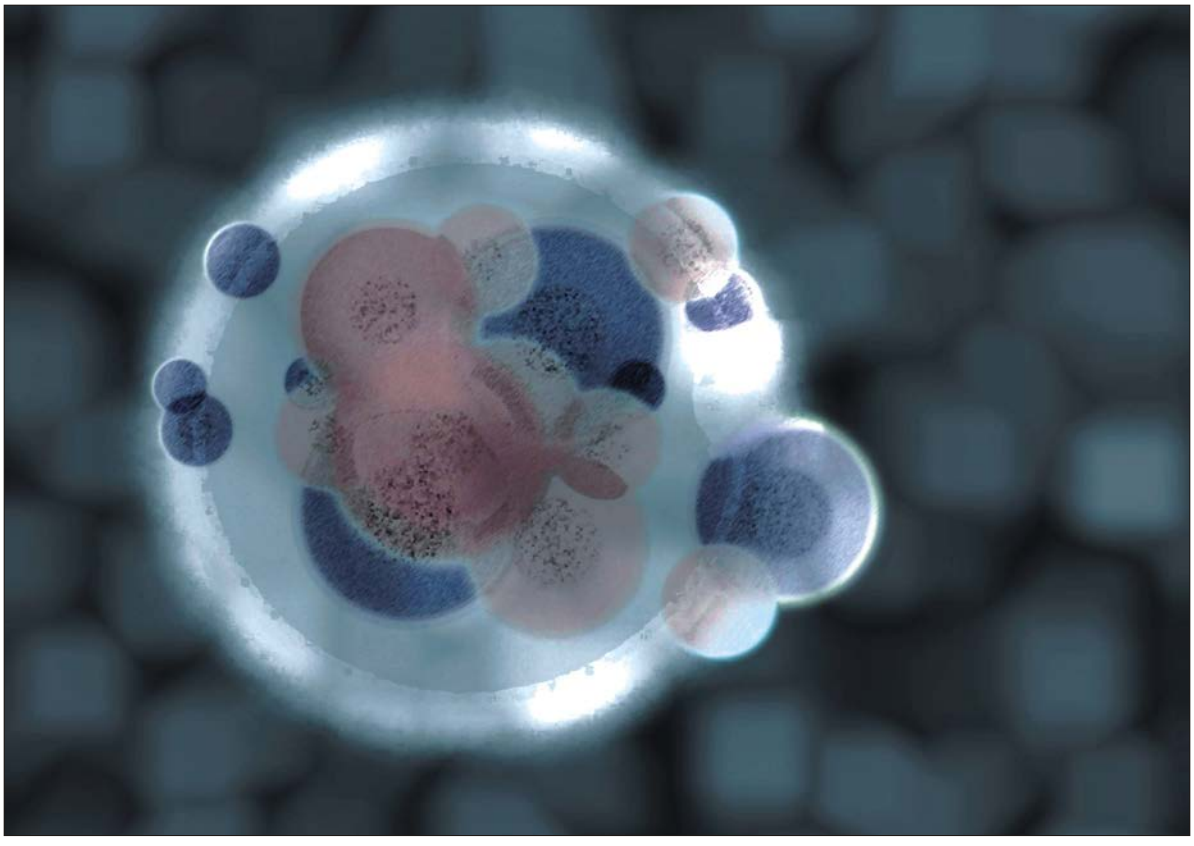

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Effect of Phosphorus and Potassium Application on Growth and Yield of Mungbean (*Vigna radiata* L.)

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Abstract: A study was conducted to determine the effect of phosphorus and potassium application on growth and yield of mungbean on a sandy clay loam soil under irrigated conditions of Faisalabad. Plant height and number of branches per plant were significantly increased by phosphorus and potassium application. Number of pods per plant, number of seeds per pod, 1000-seed weight and grain yields were also increased significantly by application of phosphorus and potassium along with nitrogen. Application of P_2O_5 and K_2O each at 70 kg ha^{-1} along with N application at 30 kg ha^{-1} produced highest grain yield of 876.32 kg ha^{-1}.

