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INTEGRATION OF ORGANIC & INORGANIC SOURCES OF PHOSPHORUS FOR INCREASED PRODUCTIVITY OF MUNGBEAN (*VIGNA RADIATA* L.)

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A field investigation was carried out to evaluate the effect of organic and inorganic sources of phosphorous on the growth and yield of mungbean (*Vigna radiate* L.). FYM, poultry manure and chemical fertilizer were accumulated at various concentrations to formulate different treatments. Analysis of data revealed significant differences with respect to plant height, number of plants m^{-2}, leaf area (cm^{2}), root length (cm), number of pod bearing branches plant $^{-1}$, number of pods plant^{-1}, number of seeds pod^{-1}, pod size (cm), number of seeds plant $^{-1}$, 1000 seed weight (g), biological yield (Kg ha^{-1}), seed yield (Kg ha^{-1}), harvest index (%) and grain protein contents (%) indicating primacy of integration of the two sources in having improved mungbean productivity.
Keywords: Mungbean, phosphorous, organic and inorganic sources, yield

INTRODUCTION

Mungbean (*Vigna radiata* L.) is important short duration, draught tolerant pulse crop in Pakistan commonly known as “green gram”. Its seed contains 24.7% protein, 0.6% fat, 0.9% fiber and 3.7% ash (Potter and Hotchkiss, 1997) as well as sufficient quantity of calcium, phosphorus and important vitamins. Due to its supply of as cheaper protein source designated it as “poor man’s meat”. In Pakistan it occupies an area of about 245.4 thousand hectares with total annual seed production of 130 thousand tones giving an average grain yield of 550-650 kg ha $^{-1}$ (Anonymous, 2006) which is low as compared to other agriculturally advanced countries of the world. The low yield of mungbean besides other factors may partially be due to lack of knowledge about nutrition and modern production technology (Hassan, 1997). Moreover, lack of attention on fertilizer use is also instrumental in lowering mungbean yields (Mansoor, 2007). Being leguminous in nature, mungbean needs low nitrogen but require optimum doses of other major nutrients as recommended. Phosphorous (P) is a vital yield determining nutrient in legumes (Chaudhary, 2008). Similarly, phosphorous is essential nutrient for getting higher output per unit area with better grain quality (Bajwa *et al*., 1992). The need to apply phosphorous is also inevitable recognizing that almost 90% of soils in Pakistan are deficient in P at different severity levels (Aslam *et al.*, 1994). Moreover, application of phosphorus in optimum amount reported an increase in yield and yield contributing parameters of mungbean (Mitra *et al.,* 1999). Reliance on the increased use of chemical fertilizers and associated hazards put back attention on organic sources which are effective in promoting health and productivity of the soil. 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 (Rautaray *et al*., 2003). The availability of P can be increased if it is mixed with FYM (Hussain *et al*., 2008) Integrated use of organic and inorganic fertilizers guarantee improved soil health and fertility (Satyanarayana *et al*., 2002). Bending *et al.,* (2002) concluded that crop residues and soil organic matter both could affect the diversity of soil microbial community and increase the crop growth and yield. Integrated use of nutrient may be one of the solutions to increase mungbean production as well as reducing cost of production and make the best use of locally available resources like animal dung, urine, crop residues etc. The use of organic matter as a low cost supplement to the artificial fertilizers may help decreasing the cost of production. Therefore, present study was designed to investigate the suitable levels of organic and inorganic sources of phosphorus at constant levels of nitrogen and potassium for obtaining increased growth, yield and quality of mungbean.

MATERIALS AND METHODS

A field experiment was conducted to study the effect of Organic (FYM & Poultry Manure) and inorganic sources of Phosphorus on the growth and yield of Mungbean (*Vigna radiata* L.). Mungbean genotype NM-92 was used in the experiment. The trial was laid out in Randomized Complete Blocked Design (RCBD) with three replications. The net plot size was measured 1.5 x 3.0 m. All the Nitrogen and Potash, @30 Kg ha^{-1} each in the form of Urea and SOP, was applied while Phosphorus and organic sources were applied as per treatment of experiment in each plot. The treatment plan is represented as:

T_1=Control, T_2=P_2O_5 @ 75 kg ha^{-1},T_3=FYM @ 12500 kg ha^{-1}, T_4=Poultry manure @ 4680 kg ha^{-1}, T_5=Chemical P_2O_5 @ 38 kg ha^{-1} + FYM @ 6250 kg ha^{-1}, T_6=Chemical P_2O_5 @ 38 kg ha^{-1} + Poultry manure@2345 kg ha^{-1}, T_7=Chemical P_2O_5 @ 75 kg ha^{-1} + FYM @ 12500 kg ha^{-1}, T_8=Chemical P_2O_5@75 kg ha^{-1}+Poultry manure@4680 kg ha^{-1}.

