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Determination of Optimum Level of Potassium and its Effects on Yield and Quality of Three Mungbean (*Vigna radiata* L.) Cultivars

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Abstract

The experiment was carried out to determine the optimum potassium levels and its effects on growth, yield and quality of mungbean (NM-92, NM-54 and NM-51). The yield relationship in NM-51 with its yield components was found to be positively correlated and significant, whereas NM-92 and NM-54 was non-significant. Number of pods per plant, number of seeds per pod were significantly affected by potash applications but 1000 seed weight remained unaffected. Among the fertilizer levels 50 kg K_2O per hectare produced the highest average seed yield of 832 kg per hectare however the optimum level was between 50 to 100 kg K_2O per hectare.

Introduction

Mungbean ranks second next to chickpea among the grain legumes. It is grown twice a year so fits very well in our cropping system without any major change in the present agricultural practices. It is also a drought tolerant and short duration (65-80 days) crop. The average seed yield of mungbean is low in Pakistan. The research work on this crop has not been given due importance in past and most of areas relating to its production remained unexplored.

Potash is one of the essential elements for plant growth. Its role is well documented in photosynthesis, enzymatic activity, synthesis of proteins, carbohydrates and fats, translocation of photosynthates and enabling the plants to resist pests and diseases (Tisdale *et al.*, 1985). Potash also plays a key role in increasing crop yield and improving the quality of product. Soils of Pakistan in general are made of such minerals which have large capacity to provide potassium to crop under normal conditions because of the dominance of illite clay minerals (Ranjha *et al.*, 1990). But increased intensity of cropping and introduction of high yielding varieties resulted in considerable use of potassium reserves and the crops are becoming responsive to potassium fertilization (Gowda and Gowda, 1978). The objective of this research was to determine the optimum potassium level and its effects on growth, yield and quality of mungbean.

Materials and Methods

The crop was sown on 2nd August, 1997 at the Agronomic Research Farm, University of Agriculture, Faisalabad using split plot design with four replications. The net plot size was 6 x 1.5 meters. Soil upto 30 cm layer was sampled before the start of the experiment and subjected to physico-chemical analysis. The row to row distance was kept 30 cm apart. Sowing of the crop was done by single row hand drill. A fertilizer dose of NP at the rate of 25, 20 kg per hectare, respectively, alongwith different levels of potash were side drilled immediately after sowing. All other agronomic practices were kept uniform. The crop was harvested on 13th of October, 1997. Nitrogen contents of grains was determined by using micro Kjeldahl's apparatus (Jackson, 1962). Nitrogen percentage was multiplied by a constant factor (6.25) for calculating protein contents (Hiller *et al.*, 1948). A square root transformation were applied on data where the values were 0 to 10 or in percentage from 0 to 30. Data were analysed statistically using Fisher's analysis of variance technique (Steel and Torrie, 1984). The law of diminishing return was used to determine the optimum level of K by equating the inverse price ratio with marginal product (Sharma and Sharma, 1981).

Results and Discussion

Yield: Data presented in Table 1 showed that different potash rates significantly affected the grain yield of mungbean. The potash level of 50 kg ha^{-1} gave the highest seed yield than all other treatments by giving 832.2 kg ha^{-1} and remained at par with 100 kg ha^{-1}. However, 50 kg ha^{-1} was found to be statistically significant from control. These results are in agreement with Gowda and Gowda (1978) and Tomar *et al.* (1985). The cultivar effect as well as the interaction between cultivars and potash treatments were found to be non-significant.

Optimum level: Optimum level of potash was determined by equating the inverse price ratio with marginal product (Table 3) which indicated that the potash application in the range of 50-100 kg ha^{-1} has the optimum level for all the three cultivars. The present recommendation for mungbean of potash by agricultural department is 54.34 kg K_2O ha^{-1}. As in the range of 50-100 kg K_2O ha^{-1} inverse price ratio equalizes the marginal product. So in future there is scope of experimentation by keeping potassium treatments at little gap within this range.

Yield components: The relationship between grain yield of cultivars and yield components were studied by regression analysis. It was found that with the exception of NM-51 where yield relationship with it yield components was positively correlated and significant, in other two cultivars (NM-92 and NM-54) it was non-significant. Yield components contribution to final yield varied greatly in each variety, is also confirmed by Paramasivan and Rajasekaren (1980). Results showed that number of branches per plant were not significantly affected by various potash levels. However NM-51 produced significantly higher number of branches than NM-54 and NM-92 (Table 3). The interaction between cultivar and potash treatments was found to be non-significant. However in individual regression analysis of cultivars the number of branches were found to be positively correlated with the yields of NM-92 and NM-54 but effects were non-significant. The yield of NM-51 was found to be negatively and non-significantly correlated to number of branches.