Key words: Mungbean, phosphorus, potassium, nitrogen, yield

Introduction

Mungbean (*Vigna radiata* L.) ranks second to chickpea among grain legumes grown in Pakistan (Anonymous, 1997). Agricultural Statistics of Pakistan). Mungbean by virtue of its richness in protein and essential amino acids play an important role in making up the protein deficiency for poor. Moreover, this crop plant being leguminous in nature, improve soil fertility by fixing atmospheric nitrogen to available form through bacterial symbiosis. In addition, it is a short duration pulse crop requiring low inputs and suitable for cultivation both under rainfed and irrigated conditions. It is grown in Pakistan on an area of 192.4 thousands hectare annually with a total production of 89.5 thousand tones and with an average yield of 465 kg ha^{-1} as against the inherent potential (Anonymous, 1997). The advanced production technology stresses on the use of appropriate level of fertilizers which is a key input contributing about 30-70% increase in crop yield. Being a legume crop it requires less nitrogen but application of phosphorus and potassium plays a vital role in getting high yield per unit area. Samiullah *et al*. (1987) conducted trial with *Vigna radiata* and added 10, 20 kg N and 30, 45, 60 or 75 kg P_2O_5 ha^{-1}. They concluded that number of pods per plant and number of seeds per pod were the highest with 10 kg N + 75 kg P_2O_5, seed yield with 20 kg N + 75 kg P_2O_5 and 1000-seed weight with 20 kg N + 60 kg P_2O_5 ha^{-1}. El-Essawi and Abadi (1990) while applying 213 kg N, 24 kg P_2O_5 + 48 kg K_2O ha^{-1} to soybean obtained the maximum seed yield of 5.29 t ha^{-1} on the non saline and 4.72 t ha^{-1} on the saline soils by the above mentioned NPK combination as compared to control. Malik *et al*. (1991) revealed that combined application of NPK, NP and PK was more effective in increasing number of pods per plant and 1000-seed weight than single application of N, P, or K. Fertilizer application at 25-50-50 kg ha^{-1} produced higher yield and protein contents in seed. A fertilizer treatment (34-67 kg N.P. ha^{-1}) gave a grain yield of 802.50 kg ha^{-1}. Sandhu (1993) reported that application of phosphorus and potassium along with nitrogen is essential to harvest good yield of mungbean and 25 + 73 kg P + K ha^{-1} on a sandy loam soil appeared to be the best level.

There is a need to develop appropriate levels of phosphorus and potassium application to harvest the maximum potential of existing mungbean yield under irrigated conditions. This project was planned and executed under irrigated conditions of Faisalabad to get information that may be useful in achieving the increased harvest of mungbean crop.

Materials and Methods

Sandy clay loam soil at Agronomic Research Area, University of Agriculture, Faisalabad during the year 1997. Mungbean variety NM-92 was used for this study, experiment was laid out in a randomized complete block design with four replications and net plot size was 1.8×6.5 m^2. Fertilizer rates of NPK was mantioned in Table 1.

All urea, triple super phosphate and sulphate of potash as a source of nitrogen, phosphorus and potassium, respectively were dressed by drilling. The mungbean was sown in 30cm apart rows with the help of a single row hand drill using the seed rate of 20 kg ha^{-1}. The plant to plant distance was maintained 10 cm by thinning. Plant height, number of branches per plant, number of pods per plant, number of seeds per pod, 1000-seed weight, grain yield and harvest Index, were recorded.

The height of the plant was measured from the base to the upper most growing point of the plant whereas the number of branches per plant, number of pods per plant and number of seeds per pod were recorded from five randomly selected plants. 1000-seed and grain yield was calculated in kg ha^{-1} on the basis of plot yield. Harvest Index was calculated using the following formula:

$$\text{Harvest Index} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

Fisher's analysis of variance technique and least significance difference (LSD) test at 5% probability level was applied to compare the difference among the treatments means (Steel and Torrie, 1984).

Results and Discussion

Plant height at maturity (cm): The data regarding plant height at maturity (Table 1) indicated that P_2O_5 and K_2O application significantly increased plant height over control. Lowest rates of P_2O_5 and K_2O fertilizer (30 kg ha^{-1} each) produced the same plant height as was recorded where N alone was applied. However, further increase in P_2O_5 and K_2O levels did not increase plant height. This might be due to the reason that soil had already enough P_2O_5 and K_2O level and higher doses of P_2O_5 and K_2O were ineffective in increasing plant height.

Number of branches per plant: Numbers of branches per plant were significantly increased by fertilizer application over control (Table 1). Maximum number of branches per plant (9.62) were recorded in plots where P_2O_5 and K_2O fertilizers were applied at 70 kg ha^{-1} each along with 30 kg N ha^{-1}. All other rates of P_2O_5 and K_2O produced statistically same number of branches per plant (i.e. 8.97, 9.15 and 9.25).