Crop was sown with the help of single row hand drill in rows 30 cm apart. The seed rate @ 25 Kg ha^{-1} was used to obtain desired plant population .The entire quantity of organic and inorganic fertilizer was applied before drilling the seed. Inorganic phosphorus, nitrogen and potassium were applied in the form of triple super phosphate, urea and potassium sulphate and organic phosphorus in the form of FYM and poultry manure, respectively. The plant population was maintained by thinning out the surplus plants. All other cultural practices were performed uniformly for all treatments. The observations were recorded during the course of study including number of plants m^{-2}, plant height at maturity (cm), 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 (%). The data analyzed statistically by using Fishers' analysis of variance technique and Duncan 's New Multiple Range test at 5 % probability level was used to compare the difference among the treatment means (Steel and Torrie, 1984). The economic analysis of the data was done all to the methodology described in CIMMYT (1988).

RESULTS AND DISCUSSION

Table 1 shows the effect of organic and inorganic sources of phosphorous on different parameters of mungbean. Plant height reflects significant differences as affected by different sources of phosphorus The maximum plant height of 66 cm was recorded in treatments T_3 and T_4 which remained at par with T_2, T_5 and T_7 . Similar results were reported by Deotale *et al*. (2005) that cow urine alone and along with DAP or urea was also useful in improving the plant height of green gram. Treatment T_5 produced the maximum leaf area (61.37 cm^2) which corroborates the findings of Anburani and Manivannan (2002), Das *et al*., (2002) and LiZongxin *et al.,* (2004). Maximum root length (25.17 cm) was recorded in T_7 which is statistically equal to T_2 (24.67 cm). These results are in complete agreement with those of Das *et al*. (2002) and Deotale *et al.* (2005). Regarding producing pod bearing branches T_5 resulted in the maximum number of pod bearing branches $plant^{-1}$ (6.67) but it did not differ statistically from treatment T_4, T_3 and T_7. Conformity to these results is obtained with those of Deotale *et al.* (2005). Data on number of pods revealed T_3 yielded maximum pods $plant^{-1}$ (25.67). These results are similar to the findings of Lakpale *et al.* (2003) and Khan *et al.* (2004). When number of seeds pod^{-1} were estimated, T_5 and T_3 produced the maximum numbers (10) which substantiate the results by Lakpale *et al.* (2003) who revealed that application of Farmyard manure alone or in combination with the inorganic fertilizer significantly increased the number of seeds pod^{-1} of green gram. Similarly T_3 produced maximum pod length (8.67), number of seeds $plant^{-1}$ (244.33) and 1000-seed weight (77.67 g), seed yield (1775.33 Kg ha^{-1}) and harvest index (31.14%). These findings are well supported by Ghaffar (1990), Lakpale *et al.,* (2003), Khan *et al.* (2004), Vikrant *et al.* (2004), Deotale *et al.* (2005), Mahavishnan *et al.,* (2005) and Kumar *et al.* (2005). Regarding grain protein contents, higher percentage (25.26) was recorded in T_7 which is comparable to T_8. These results are similar to the findings Ghafoor (1988) who revealed that protein contents in seed were increased with the application of nitrogen and phosphorous at higher level. Data presented in Table 2 presented net income and cost benefit ratio. Data revealed the highest NFB (Rs. 71013 ha^{-1} and 69293 ha^{-1}, respectively) with BCR of (2.69) was recorded with T_3 and T_5.

CONCLUSION

Organic sources alone or in combination with inorganic sources proved vital in attaining economical harvests that emphasize the need to adopt integrated nutrient management. This will result into increasing farmer's premiums as well as maintain soil nutrition. Moreover, this practice would have an environmental friendly strategy.

Table 1. Effect of organic and inorganic sources of phosphorous on the growth and yield of mungbean (*Vigna radiate* L.)

