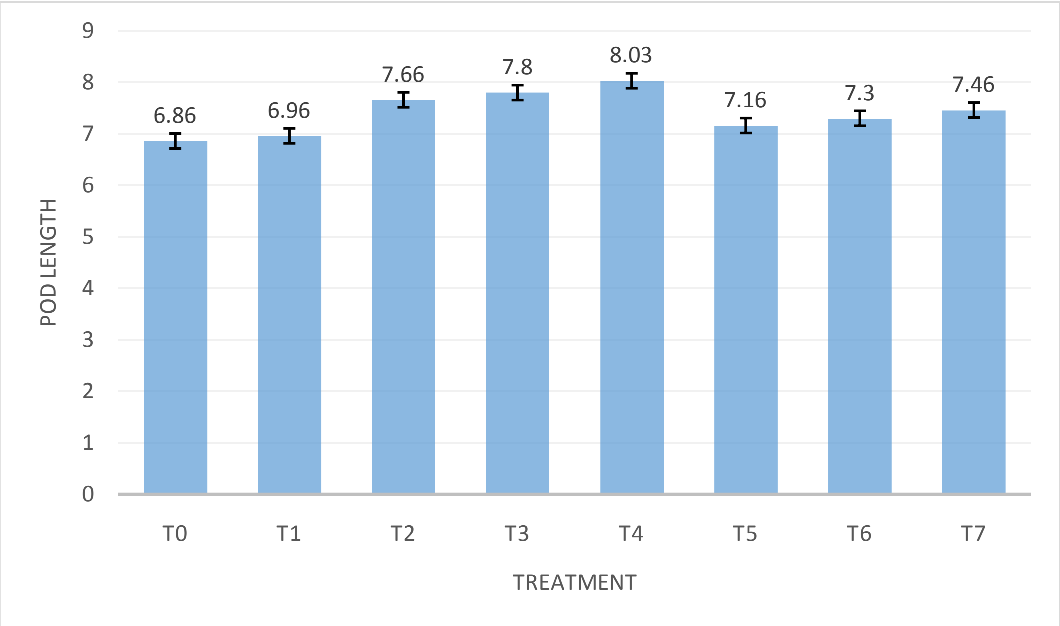


T_0= control condition, T_1=100% Recommended chemical fertilizer + 0 t ha^{-1}vermicompost, T_2= 80% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_3= 80% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_4= 80% Recommended chemical fertilizer+ 6 t ha^{-1}vermicomost, T_5 = 60% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_6=60% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_7= 60% Recommended chemical fertilizer +6 t ha^{-1}vermicompost.

4.2.3 Pod length

There was statistically significant effect of the pod length of mungbean due to different doses of fertilizer (Figure 3). The pod length of mungbeanplants was significantly affected by the combined application ofvermicompost and different doses of inorganic fertilizer (recommended chemical fertilizer dose) (Figure 3). The minimum pod length of mungbean was (6.86 cm) in the T_0 treatment where control condition was used. On the other hand, the maximum pod length of mungbean(8.03 cm) was recorded with T_4 (80% Recommendation dose + 6 t ha^{-1}vermicompost) treatment. It is understand from the data that 80% of inorganic fertilizer along with 6 t ha^{-1} of vermicompost resultedthe maximum pod length of mungbean plants.

Figure 3: Effect of vermicompost and inorganic fertilizers on pod lenthof mungbean.



T_0= control condition, T_1=100% Recommended chemical fertilizer + 0 t ha^{-1}vermicompost, T_2= 80% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_3= 80% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_4= 80% Recommended chemical fertilizer+ 6 t ha^{-1}vermicomost, T_5 = 60% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_6=60% Recommended chemical fertilizer

+ 4 t ha^{-1}vermicompost, T_7= 60% Recommended chemical fertilizer +6 t ha^{-1}vermicompost.

4.2.4 Weight of 1000 grain

There was significant effect in the weight of 1000 grain of mungbean due to different doses of fertilizer (Table 4).

