

Comparative Study of Inorganic Fertilizers and Organic Manures on Yield and Yield Components of Mungbean (*Vigna radiata* L.)

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ABSTRACT

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

Key Words: Organic manures; Inorganic fertilizers; Mungbean; Bio-fertilizers

INTRODUCTION

Mungbean is cultivated on an area of 261.4 thousands hectares with total grain production of 134.4 thousands tonnes and average yield of 482.63 kg ha⁻¹ (Anonymous, 2003). It has the potential of producing higher grain yield of about 1295 kg ha⁻¹ (Bilal, 1994). Average yield of mungbean in Pakistan 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.

Organic farming preserves the ecosystem. Symbiotic life forms are cultured ensuring weed and pest control and optimum soil biological activity, which maintain fertility. Organic farming neither demands the use of synthetic fertilizers nor the harmful chemicals (pesticides & fungicides) for controlling weeds, insects and pests. The synthetic fertilizers are harmful for soil and aerial environment, because the inorganic fertilizers mainly contain major nutrients NPK in large quantities and are neglecting the use of organic manures and biofertilizers and hence have paved the way for deterioration of soil health and in turn ill-effects on plants, human being and livestock (Choudhry, 2005). Most of the soil applied fertilizers (nitrogenous), leach down below the root zone or into the ground water, which pollute the ground water causing diseases mainly "Methemoglobinemia" (Choudhry, 2005). Organic farming relies on large-scale application of animal or farm yard manure (FYM), compost, crop rotation,

residues, green manuring, vermicompost, bio-fertilizers and bio-pesticides.

Improved cultivars are an important input, which geared revolution in many countries of the world. Like other factors such as quality seed, proper use of fertilizer and irrigation, cultivar with higher yield potential is of prime importance. The present paper aims at finding the effect of seed inoculation, organic manures and inorganic fertilizers on growth and yield of two mungbean cultivars under conditions in Faisalabad.

MATERIALS AND METHODS

A field experiment was conducted to see the effect of inorganic and organic fertilizers on growth and yield of mungbean at Post Graduate Agricultural Research Station (PARS), University of Agriculture Faisalabad during the year 2005. The soil was loam soil having 1.10% organic matter, 22.4 ppm available P and 170 ppm available K with pH of 7.5 at a depth of 0 - 15 cm and 0.93% organic matter, 18.7 ppm available P and 155 ppm available K with pH of 7.8 at a depth of 16 - 30 cm. The experiment treatments were NPK at 25 - 50 - 50 kg ha⁻¹, poultry manure at 3.5 t ha⁻¹, FYM at 5 t ha⁻¹ and Bio-fertilizer at 8 g kg⁻¹ seed.

Urea, di-ammonium phosphate (DAP) and potassium sulfate (K₂SO₄) were used as sources of N, P₂O₅ and K₂O, respectively. Nitrogen was applied as a starter dose to meet the initial N requirement and all other fertilizers i.e., DAP, K₂SO₄ and organic manures were applied at the time of seedbed preparation. Bio-fertilizer was applied through seed inoculation just prior to sowing. All other agronomic

practices were same for all treatments. Experiment was laid out in randomized complete block design (RCBD) with factorial arrangement having three replications. Net plot size was 3.0 m × 5.0 m. Mungbean cultivars were sown on August 10, 2005 on a well-prepared seedbed with the help of single row hand drill using seed rate of 20 kg ha⁻¹. Thinning was done to maintain a row-to-row distance of 30 cm. Crop took 70 days to mature. Data regarding number of pods per plant, number of grains per pod, 1000 grain weight (g) and grain yield (kg ha⁻¹) were recorded. Standard procedures were adopted to record data. The data so collected were analyzed statistically by using Fisher's analysis of variance technique and least significance difference test at 0.05-probability level was used to separate the treatment means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

The maximum number of pods plant⁻¹ (18.43) were recorded in treatment NPK in variety NM-98 and (17.70) in variety M-1. These both were, however, statistically at par with variety NM-98, where PM was applied (Table I). The minimum number of pods plant⁻¹ (14.50) was observed in seed inoculation treatment in variety M-1 and (15.23) in variety NM-98. The increased pod formation in treatment, where NPK fertilizers were applied may be attributed due to better plant development through efficient utilization of soil resources by the plant, where primary growth elements were available in sufficient amount. It also showed that either NM-98 was best utilizer of fertilizers or it had more genetic potential to produce more pods plant⁻¹. Similar results were also reported by Khan (2004).