Table 1: Effect of potassium on various yield and quality parameters.

	Treatments (K_2O kg ha^{-1})		
Parameters	0	50	100
Grain yield (kg ha^{-1})	749.50b	832.20a	831.60a
No. of pods per plant	18.12b	20.58ab	24.30a
No. of seeds per pod (transformed)	0.88b	0.94ab	0.88b
Protein contents (Transformed)	5.02b	5.28a	5.25a

Table 2: Mungbean cultivars comparison for different plant characteristics.

	Cultivars		
Parameters	NM-92	NM-54	NM-54
No. of branches per plant (transformed)	0.92c	0.99b	1.07a
1000-grain weight (g)	54.50b	69.97a	52.96b
Plant height (cm)	63.23c	68.82b	75.67a

Any two means not sharing a common letter differ significantly at 5% probability level.

Table 1 showed that number of pods per plant were significantly affected by different potash treatments. But the cultivar as well as interaction between cultivars and potash rates were found to be non-significant. Potash application of 100 kg ha^{-1} produced highest number of pods per plant, however it was statistically at par with 50 kg ha^{-1}. Both these treatments were significantly different from control. Similar results were obtained by Gowda and Gowda (1978). The yield and number of pods per plant were found to be positively but non-significantly correlated. The seed yield increase with the increase of the number of pods are in agreement with the work of Gupta *et al.* (1982).

Table 3: Average, marginal products and inverse price ratio at different levels of potassium

	K_2O applied (kg ha^{-1})		
	0	50	100
Yield obtained (kg ha^{-1})		876.25	918.43
NM-92	870.18	795.60	800.30
NM-54	634.10	824.68	776.20
NM-51	744.50		
Total produced due to K			6.07
48.25			
NM-92		161.50	166.20
NM-54		80.18	31.70
NM-51			
Average product		0.12	0.97
NM-92		3.23	3.32
NM-54		1.60	0.63
NM-51			
Marginal product		0.12	0.84
NM-92		3.23	0.09
NM-54		1.60	-0.97
NM-51			
Inverse price ratio		0.79	0.79

Data in Table 1 showed that potash levels had significant affected the number of grains per pod. However, cultivar as well as interaction effects between cultivars and potas treatments were found to be non-significant. The highes number of seeds per pod were recorded in case of 50 k K_2O ha^{-1} and was significantly different from 100 kg K_2 ha^{-1} which was at par with control. These results are agreement with Sangakhara *et al.* (1990). The relationsh between yield and number of seeds per pod was found be positively correlated. The simple regression equations f NM-92 showed that number of seeds per pod d significantly bring variations in yield. However a no significant response was observed to the yields of NM-5 and NM-51 respectively by number of seeds per pod.

Potash level did not increase 1000-grain weig significantly. The interaction between cultivars and pota levels also remained non-significant. However, cultiva showed significance from each other (Table 2). The findings are in line with Shah *et al.* (1986). The Table indicated the maximum 1000-seed weight was obtained case of NM-54 and was found to be statistically significa from NM-51 and NM-92 which were at par with each oth There was positive and significant correlation betwe yields and 1000 seed weight for NM-92 and NM-5 However, for NM-54, a negative and non-signific correlation response was observed, this behaviour different cultivars to same yield component is observed Paramasivan and Rajasekaran (1980).

Photobiomass production: Total photobiomass production is determined by the parameters like number of plants per plot, plant height and biological yield. Plant height was not significantly affected by potash applications. The interaction between cultivars and potash treatments were also found to be non-significant. However the cultivars were highly significant from each other. Table 2 indicated that NM-51 produced significantly more plant height than NM-54 which was also statistically different from NM-92.

The potash treatments effect, the cultivar effect as well as interaction effect between cultivars and potash treatments remained statistically non-significant for number of plants per plot, biological yield and harvest index. The reason for non-significance of harvest index might be due to the non-significant results obtained in case of biological yield. As harvest index is the proportion of seed yield obtained from biological yield.

Quality: Regarding protein as it is the major constituent of seed which determine the ultimate quality of pulses. Table 1 showed that potash applications significantly affected the seed protein quality, whereas cultivar effect as well as interaction between cultivar and potash application did not affect significantly the protein quality.

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