Combined Effect of Organic and Inorganic Fertilizers on the Growth and Yield of Mungbean (Bari Mung 6)

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Abstract- An experiment was conducted at the experimental field of the farm of Sher-e-Bangla Agricultural University during the period from February to April (kharif-I season) of 2012 to study the effect of different combinations of organic and inorganic fertilizers on growth and yield of mungbean (BARI Mung 6) using RCBD (Randomized Completely Block Design) with three replications. During the experiment, three different organic fertilizers (Poultry manure, vermicompost and farm yard manure) were combined with four doses of inorganic fertilizers (25%, 50%, 75% and 100% of optimum dose) and one control treatment using no fertilizer and one treatment using only 100% of the optimum doses were included. At 30 DAS and at harvest highest plant height, number of leaves plant^{-1} and branches plant^{-1} were found from the combination of vermicompost and 100% inorganic fertilizer which was statistically similar or closely followed by vermicompost and 75% inorganic fertilizer treatment. Maximum numbers of pods plant^{-1}, seeds pod^{-1} and seeds plant^{-1} were recorded in vermicompost and 100% inorganic fertilizer and it was closely followed by vermicompost and 75% inorganic fertilizer. Highest seed yield plant^{-1}, 1000-seed weight and seed yield ha^{-1} was recorded in vermicompost + 100% of optimum dose of inorganic fertilizer and it was statistically similar with the treatment of vermicompost + 75% of optimum dose of inorganic fertilizer. It was observed that, for the above parameters; poultry manure + 100% of optimum dose of inorganic fertilizer and farm yard manure + 100% of optimum dose of inorganic fertilizer showed better results than sole 100% inorganic fertilizer. In some cases, poultry manure + 75% of optimum dose of inorganic fertilizer and farm yard manure + 75% of optimum dose of inorganic fertilizer also performed better than sole 100% inorganic fertilizer. Lowest values for all of the growth and yield parameters obtained from the treatment using no fertilizer.

Index Terms- Mungbean, Poultry manure, Vermicompost, Farm Yard Manure, Growth, Yield.

I. INTRODUCTION

Mungbean [*Vigna radiata* (L.)] is one of the most important pulse crops grown in Bangladesh. Its edible grain is characterized by good digestibility, flavor, high protein content and absence of any flatulence effects [1]. Its seed contains 24.7% protein, 0.6% fat, 0.9% fiber and 3.7% ash [2]as well as sufficient quantity of calcium, phosphorus and important vitamins. Due to its supply of cheaper protein source, it is designated as “poor man’s meat”. In Bangladesh, total production of pulses is only 0.65 million ton against 2.7 million tons requirement. This means the shortage is almost 80% of the total requirement [3]. This is mostly due to low yield [4]. Average yield of mungbean in Bangladesh is very low, which is primarily due to substandard methods of cultivation, poor crop stand, imbalanced nutrition, poor plant protection measures and lack of high yielding varieties. Mungbean yield and quality can be improved by the balanced use of fertilizers and also by managing the organic manures properly. Soil and fertilizer management is very complex and dynamic in nature. We are increasingly forced to meet up growing food needs from increase in yield from existing or even shrinking land areas. In this process, we are moving away from the traditional and rather static "soil dependent" agriculture to dynamic "fertilizer dependent" agriculture [5]. On one hand tropical soils are deficient in all necessary plant nutrients and on the other hand large quantities of such nutrients contained in domestic wastes and agricultural byproducts are wasted. Such large quantities of organic wastes generated also pose a problem for safe disposal. Most of these organic residues are burned currently or used as land fillings. In nature’s laboratory there are a number of organisms (micro and macro) that have the ability to convert organic waste into valuable resources containing plant nutrients and organic matter, which are critical for maintaining soil productivity. Microorganisms and earthworms are important biological organisms helping nature to maintain nutrient flows from one system to another and also minimize environmental degradation. Integrated management of chemical fertilizers and organic wastes may be an important strategy for sustainable production of crops. This may not only improve the efficiency of chemical fertilizers along with their minimal use in crop production besides increasing crop yield and improving available major and minor nutrients [6]. Being leguminous in nature, mungbean needs low nitrogen but require optimum doses of other major nutrients as recommended. Organic materials hold great promise as a source of multiple nutrients and ability to improve soil characteristics [7]. Organic farming preserves the ecosystem. Management of soil organic matter has now become a major issue in dealing with the problems of soil fertility and productivity in Bangladesh. Depletion of soil fertility has arisen principally due to increasing cropping intensity (presently about 190%), increasing use of MVs, soil erosion, sandy soils, and higher decomposition of organic matter due to sub-tropical humid climate. Balance use of fertilizer is important to obtain

maximum seed yield. Therefore, the objective of the study is to find the best combination of organic and inorganic fertilizer doses for better yield and quality of mungbean.