The maximum number of grains pod⁻¹ (12.54) was found in treatment NPK in variety NM-98 and (11.38) in variety M-1 (Table I). The minimum number of grains pod⁻¹ (9.78) were noted in seed inoculation treatment in variety M-1 and (10.63) in variety NM-98. The decrease in number

of grains pod⁻¹ may be attributed due to deficiency of essential nutrients (NPK) at the time of flowering and seed setting stage of plant, because at this stage phosphorous is required by the plant to complete such important growth stages like that of flowering and seed setting optimally, while K is required by the plant to improve seeds quality. While in case of treatment NPK at 25:50:50 kg ha⁻¹ these nutrients were available in optimum dose for the plant to complete the mentioned stages with out facing any difficulty. Similar results were reported by Malik *et al.* (1988), Srinivas and Shaik (2002).

The maximum 1000-grain weight (40.86) was recorded in treatment NPK in variety NM-98 and (40.55) in the same variety NM-98 but the treatment was PM, which was however statistically at par with variety M-1 in NPK treatment (Table I). The minimum 1000-grain weight (36.99) was found in seed inoculation treatment in variety M-1 and (37.94) in variety NM-98. Increase in 1000-grain weight may be due to application of optimum dose of fertilizers particularly phosphorous, because phosphorous contents of seed (Phosphoprotein, Phospholipids & Adenosine Triphosphate etc.) were increased, which finally improved the seed weight and application of optimum dose of K to improve the quality of seed may have effect on seed weight. These results are in line with that of Rao *et al.* (1993), Srinivas and Shaik (2002).

The treatment NPK produced maximum grain yield (1122.0) in variety NM-98 and (1085.0) in variety M-1 (Table I). The minimum grain yield (816.6) was noted in seed inoculation treatment in variety NM-98 and (902.7) in variety M-1, which are statistically at par with each other. The better grain yield may be due to that all plant parameters like number of pods plant⁻¹, number of grains pod⁻¹, 1000-grain weight. Reduction in yield may be due to nutritional imbalance and deficiency of certain important plant growth nutrients at various important growth stages like that of flowering, seed formation and seed maturity.

Table I. Effect of inorganic fertilizers, organic manures and bio-fertilizer on yield and yield components of mungbean

Treatments		Number of pods plant ⁻¹	Number of grains pod ⁻¹	1000-grain weight (g)	Grain yield (kg ha ⁻¹)
Varieties					
V ₁	NM-98	16.77 a*	11.46 a	39.71 a	962.52 a
V ₂	M-1	15.76 b	10.25 b	38.57 a	940.05 a
Inorganic fertilizers and organic manures					
F ₁	NPK at -25-50-50 kg ha ⁻¹	18.06 a	11.55 a	40.55 a	1104.0 a
F ₂	PM at 3.5 t ha ⁻¹	16.93 b	10.86 b	39.55 b	1001.25 b
F ₃	FYM at 5 t ha ⁻¹	15.20 c	10.82 b	39.03 b	890.75 c
F ₄	Rhizobia at 8 g kg ⁻¹ seed	14.87 c	10.20 c	37.46 c	809.65 d
Interaction					
V ₁ x F ₁		18.43 a	12.54 a	40.86 a	1122.0 a
V ₁ x F ₂		17.70 a	11.38 b	40.55 ab	1009.0 b
V ₁ x F ₃		15.73 b	11.32 b	39.50 bc	902.5 c
V ₁ x F ₄		15.23 bc	10.63 c	37.94 de	816.6 d
V ₂ x F ₁		17.70 a	10.57 c	40.42 ab	1085.0 a
V ₂ x F ₂		16.17 b	10.34 cd	38.50 cd	993.5 b
V ₂ x F ₃		14.67 c	10.33 cd	38.57 cd	879.0 c
V ₂ x F ₄		14.50 c	9.78 d	36.99 e	802.7 d