Variables	Treatment Means								F. value
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	
Number of plants^{-1}	45.00	46.00	47.00	46.00	47.00	46.00	47.00	46.00	1.20^{NS}
Plant height (cm)	51.67 c	64.00 a	66.00 a	66.00 a	65.00 a	59.00 b	64.33 a	58.00 b	23.49**
Leaf area (cm^{-2})	44.96 c	42.17 c	56.19 ab	60.92 ab	61.37 a	45.62 c	54.83 b	45.83 c	14.26**
Root length (cm)	18.00 e	24.67 ab	22.33 cd	21.42 d	23.50abc	21.92 cd	25.17 a	23.42 bc	16.47**
Pod bearing branches plant^{-1}	4.33 d	5.33 bcd	6.00 ab	6.00 ab	6.67 a	5.67 abc	6.00 ab	4.67 cd	5.00**
Number of pods plant^{-1}	16.00 d	24.00 ab	25.67 a	19.67 c	24.33 ab	20.33 c	23.00 b	19.00 c	32.38**
Number of seeds plant^{-1}	7.33 d	9.67 ab	10.00 a	8.67 bc	10.00 a	8.67 bc	9.67 ab	8.33 cd	7.71**
Pod size (cm)	6.83 d	7.75 bc	8.67 a	7.67 bcd	8.33 ab	7.67 bcd	8.33 ab	7.33 cd	4.57**
Number of seeds plant^{-1}	126 d	240 a	244 a	190 bc	243 a	224a bc	234 ab	183 c	7.22**
1000-seed weight (g)	70.67 d	75 b	77.67 a	74.00 bc	76.00 ab	72.33 cd	75 b	71.67 cd	7.67**
Biological yield (kg ha^{-1})	5558 c	5579 bc	5701 a	5614 b	5689 a	5592 bc	5578 bc	5625 b	8.68**
Seed yield (kg ha^{-1})	1394 e	1689abc	1775 a	1607bcd	1732 ab	1578 cd	1689 abc	1521 de	7.53**
Harvest Index (%)	25.09 d	30.28 ab	31.14 a	28.60 bc	30.45 ab	28.33 bc	30.28 ab	27.02 cd	7.42**
Grain protein contents (%)	21.95 c	22.89 bc	23.52 b	22.33 c	23.81 b	22.22 c	25.26 a	24.79 a	14.33**

NS = Non-significant (P>0.05), ** = Highly significant (P<0.01)

Means followed by different letters in the same column are significantly different from each other at 5% level.

T_1=Control, **T_2**=P_2O_5 @ 75 kg ha^{-1},**T_3**=FYM @ 12500 kg ha^{-1}, **T_4**=Poultry manure @ 4680 kg ha^{-1}, **T_5**=Chemical P_2O_5 @ 38 kg ha^{-1} + FYM @ 6250 kg ha^{-1}, **T_6**=Chemical P_2O_5 @ 38 kg ha^{-1} + Poultry manure@2345 kg ha^{-1}, **T_7**=Chemical P_2O_5 @ 75 kg ha^{-1} + FYM @ 12500 kg ha^{-1}, **T_8**=Chemical P_2O_5@75 kg ha^{-1}+Poultry manure@4680 kgha^{-1}

Table 2. Net income and benefit cost ratio (BCR) as affected by different Organic and inorganic sources of phosphorus

Treatments	Total expenditure (Rs. Ha^{-1})	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	BCR
T_1	24921	55773	34009	2.23
T_2	25201	67573	42372	2.68
T_3	26386	71013	44627	2.69
T_4	25667	64293	39626	2.50
T_5	25794	69293	43499	2.69
T_6	25934	63120	38186	2.43
T_7	30266	67573	37307	2.23
T_8	28547	60840	32293	2.13

T_1=Control, **T_2**=P_2O_5 @ 75 kg ha^{-1},**T_3**=FYM @ 12500 kg ha^{-1}, **T_4**=Poultry manure @ 4680 kg ha^{-1}, **T_5**=Chemical P_2O_5 @ 38 kg ha^{-1} + FYM @ 6250 kg ha^{-1}, **T_6**=Chemical P_2O_5 @ 38 kg ha^{-1} + Poultry manure@2345 kg ha^{-1}, **T_7**=Chemical P_2O_5 @ 75 kg ha^{-1} + FYM @ 12500 kg ha^{-1}, **T_8**=Chemical P_2O_5@75 kg ha^{-1}+Poultry manure@4680 kgha^{-1}.

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