The combined application of vermicompost and different dosages of inorganic fertilizer (recommended chemical fertilizer dose) had a substantial impact on the 1000 grain weight as well (Table 4). The minimum 1000 grain weight (37.65 gm) in the T_0 treatment where control condition was used . On the other hand, the maximum 1000 grain weight (44.70 gm) was recorded with T_4 (80% Recommended chemical fertilizer dose + 6 t ha^{-1}vermicompost) treatment. It is understand from the data that 80% of inorganic fertilizer along with 6 t ha^{-1} of vermicompost resulted the maximum 1000 grain weight.

Table 4: Effect of vermicompostand inorganic fertilizers on 1000 grain weight (gm)of mungbean.

Treatment	1000-grain weight (g)
T_0	37.65d
T_1	40.48c
T_2	43.87a
T_3	44.67a
T_4	44.70a
T_5	42.02b
T_6	42.08b
T_7	42.16b
$LSD_{(0.05)}$	**1.16**
CV (%)	**1.58**

T_0= control condition, T_1=100% Recommended chemical fertilizer + 0 t ha^{-1}vermicompost, T_2= 80% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_3= 80% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_4= 80% Recommended chemical fertilizer+ 6 t ha^{-1}vermicomost, T_5 = 60% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_6=60% Recommended chemical fertilizer+ 4 t ha^{-1}vermicompost, T_7= 60% Recommended chemical fertilizer +6 t ha^{-1}vermicompost.

4.2.5 Grain yield

Combined use of various doses of vermicompost and inorganic fertilizer (recommendation dose) had also significant effect on the grain yield (Table 5).The minimum grain yield (0.37 t ha^{-1}) in the T_0 treatment where control condition was used. On the other hand, the maximum grain yield (1.41 t ha^{-1}) was recorded with T_4 (80% Recommendation dose + 6 t ha^{-1}vermicompost) treatment . It is understand from the data that 80% of inorganic fertilizer along with 6 t ha^{-1} of vermicompost resulted the maximum grain yield. These are in agreement with those of Tolanur and Badanur (2003) who have reported that combined application of vermicompost and inorganic fertilizer significantly increased grain yield.

Table 5: Effect of vermicompost and inorganic fertilizers on grain yield (ton ha^{-1}) of mungbean.

Treatment	**Grain yield (ton ha^{-1})**
T_0	0.37f
T_1	1.03e
T_2	1.30b
T_3	1.34b
T_4	1.41a
T_5	1.13d
T_6	1.18c
T_7	1.20c
$LSD_{(0.05)}$	**0.03**
CV (%)	**1.83**

T_0= control condition, T_1=100% Recommended chemical fertilizer + 0 t ha^{-1}vermicompost, T_2= 80% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_3= 80% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_4= 80% Recommended chemical fertilizer+ 6 t ha^{-1}vermicomost, T_5= 60% Recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_6=60% Recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_7= 60% Recommended chemical fertilizer +6 t ha^{-1}vermicompost.

CHAPTER 5

SUMMARY

An experiment was conducted at the Sher-e-Bangla Agricultural University Farm (SAU Farm), Dhaka-1207 (Tejgaon series under AEZ No. 28) during Kharif season of 2020 to study the effect of vermicompost and inorganic fertilizer on the yield of mungbean. The soil was silty loam in texture having pH6.3, organic matter 0.88%. Randomized complete block design was followed with eight treatments having unit plot size of 4m^2 replicated thrice. The treatments were T_0 = control condition, T_1 = 100% recommended chemical fertilizer + 0 t ha^{-1}vermicompost, T_2 = 80% recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_3 = 80% recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_4 = 80% recommended chemical fertilizer + 6 t ha^{-1}vermicompost, T_5 = 60% recommended chemical fertilizer + 2 t ha^{-1}vermicompost, T_6 = 60% recommended chemical fertilizer + 4 t ha^{-1}vermicompost, T_7 = 60% recommended chemical fertilizer + 6 t ha^{-1}vermicompost. Nitrogen from urea, P from TSP and K from Muriate of potash were used. At the time of the last land preparation, the full volumes of urea, TSP, and MR were used, and vermicompost was applied in accordance with sowing. Mungbean seeds cv. BARI MUNG-6 were sown on 21th March, 2020 and the crop was harvested on 20th May, 2020. Intercultural operations were done when required. The data were collected plot wise for plant height, number of leaves plant^{-1}. Number of branches plant^{-1}, number of pods plant^{-1}, number of seed plant^{-1}, pod length, number of seeds pod^{-1}, weight of 1000 grains, grain yields. . All the data were statistically analyzed following F-test and the mean comparison was made by DMRT at 5% and 1% level. The results of the experiment are stated below:

