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Response of Phosphorus Application on Growth and Yield of Inoculated and Un-inoculated Mungbean (*Vigna radiata*)

M.A. KHAN, M. ASLAM, TARIQ SULTAN AND I.A. MAHMOOD
Soil Biology and Biochemistry, NARC, Park Road, Islamabad–45500, Pakistan

ABSTRACT

A pot study was conducted at National Agricultural Research Centre, Islamabad to determine the effect of different levels of phosphorus on growth and yield of mungbean under inoculated and un-inoculated conditions. The rates of phosphorus application were 0, 50, 75, and 100 kg P_2O_5 ha^{-1} as SSP. In control (uninoculated) treatments, linear increase in total Biomass, straw yield and grain yield was observed with increasing the rates of phosphorus fertilizer. Maximum increase in these parameters was found with phosphorus application @ 100 kg ha^{-1} P_2O_5. While in case of inoculated treatments, maximum increase in number of pods, total Biomass, straw yield and grain yield was observed with phosphorus @ 75 kg ha^{-1} P_2O_5 as compared to the rest of treatments. Further increase in phosphorus (100-kg ha^{-1} P_2O_5) application decreased the number of pods, total Biomass, straw and grain yield.

Key Words: Mungbean; Phosphorus; Inoculation; Growth; Yield

INTRODUCTION

Pulses are cheap source of vegetable protein, contain 20-25% protein and are known as poor man's meat in the developing countries. The Mungbean (*Vigna radiata*) is prized among all the pulse species because it is easily digestible pulse. Mungbean production has remained static during the last decade; as a result, the gap between supply and demand is widening. It is grown in Pakistan on 197.6 thousand hectares with the production of 91.2 thousand tones of grain annually giving an average yield of 461.5 kg ha^{-1} (Anonymous, 1998), which is much below the harvested potential of our existing varieties. Therefore, it is necessary to improve the weak chains of crop production lays emphasis on the judicious use of artificial/commercial fertilizer to ensure a rich crop harvest.

Being a legume crop, it requires less nitrogen but phosphorus is considered important inputs to get high yields per unit area, moreover, mungbean is naturally nodulation crop to some extent and the degree of nodulation varies with the area and culture being used. Patel *et al.* (1984) found significant increase in mungbean yield with 20 kg N and 40 kg P_2O_5 ha^{-1}. They further observed that increasing phosphorus rates showed an increase in the number of pods per plant and 1000 grain weight, while Ghafoor (1985) stated that maximum protein contents were obtained with the application of 20 and 100 kg ha^{-1} N and P to Mungbean. However, Arya *et al.* (1988) reported that application of 25-75 kg ha^{-1} P_2O_5 to *Vigna radiata* increased the seed yield, protein content and P uptake. The present study was, therefore, designed to see the response of Mungbean to different rates of phosphorus for realizing the maximum yield potential under inoculated and uninoculated soil conditions.

MATERIALS AND METHODS

A pot experiment was conducted to determine the varying levels of P on the growth and yield of Mungbean under inoculated and uninoculated conditions in the Green house of National Agricultural Research Centre, Islamabad during 1999. The seven treatments were: T_1= control (No P_2O_5); T_2= 50 kg P_2O_5 (uninoculated); T_3= 75 kg P_2O_5 (uninoculated); T_4= 100 kg P_2O_5 (uninoculated); T_5= 50 kg P_2O_5 (inoculated); T_6= 75 kg P_2O_5 (inoculated); T_7= 100 kg P_2O_5 (inoculated).

The experiment was laid out in a Randomized Complete Block Design. Each pot (30 x 20 cm) was filled with air dried homogenized soil (OM=0.34%, N =0.04%, P = 0.27 µg g^{-1}, sandy clay loam). Seed of rhizobium treatments were incubated before sowing. After germination, thinning was done to three plants per pot. The crop was irrigated throughout the season. All P fertilizer as SSP was applied at the time of sowing according to the planned treatments. At maturity the data regarding total biomass, number of pods, straw and grain yield were recorded. Oven dried plant material ground to analyze for P concentration and P uptake. The data thus obtained were analyzed statistically according to ANOVA techniques (Steel & Torrie, 1980).