II. MATERIALS AND METHODS

Experimental site

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

Soil and climate

The experiment was conducted on silty clay loam soil of the Order Inceptisols. The soil of SAU farm is high land having irrigation facilities. The 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.

Experimental design

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

Organic and Inorganic Fertilizers and Doses :

1. Organic Fertilizers

a) Poultry manure (5 t ha^{-1})
b) Vermicompost (7 t ha^{-1})
c) Farm Yard Manure (8.5 t ha^{-1})

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

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

Organic fertilizer	C (%)	N (%)	P (%)	K (%)	C: N
Poultry manure[1]	29	2.19	1.98	0.81	8
Vermicompost[1]	11.54	1.66	1.25	0.254	9.60
Farm Yard Manure[2]	24	1.30	0.90	1.00	18.46

[8] Hasanuzzaman *et al*., 2010
[9] Chhonkar, 2003

2. Inorganic Fertilizer

a) Urea for nitrogen @ 25 kg ha^{-1}
b) TSP for phosphorous@ 50 kg ha^{-1}
c) MoP for potassium at @ 20 kg ha^{-1}
d) Gypsum for sulphur @30 kg ha^{-1}
e) Zinc sulphate for zinc @ 2.0 kg ha^{-1}
f) Boric acid for boron @ 1.5 kg ha^{-1}

Different treatments:

T_0 –Control

T_1 - Poultry manure + 25% ofoptimum dose of inorganic fertilizer

T_2 - Poultry manure + 50 % of optimum dose of inorganic fertilizer

T_3 - Poultry manure + 75 % of optimum dose of inorganic fertilizer

T_4 – Poultry manure + 100 % of optimum dose of inorganic fertilizer

T_5 -Vermicompost + 25% of optimum dose of inorganic fertilizer

T_6 - Vermicompost + 50 % of optimum dose of inorganic fertilizer

T_7 - Vermicompost + 75 % of optimum dose of inorganic fertilizer

T_8 - Vermicompost + 100 % of optimum dose of inorganic fertilizer

T_9 - Farm Yard Manure + 25% of optimum dose of inorganic fertilizer

T_{10} - Farm Yard Manure + 50 % of optimum dose of inorganic fertilizer

T_{11}- Farm Yard Manure + 75 % of optimum dose of inorganic fertilizer

T_{12} - Farm Yard Manure + 100 % of optimum dose of inorganic fertilizer

T_{13} - 100 % Inorganic Fertilizer

Fertilizer application

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

Harvesting

The crops were harvested at a time due to synchronous maturity of pods. At first 50% of early matured pods were harvested by hand picking at 55 days after sowing. Finally 4 days after first harvesting all plants were harvested plot-wise by uprooting and were bundled separately, tagged and brought to the threshing floor of the SAU farm.

Statistical analysis

The collected data on different growth and yield parameters and nutrient contents of mungbean were statistically analyzed. The means for all treatments were calculated and the analyses of variances for all the characters were performed by 'F' variance test using MSTAT-C computer package program. The significance of difference between pair of means was performed by the Dancan's Multiple Range Test (DMRT) [10].

III. RESULTS AND DISCUSSION

Plant height

The data on plant height of mungbean at different growth stages as influenced by organic and inorganic fertilizers are presented in Table 2. The plant height at 30 days after sowing (DAS) differed significantly due to combined application of organic and inorganic fertilizers. Significantly higher plant height (29.25 cm) was recorded in T_8 and it was followed by T_7 (28.05 cm) and T_4 (28.03 cm). T_7 and T_4 were statistically similar with T_{12} (27.89 cm), T_3 (27.45 cm) and T_{13} (27.58 cm).

Lowest plant height at 30 DAS was found from the treatment using no fertilizer (T_0 : 20.13 cm).

The plant height at harvest also differed significantly due to different treatments. Significantly higher plant height (43.81 cm) was recorded in T_8 and it was statistically similar with the application of vermicompost + 75% of optimum dose of inorganic fertilizer (T_7 : 43.60 cm) and followed by T_{12} (39.67 cm) and T_{13} (39.63 cm). Better results were also showed by T_4 and T_{11} which gave numerically equal plant height (38.77 cm). Lowest plant height at harvest was found from the treatment using no fertilizer (T_0 : 32.11 cm).