Different organic levels have a considerable impact on several plant and yield characteristics. The maximum plant height at 30 DAS, 40 DAS and harvest time (29.84 cm, 41.14 cm, 55.19 cm respectively) , number of leaves plant^{-1}at 30 DAS, 40 DAS and harvest time (6.76, 6.90, 8.14 respectively) , number of branches plant^{-1} (4.46) , number of pods plant^{-1} (16.90) , number of seeds pod^{-1} (10.40), pod length (8.03 cm), 1000 grain weight (44.70 g) and grain yield (1.41 t ha^{-1}) were recorded by T_4 and the lowest plant height at 30 DAS, 40 DAS and harvest time (22.79cm, 32.49 cm, 46.92 cm respectively), number of leaves plant^{-1} at 30 DAS, 40 DAS and harvest time (3.13, 3.03, 4.36 respectively), of branches number plant^{-1} (2.03), number of podsplant^{-1}(9.23), number of seeds pod^{-1} (6.63), pod length (6.86), 1000 grain weight (37.65 g) and grain yield (0.37 t ha^{-1}) were recordedby T_0 where control condition was used. When vermicompost and inorganic fertilizer were applied together, the mungbean crop's grain production dramatically increased. The maximum grain yield (1.41 t ha^{-1}) was obtained in T_4 (80% Recommendation chemical fertilizer + 6 t ha^{-1}vermicompost). The minimum grain yield (0.37 t ha^{-1}) was observed in the T_0 treatment where control condition was applied. The outcome showed that using vermicompost along with inorganic fertilizers had a greater impact on crop output than either vermicompostor inorganic fertilizer alone. The maximum plant height at 30 DAS, 40 DAS and harvest time (29.84 cm, 41.14 cm, 55.19 cm respectively) , number of leaves plant^{-1} at 30 DAS, 40 DAS and harvest time (6.76, 6.90, 8.14 respectively) , number of branches plant^{-1} (4.46) , number of pods plant^{-1} (16.90) , number of seeds pod^{-1} (10.40), pod length (8.03 cm), 1000 grain weight (44.70 g) and grain yield (1.41 t ha^{-1})were generated by the treatment combination T_4 (80% recommendation chemical fertilizer dose + 6 t ha^{-1}vermicompost). The T_0 with control condition had the lowest plant height at 30 DAS, 40 DAS and harvest time (22.79cm, 32.49 cm, 46.92 cm respectively), number of leaves plant^{-1} at 30 DAS, 40 DAS and harvest time (3.13, 3.03, 4.36 respectively) , of branches number plant^{-1} (2.03), number of pods plant^{-1} (9.23), number of seeds pod^{-1} (6.63), pod length (6.86 cm), 1000 grain weight (37.65 g) and grain yield (0.37 t ha^{-1}).

CHAPTER 6

CONCLUSION AND RECOMMENDATION

Considering the above results of this experiment, it may be summarized that growth and yield contributing parameters of mungbean are positively correlated with vermicompost and inorganic fertilizer. Therefore, the present experimental results suggest that the combined use of vermicompost and inorganic fertilizer were applied together, the mungbean crop's grain production dramatically increased. The maximum grain yield (1.41 t ha^{-1}) was obtained in T_4 (80% recommendation chemical fertilizer + 6 t ha^{-1} vermicompost) of BARI Mung-6 under the climatic and edaphic condition of Sher-e-Bangla Agricultural University, Dhaka and similar environment else where in Bangladesh.

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

- Such study is needed indifferent agro-ecological zones (AEZ) of Bangladesh to investigate regional adaptability and other performance.
- It needs to conduct more researches of combined use of vermicompost and recommendation inorganic fertilizer to investigate the growth and yield BARI Mung-6.
- It needs to conduct more advanced and related experiments with other varieties of mungbean and also in different climate and soil condition.