RESULTS AND DISCUSSION

Number of pods. The application of Phosphorus @ 100 kg P_2O_5 with inoculation resulted maximum number of pods $plant^{-1}$ which was at par with all other treatments (Table I). This increasing trend in number of pods with increasing levels of phosphorus (both inoculated and uninoculated conditions) might be due to enzymatic activities which

controlled flower formation. Kalita (1989) reported that application of Phosphorus at the rate of 30 kg ha^{-1} gave 0.90 -0.96 t ha^{-1} seed yield as compared to 0.59-0.63 t ha^{-1} in check plots. He also observed that number of pods $plant^{-1}$ and seeds pod^{-1} increased significantly by application of phosphorus.

Grain yield. The application of phosphorus with inoculation gave higher yields than inoculated condition, while in control minimum grain yield was observed (Table I). The grain yield with inoculation and 75 kg P_2O_5 ha^{-1} was almost similar to 100 kg P_2O_5 ha^{-1} without inoculation. Rao *et al.* (1993) stated that seed yield was increased with phosphorus application.

Table I. Effect of P fertilization on growth and yield of Mungbean under inoculated and uninoculated conditions (Average of four repeats)

Treatment	Pods $plant^{-1}$	Grain yield (g pot^{-1})	Straw yield (g pot^{-1})	Total Biomass (g pot^{-1})
T_1*	3g	0.105f	1.539f	1.631f
T_2	5f	0.121e	1.569d	1.690def
T_3	7e	0.182c	1.560de	1.753de
T_4	10d	0.211ab	1.625c	1.836d
T_5	12c	0.152d	1.932ab	2.085bc
T_6	14b	0.217b	1.965a	2.232b
T_7	16a	0.266a	2.056a	2.322a

Table II. Effect of P fertilization on P concentration and P uptake by Mungbean under inoculated and uninoculated conditions (Average of four repeats)

Treatment	P concentration (mg kg^{-1})	P uptake (mg pot^{-1})
T_1	845.42g	1.38dc
T_2	1162.97f	1.97d
T_3	1340.30e	2.35bc
T_4	1545.75c	2.84c
T_5	1437.74d	3.00b
T_6	1585.26b	3.54a
T_7	1662.74a	3.53a

*T_1= control (No P_2O_5); T_2= 50 kg P_2O_5 (uninoculated); T_3= 75 kg P_2O_5 (uninoculated); T_4= 100 kg P_2O_5 (uninoculated); T_5= 50 kg P_2O_5 (inoculated); T_6= 75 kg P_2O_5 (inoculated); T_7= 100 kg P_2O_5 (inoculated)

Straw yield. The straw yield was higher in the when phosphorus was applied with rhizobium strain treatment. The maximum straw yield 2.056 g pot^{-1} was observed with 100 kg P_2O_5 ha^{-1}(inoculated), which was at par with control and without inoculated treatments. Ahmed *et al.* (1986) observed that phosphorus application upto 60 kg ha^{-1} progressively and significantly enhanced the growth and yield parameters, while P x Zn interaction significantly increased plant height at maturity, number of pods $plant^{-1}$ and straw yields.

Total biomass. The data regarding total biomes (Table I) as influenced by phosphorus and rhizobium interaction. With the application of phosphorus and rhizobium the total Biomass was almost similar in 50, 75 and 100 kg P_2O_5 ha^{-1}, but at par with rest of the treatments.

Phosphorus concentration (mg kg^{-1}). The data regarding phosphorus concentration in plant is presented in Table II, showed that there was linear increase in P concentration in plant, with the increasing concentration of phosphorus. The minimum P concentration was observed in control treatment and maximum P concentration was in the treatment where Phosphorus was applied @ 100 kg P_2O_5 ha^{-1} with inoculation, which might be due to the interaction of phosphorus and rhizobium.

Phosphorus uptake (mg pot^{-1}). The data given in Table II showed that the P uptake was significantly higher in all the treatments with Phosphorus application. But the treatments with rhizobium inoculation and phosphorus were at par with all other treatments. The minimum P uptake was observed in control and maximum was in treatment where phosphorus was applied @ 75 kg P_2O_5 ha^{-1} with inoculation. Arya *et al.* (1988) reported that application of 25-75 kg ha^{-1} P_2O_5 to Vigna radiata increased the seed yield, protein content and P uptake.

CONCLUSIONS

Inoculation with rhizobium can increase nitrogen fixation and yield of Mungbean. The combination of P and inoculation has maximum positive effect on P-uptake and P concentration of plant.

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