It seems from the results that combination of organic and inorganic fertilizers significantly increased the plant height than sole use of inorganic fertilizer. Actually organic fertilizers help to increase the organic matter content of soil, thus reducing the bulk density and decreasing compaction. Thus plants get a suitable growing environment which promotes better growth and development. Similar sort of findings were found by many scientists while experimenting with various crops. Combination of organic and inorganic fertilizers was found better by A.S. Channaveerswami (2005) in groundnut and D.J. Rajkhowa *et al*. (2002) in green gram than only inorganic fertilizers [11, 12].

Number of leaves

The data on number of leaves plant^{-1} of mungbean at different growth stages as influenced by organic and inorganic fertilizers are presented in Table 2. The number of leaves plant^{-1} at 30 days after sowing (DAS) differed significantly due to different treatments. Significantly higher number of leaves plant^{-1} (13.78) was recorded in T_8 and it was statistically similar with T_7 (13.67) and followed by T_{12} (12.80). Better results were also showed by T_{11} and T_4 which gave numerically equal value (11.86). On the other hand, 100 % inorganic fertilizer (T_{13}) (11.68) gave statistically similar number of leaves plant^{-1} with T_{11} and T_4. The treatment using no fertilizer produced lowest number of leaves plant^{-1} at 30 DAS among all the treatments (T_0 : 9.80).

The number of leaves plant^{-1} at harvest differed significantly due to different treatments. Highest number of leaves plant^{-1} (21.62) was recorded in T_8 and it was statistically similar with T_7 (21.53). T_4 (18.97) and T_{12} (20.87) with application of farm yard manure + 100% of optimum dose of inorganic fertilizer also showed better performances in comparison to sole 100 % inorganic fertilizer (T_{13}) which gave 18.74 leaves plant^{-1}. On the other hand, T_0 (No fertilizer) treatment showed lowest number of leaves plant^{-1} (14.07).

Results showed that the combination of organic and inorganic fertilizers significantly increased the number of leaves plant^{-1} than sole use of inorganic fertilizer. As organic fertilizers help to improve the soil condition and inorganic fertilizers assure quick availability of essential nutrients, the combination of two proved better than single use of the each. A.S. Channaveerswami (2005) and D.J. Rajkhowa *et al*. (2002) found better growth by using combination of organic and inorganic fertilizers than only inorganic fertilizers in groundnut and in green gram respectively [11, 12].

Number of branches plant^{-1}

The data on number of branches plant^{-1} of mungbean at different growth stages as influenced by organic and inorganic fertilizers are presented in (Table 3). The number of branches plant^{-1} at harvest also differed significantly due to different treatments. Significantly higher number of branches plant^{-1} (4.77) was recorded in T_8 and it was followed by T_7 (4.70) which was statistically similar with T_{12} (4.69) and T_{13} (4.59) and T_4 (4.41) also showed better performances among the rest treatments. On the other hand, among all the treatments, T_0 (No fertilizer) treatment showed lowest number of branches plant^{-1} (3.30) at harvest. Combination of organic and inorganic fertilizers significantly increased the number of branches plant^{-1} than sole use of inorganic fertilizer. As organic fertilizers help to improve the soil condition and inorganic fertilizers assure quick availability of essential nutrients, the combination of two proved better than single use of the each. A.S. Channaveerswami (2005) reported that combined application of vermicompost @ 2.5 t per ha + RDF (25:50:50 kg NPK per ha) + copper ore tailing recorded higher number of branches (6.92) in groundnut [11].

Number of pods plant^{-1}

The data on number of pods plant^{-1} of mungbean as influenced by organic and inorganic fertilizers are presented in (Table 3). Number of pods plant^{-1} showed significant variation due to the different combinations of organic and inorganic fertilizer doses. Maximum number of pods plant^{-1} (25.13) was recorded in T_8 and it was followed by T_7 (24.20) and T_4 (23.65). Better results were also showed by T_{12} (23.13) among rest of the treatments while 100 % inorganic fertilizer (T_{13}) gave 21.72 pods plant^{-1}. Minimum number of pods plant^{-1} was found from the treatment using no fertilizer (T_0 :13.47). Combination of organic and inorganic fertilizers increased the number of pods plant^{-1} than use of inorganic fertilizer alone. This may be because combination of organic and inorganic fertilizers improves soil physical properties, which provide health and favourable soil conditions to enhance nutrient use efficiency. Similar results were reported by A.S. Channaveerswami (2005) in groundnut and D.J. Rajkhowa *et al.* (2002) in green gram [11, 12]. Patil (1998) reported that in groundnut the maximum pod yield (30.04 q/ha) was recorded with the application of vermicompost @ 2.50 t per ha + fly ash @ 30 t per ha + RDF, whereas, the lowest pod yield (20.66 q/ha) was recorded with the application of RDF alone [13]. Abbas *et al.* (2011) found that application of DAP at 124 kg along with 10 tons ha^{-1} of poultry litter yielded maximum number of pods plant^{-1} [14].