CHAPTER 7

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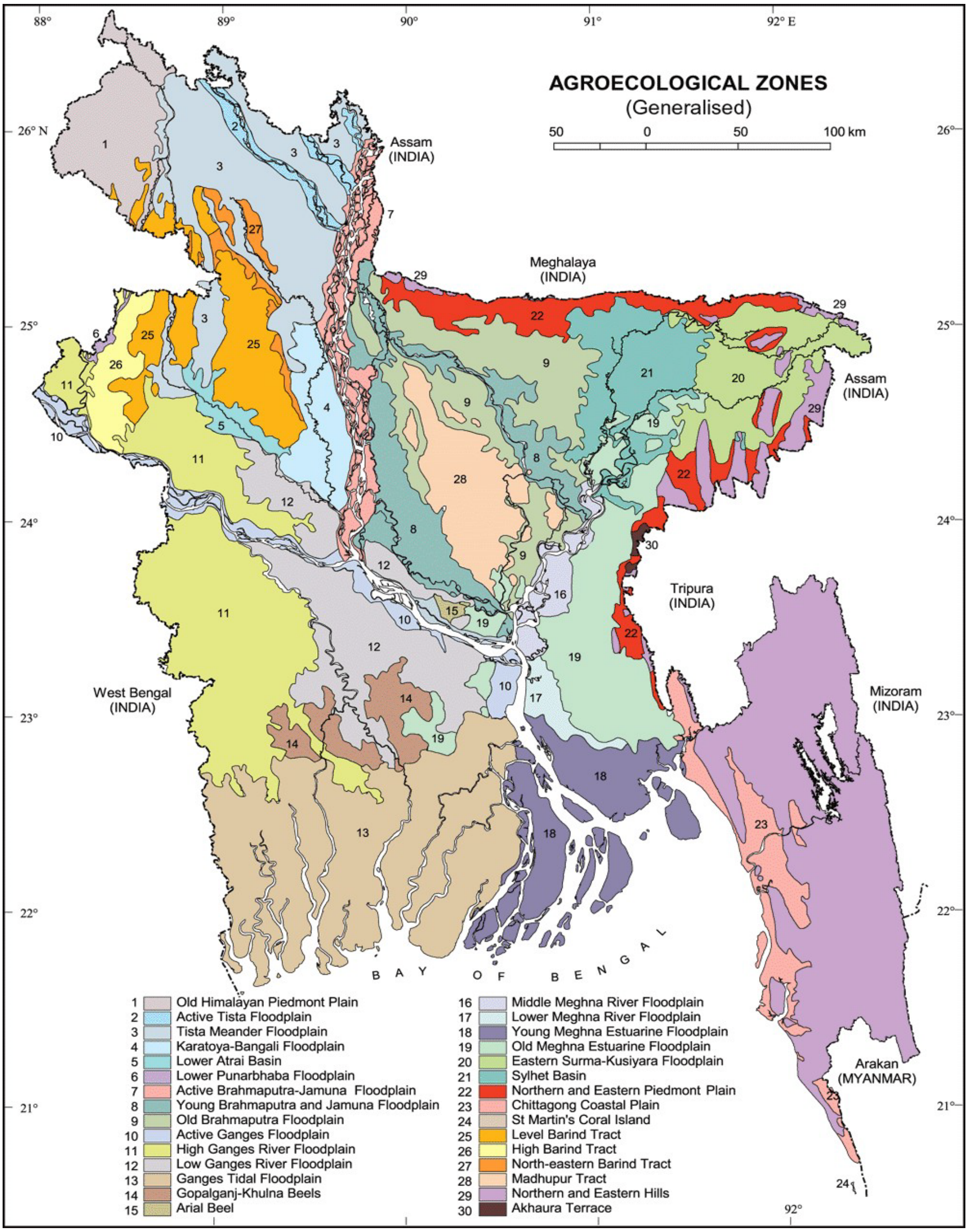
APPENDICES

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



Appendix II: Layout of the experimental field