*Means not sharing a letter in common differ significantly at 5% probability (LSD); PM: Poultry manure; FYM: Farm yard manure

Table II. Economic analysis

	T1	T2	T3	T4	T5	T6	T7	T8	Remarks
Grain yield	1122	1009	902	817	1085	994	879	803	Kg ha ⁻¹
Adjusted Yield	1010	908	812	735	977	894	790	722	Bring at farmers levels (10%)
Gross income	21462	19295	18530	15618	20761	18997	16787	15342	Rs. 850/40 Kg.
NPK fertilizer	4450	0	0	0	4450	0	0	0	Rs. ha ⁻¹
Poultry manure	0	1500	0	0	0	1500	0	0	Rs. 430/t
Farm yard manure	0	0	1100	0	0	0	1100	0	Rs. 220/t
Seed Inoculant	0	0	0	30	0	0	0	30	Rs. 15/packet
Spray charges	500	0	0	0	500	0	0	0	Chloropyrifos at Rs.500/L/ha ⁻¹
Cost that vary	4950	1500	1100	30	4950	1500	1100	30	Rs. ha ⁻¹
Net Profit	16512	17795	17430	15588	15811	17497	15687	15312	Rs. ha ⁻¹

T1= NPK @ 25:50:50 kg ha⁻¹ + NM-98, T2= PM @ 3.5 t ha⁻¹ +NM-98, T3= FYM @ 5 t ha⁻¹ + NM-98, T4= Biofertilizer (*Rhizobium*) @ 8 g per kg of seed +NM-98, T5= NPK @ 25:50:50 kg ha⁻¹ + M-1, T6= PM @ 3.5 t ha⁻¹ + M-1, T7= FYM @ 5 t ha⁻¹ + M-1 T8= Biofertilizer (*Rhizobium*) @ 8 g per kg of seed +M-1

Table III. Marginal analysis

Treatments	Rates	Cost that vary (Rs.)	Net profit (Rs.)	Change in cost vary (Rs.)	Change in net benefit (Rs.)	Marginal rate of return (%)
T8= Biofertilizer (<i>Rhizobium</i>)	8 g per kg of seed + M-1	30	15312	30	0	0
T4 = Biofertilizer (<i>Rhizobium</i>)	8 g per kg of seed +NM-98	30	15588	0	276	0
T3 = Farm Yard Manure	5 t ha ⁻¹ + NM-98	1100	17430	1070	1842	172.14
T7 = Farm Yard Manure	5 t ha ⁻¹ + M-1	1100	15687	0	-	D
T6 = Poultry Manure	3.5 t ha ⁻¹ +M-1	1500	17497	400	-	D
T2 = Poultry Manure	3.5 t ha ⁻¹ +NM-98	1500	17795	0	-	D
T5= NPK fertilizer	25:50:50 kg ha ⁻¹ + M-1	4950	15811	3450	-	D
T1 =NPK fertilizer	25:50:50 kg ha ⁻¹ +NM-98	4950	16512	0	-	D

D = Dominated; Marginal rate of return (%) = $\frac{\text{Change in net benefit}}{\text{Change in cost}} \times 100$; Cost that vary = The cost that is incurred on variable inputs in the production

These results strongly confirm the reported findings of Sharma and Room (1993), Shahi (2002) and Khan *et al.* (2002).

In economic analysis, maximum net benefit was obtained in treatment T₂ (Table II), where Poultry Manure at 3.5 t ha⁻¹ + NM-98 was applied. This was followed by the treatment T₆, where Poultry Manure at 3.5 t ha⁻¹ + M-1, was applied. But the plot in which Farmyard manure at 5 t ha⁻¹ + NM-98 (T₃) was applied gave the maximum marginal rate of return i.e., 172.14% (Table III). All other treatments were dominated or un-economical than treatment T₃ (PM at 3.5 t ha⁻¹ + NM-98). Findings of this study provided a sound base to believe that organic manures especially farmyard manure can replace the application of inorganic fertilizers for obtaining maximum net benefit.

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