Table 1: Effect of Phosphorus and Potassium Application on Growth and Yield of Mungbean

Treatment (kg ha^{-1})	Plant height (cm)	Number of branches per plant	Number of pods per plant	Number of seeds per pod	1000-seed weight (g)	Seed yield (kg ha^{-1})	Harvest Index (%)
F0 (0-0-0)	62.85c	7.25d	16.74e	10.53d	52.28c	697.86e	22.98d
F1 (30-0-0)	66.53b	8.32c	18.69d	11.02c	55.64b	748.09d	23.71cd
F2 (30-30-30)	69.48ab	8.97b	20.37c	11.30bc	55.53b	761.63d	23.27cd
F3 (30-50-50)	70.55a	9.15b	23.11b	11.40bc	55.61b	801.76c	24.05bc
F4 (30-70-70)	71.90a	9.62a	24.82a	11.93a	58.13a	876.32a	25.85a
F5 (30-90-90)	70.68a	9.25b	24.37ab	11.63ab	54.66b	839.49b	24.84ab

Means sharing the same letters do not differ significantly, at 5% probability level by LSD test

However application of N alone at 30 kg ha^{-1} also produced significantly higher number of branches per plant (8.32) over control (7.25). Lowest number of branches per plot in control plots may be due to low nutrient supply not enough for a good sprouting of branches in such plants.

Number of pods per plant: Highest and statistically similar number of pods per plant (24.82 and 24.37) were produced in plots where P_2O_5 and K_2O were applied at 70:70 and 90:90 kg ha^{-1} each with 30 kg ha^{-1} N, respectively (Table 1). However, P_2O_5 and K_2O applied at 50 kg ha^{-1} each produced statistically similar number of pods per plant (23.11) as in plots with 90 kg ha^{-1} of each of these two fertilizers. Minimum numbers of pods per plant (16.74) were produced in control plots.

Number of seeds per pod: Fertilizer application increased the number of seeds per pod over control (10.53) (Table 1). Application of N alone at 30 kg ha^{-1} and P_2O_5 and K_2O at 30, 50 and 90 kg ha^{-1} each produced statistically similar number of seeds per pod i.e., 11.30, 11.40 and 11.63, respectively. Fertilizer application at 30:70:70 and 30:90:90 kg ha^{-1} NPK produced statistically highest and similar number of seeds per pod (11.93 and 11.63, respectively). The narrow differences between the number of seeds per pod suggested that this parameter is controlled more genetically then environmentally.

1000-seed weight (g): Fertilizer application statistically increased 1000-seed weight in all the plots over control plots (Table 1). Application of N alone at 30 kg ha^{-1} or in combination with each of 30, 50 or 90 kg P_2O_5 and K_2O produced statistically similar 1000-seed weight of 55.64, 55.53, 55.61 and 54.66 grams, respectively. Highest 1000-seed weight (58.13 g) was produced in plots receiving P_2O_5 and K_2O at 70 kg ha^{-1} each along with 30 kg Nha^{-1}. Decrease in 1000-seed weight at higher rates of applied P_2O_5 and K_2O might be due to some impaired metabolic pathway leading to less assimilation/ accumulation of photo assimilates in seeds of the mungbean crop.

Grain yield (kg ha^{-1}): Grain yield was significantly increased by the application of all fertilizer levels over control (697.86 kg) (Table 1). Among various fertilizer treatments N alone at 30 kg ha^{-1} or in combination with 30 kg ha^{-1} of each P_2O_5 and K_2O produced the lowest and statistically similar grain yield of 748.09 and 761.63 kg ha^{-1}, respectively. It was followed by grain yield of 801.76 and 839.49 kg ha^{-1} produced in plots receiving 50 and 90 kg ha^{-1} each of P_2O_5 and K_2O along with 30 kg ha^{-1} N, respectively. Statistically highest grain yield (876.32 kg ha^{-1}) was recorded in plots receiving 30:70:70 kg ha^{-1} of N, P_2O_5 and K_2O. A further increase in P_2O_5 and K_2O application rate beyond this did not increase rather had a decreasing effect on grain yield of mungbean. Different yield components were positively related with grain yield at this fertilizer dose of 30:70:70 kg ha^{-1} NPK.

Harvest Index (%): Harvest indices were invariably affected by different fertilizer levels(Table 1). Plots receiving no fertilizer or fertilized with N alone at 30 kg ha^{-1} or with N and P_2O_5 and K_2O at 30 kg ha^{-1} each depicted the lowest and statistically same harvest indices of 22.98, 23.71 and 23.27, respectively. P_2O_5 and K_2O at 70 and 90 kg ha^{-1} each along with 30 kg ha^{-1} N showed highest and statistically similar harvest indices of 25.85 and 24.24, respectively.

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