Number of seeds pod^{-1}

The data on number of seeds pod^{-1} of mungbean as influenced by organic and inorganic fertilizers are presented in (Table 3). Number of seeds pod^{-1} showed significant variation due to the different combinations of organic and inorganic fertilizer doses. Maximum number of seeds pod^{-1} (14.87) was recorded in T_8 and it was closely followed by T_7 (14.31) which was statistically similar with T_4, T_{12} (13.97), T_{13} (13.76), T_{11} (13.73) and T_3 (13.68). Minimum number of seeds pod^{-1} was found from the treatment using no fertilizer (T_0 :10.93). Combination of organic and inorganic fertilizers increased the number of seeds pod^{-1} than use of inorganic fertilizer alone. This may be because combination of organic and inorganic fertilizers

improves soil physical properties, which provide health and favourable soil conditions to enhance nutrient use efficiency. Similar results were reported by A.S. Channaveerswami (2005) in groundnut and D.J. Rajkhowa *et al*. (2002) in green gram. B.S. Patil (1998) reported that in groundnut the maximum number of seeds pod^{-1} was recorded with the application of vermicompost @ 2.50 t per ha + fly ash @ 30 t per ha + RDF, whereas, the lowest number of seeds pod^{-1} was recorded with the application of RDF alone. G. Abbas *et al*. (2011) found that application of DAP at 124 Kg along with 10 tons ha^{-1} of poultry litter yielded maximum number of seeds pod^{-1}.

Number of seeds plant^{-1}

The data on numberof seeds plant^{-1} of mungbean as influenced by organic and inorganic fertilizers are presented in (Table 3). Number of seeds plant^{-1} showed significant variation due to the different combinations of organic and inorganic fertilizer doses. Maximum number of seeds plant^{-1} (319.56) was recorded in T_8 and it was followed by T_7 (302.17). Among the remaining treatments better results were also showed by T_{11} (Farm Yard Manure + 100% of optimum dose of inorganic fertilizer) (286.35) and T_4 (Poultry manure + 100% of optimum dose of inorganic fertilizer) (285.96) while 100 % Inorganic Fertilizer (T_{13}) gave 276.64 seeds plant^{-1}. Minimum number of seeds plant^{-1} was found from the treatment using no fertilizer (T_0 :196.16). It is revealed from the result that combination of organic and inorganic fertilizers increased the number of seeds plant^{-1} than use of inorganic fertilizer alone. This may be due to increase in the number of pods plant^{-1} and seeds pod^{-1}. Similar results were reported by A.S. Channaveerswami (2005) in groundnut and D.J. Rajkhowa *et al*. (2002) in green gram [11, 12]. B.S. Patil (1998) reported that in groundnut the maximum number of seeds pod^{-1} was recorded with the application of vermicompost @ 2.50 t per ha + fly ash @ 30 t per ha + RDF, whereas, the lowest number of seeds pod^{-1} was recorded with the application of RDF alone [13]. G. Abbas *et al*. (2011) found that application of DAP at 124 Kg along with 10 tons ha^{-1} of poultry litter yielded maximum number of seeds pod^{-1} [14].

Seed yield plant^{-1}

The data on seed yield plant^{-1} of mungbean as influenced by organic and inorganic fertilizers are presented in (Table 4). Seed yield plant^{-1} showed significant variation due to the different combinations of organic and inorganic fertilizer doses. Among all the treatments, the highest seed yield plant^{-1} (15.23 g) was recorded in T_8 vermicompost + 100% of optimum dose of inorganic fertilizer) and it was statistically similar with application of vermicompost + 75% of optimum dose of inorganic fertilizer (T_7:14.23 g) and closely followed by T_4 (Poultry manure + 100% of optimum dose of inorganic fertilizer) (13.17 g) and T_{12} (Farm Yard Manure + 100% of optimum dose of inorganic fertilizer) (12.89 g). 100 % Inorganic Fertilizer (T_{13}) gave a yield of 10.27 g plant^{-1}. The lowest seed yield plant^{-1} was found from T_0 among all the treatments which was 8.54 g plant^{-1}. It was revealed from the result that combination of organic and inorganic fertilizers increased the seed yield plant^{-1} than use of inorganic fertilizer alone. This may be due to higher pods plant^{-1}, seeds pod^{-1} and seeds plant^{-1}. Similar results were reported by A.S. Channaveerswami (2005) in groundnut and D.J. Rajkhowa *et al*. (2002) in green gram [11, 12]. B.S. Patil (1998) reported that in groundnut the maximum seed yield plant^{-1} was recorded with the application of vermicompost @ 2.50 t per ha + fly ash @ 30 t per ha + RDF, whereas, the lowest seed yield plant^{-1} was recorded with the application of RDF alone [13]. G. Abbas *et al*. (2011) found that application of DAP at 124 Kg along with 10 tons ha^{-1} of poultry litter yielded maximum seed yield plant^{-1}[14].

1000-seed weight

The data on 1000-seed weight (g) of mungbean as influenced by organic and inorganic fertilizers are presented in (Table 4). 1000-seed weight showed significant variation due to the different combinations of organic and inorganic fertilizer doses. Highest1000-seed weight (41.95 g) was recorded in T_8 and it was statistically similar with the treatment of vermicompost + 75% of optimum dose of inorganic fertilizer (T_7:41.65g) and closely followed by T_{12} (41.35 g). Among the remaining treatments better results were also showed by T_4 (39.89 g) while 100 % inorganic fertilizer (T_{13}) gave a value of 40.34 g for 1000-seed weight. Among all the treatments, the lowest 1000-seed weight was found from the treatment using no fertilizer (T_0 :35.17 g). It is revealed from the result that combination of organic and inorganic fertilizers increased the 1000-seed weight than use of inorganic fertilizer alone. This may be because organic fertilizers are known to contain plant nutrients, growth promoting substances and beneficial microflora which in combination with inorganic fertilizers provide favourable soil conditions to enhance nutrient use efficiency. Similar results were reported by A.S. Channaveerswami (2005) in groundnut and D.J. Rajkhowa *et al*. (2002) in green gram [11, 12]. B.S. Patil (1998) reported that in groundnut the maximum 1000-seed weight was recorded with the application of vermicompost @ 2.50 t per ha + fly ash @ 30 t per ha + RDF, whereas, the lowest 1000-seed weight was recorded with the application of RDF alone [13]. G. Abbas *et al*. (2011) found that application of DAP at 124 Kg along with 10 tons ha^{-1} of poultry litter yielded maximum1000-seed weight [14].

Seed yield ha^{-1}

The data on seed yield ha^{-1} of mungbean as influenced by organic and inorganic fertilizers are presented in (Table 4). Seed yield ha^{-1} showed significant variation due to the different combinations of organic and inorganic fertilizer doses. Among the treatments, the highest seed yield ha^{-1} (1156.19 kg) was recorded from T_8 and it was statistically identical with T_7 (1138.89 kg) and closely followed by T_{12} (1095.33 kg) and T_{11} (1083.33 kg). T_{12} and T_{11} showed no difference statistically. Better results were also showed by T_4 (1055.23 kg) while100 % inorganic fertilizer (T_{13}) gave seed yield of 1050.56 kg ha^{-1}. Lowest seed yield ha^{-1} was found from the treatment using no fertilizer (T_0 : 617.22 kg). It is revealed from the result that combination of organic and inorganic fertilizers increased the seed yield ha^{-1} than use of inorganic fertilizer alone. This may be because organic fertilizers are known to contain plant nutrients, growth promoting substances and beneficial microflora which in combination with inorganic fertilizers provide favourable soil conditions to enhance nutrient use efficiency. Similar results were reported by A.S. Channaveerswami (2005) in groundnut and D.J. Rajkhowa *et al*. (2002) in green gram[11, 12]. B.S. Patil

(1998) reported that in groundnut the maximum seed yield ha^{-1} was recorded with the application of vermicompost @ 2.50 t per ha + fly ash @ 30 t per ha + RDF,whereas, the lowest seed yield $ha^{-1}$was recorded with the application of RDF alone [13]. G. Abbas *et al.* (2011) found that application of DAP at 124 Kg along with 10 tons ha^{-1} of poultry litter yielded maximum seed yield ha^{-1} [14].

IV. CONCLUSION

From the above results it can be concluded that combination of organic and inorganic fertilizer is more productive compare to sole use of inorganic fertilizers. By combining the both, we may be able to reduce the doses of inorganic fertilizers. It is evident from the results that, in case of BARI Mung 6, vermicompost +75% of inorganic fertilizer gave statistically same yield with vermicompost + 100% of inorganic fertilizer. So, if we use vermicompost + 75% of inorganic fertilizer, it will allow us to reduce the use of 25% inorganic fertilizer at least.

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