The Journal of Animal & Plant Sciences, 21(3): 2011, Page: 622-625
ISSN: 1018-7081

GROWTH AND YIELD RESPONSE OF TWO CULTIVARS OF MUNGBEAN (*Vigna radiata* L.) TO DIFFERENT POTASSIUM LEVELS

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ABSTRACT

Potassium application is directly related to growth, plant biomass and yield in crops. While the deficiency of Potassium is in Pakistan is becoming nutritional limiting factor in most of areas. A study was carried out at experimental area of Department of Agronomy, University of Agriculture, Faisalabad during summer 2005. The objective was to find out the best level of potash fertilizer on growth and yield response of two mungbean **(***Vigna radiata* **L.)** cultivars (Niab Mung-92 and Chakwal Mung-06) to different levels of potassium. The experiment was laid out in Randomized Complete Block Design with factorial arrangements and replicated thrice. Treatments were comprised of five levels of potash fertilizer (0, 30, 60, 90,120 Kg ha^{-1}). Different potassium levels significantly affected the seed yield and yield contributing parameters except number of plants per plot. Maximum seed yield (753 Kg ha^{-1}) was obtained with the application of 90 Kg potash per hectare. Genotype M-06 produced higher seed yield than that of NM-92. The interactive effect of Mungbean varieties and Potassium level was found significant in parameter of protein contents (%). Maximum protein contents were observed in case of Mung-06 with application of 90 Kg potash per hectare. It is concluded that the application of Potash fertilizer gave higher yield of mungbean cultivars under agro-climatic conditions of Faisalabad.

Key words: Mungbean; Potash levels; Growth; Yield; Faisalabad.

INTRODUCTION

Mungbean is an important pulse crop having high nutritive value. Its seed contains 24.2% protein, 1.3 % fat and 60.4 % carbohydrate. It is a short duration crop and can be grown twice a year i.e. in spring and autumn seasons.

The average yield is quite low which requires attention of the crop experts. Among various factors, judicious use of fertilizer is of prime importance. It is evident from the literature that application of major nutrients, i.e. NPK improved mungbean yield (Ali *et al*., 1996; Ali *et al*., 2010). Among other macro nutrients potash (K) plays a vital role in photosynthesis, enzyme activation, protein synthesis and resistance against the pest attack and diseases (Arif *et al*., 2008).

K also plays a vital role as macronutrient in plant growth and sustainable crop production (Mrschner, 1996 and Baligar, 2001). It maintains turgor pressure of cell which is necessary for cell expansion. It helps in osmo-regulation of plant cell, assists in opening and closing of stomata (Yang *et al*., 2003). It plays a key role in activation of more than 60 enzymes (Tisdale *et al.*, 1990; Bushkh *et al*., 2011).

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 reserved and the crops are becoming responsive to potassium fertilizer. Ali *et al*. (1996) reported that number of pods per plant, seeds per pod, seed yield and seed protein contents were increased significantly with potassium application and maximum seed yield was obtained with 90 Kg potash per hectare. They observed significant difference of protein contents in different mungbean cultivars due to application of potassium

The present study was, therefore contemplated to investigate the effect of different levels of potassium under uniform levels of nitrogen and phosphorus on growth and yield performance of diverse mungbean cultivars under irrigated conditions of Faisalabad. Such study will be useful in order to create awareness among the farming community about the balanced use fertilizer to get maximum production.

MATERIALS AND METHODS

a) Experimental Site: The experiment was conducted at Agronomic Research area, University of Agriculture, Faisalabad Pakistan. Faisalabad stands in the rolling smooth plains of northeast Punjab, between longitude 73°74 east, latitude 30°31.5 North, with an altitude of 184 meters (604 ft) above sea level. The climate of the district can see extremes, with a summer maximum temperature 50°C (122°F) and a winter temperature of −1°C (30.2 °F). The mean maximum and minimum temperature in summer are 39°C (102°F) and 27°C (81 °F) respectively. In winter it peaks at around 21°C (70°F) and 6°C (43°F) respectively. The average yearly rainfall lies only at about 400 mm (16 in) and is exceedingly seasonal with approximately half of the yearly rainfall in the two months July and August.

b) Soil analysis. Composite soil samples were taken from the experimental area prior to sowing of crop. The soil samples were air dried, ground, well mixed and passed through a 2 mm sieve and analyzed for physical and chemical properties. The chemical analysis of the soil at sowing time showed that amount of P and K were 7.54 ppm and 160.60 ppm respectively, while nitrogen was 0.0376%. The pH of soil was 7.73. The soil texture was sandy clay loam.

c) Experimental Design and treatments: Five levels of potassium (0, 30, 60, 90 and 120 Kg/ha) were studied for growth and yield response of two cultivars of mungbean (Niab Mung-92, V_1 and Chakwal Mung-06, V_2) during summer, 2005. Layout system was randomized complete block design (RCBD) with factorial arrangements. Each treatment was replicated thrice. The seed bed was well prepared by three times plowings and followed by planking with last plowing.

Net plot size was 1.8 × 5.0 m. The crop was sown on 19th July, 2005 using seed rate of 20 Kg per hectare with single row hand drill in 30 cm a-part rows. A basal dose of nitrogen and phosphorus (50-75 Kg/ha) along with prescribed doses of potash was applied at sowing in the form of urea, Diammonium phosphate (DAP) and Sulphate of potash (SOP), respectively. Experimental field was irrigated as and when required particularly at all critical stages of crop. The field was kept free from weeds through hoeing. Plants from each net plot were counted at harvest (during last week of October) and ten plants were randomly selected for recording plant height, number of branches per plant, pods per plant and seeds per pod. All the plants were harvested and threshed manually to determine seed yield per plot which was converted to seed yield per hectare.

d) Protein contents of seed (%): For protein contents, seed samples from each plot were taken randomly ground and subjected to chemical analysis by Kjeldhal,s Method (Jackson, 1962). Available Nitrogen percentage was determined through Standard wet digestion method using Teactor Apparatus. Nitrogen percentage was converted to protein content by multiplying with constant factor (6.25) for calculating protein contents (Hiller *et al*., 1948)

e) Data Analysis: After collection of required data, M. Stat C software was used to analyze the data. If the F test was significant, means were compared by LSD test at 5% probability level (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Number of Plants per Plot: Optimum plant density assures good crop stand, which ultimately lead to higher crop yield. Different levels of potassium on number of plants per plot were non- significant (Table 1). Similar plant population might have been due to the use of uniform seed rate and thinning at four leaf stages to maintain the plant to plant distance. The differences for plant population between two genotypes were non-significant. The interaction between varieties and fertilizer levels was also non-significant.

Plant Height (cm): Potash levels affected the plant height significantly (Table 1). Maximum plant height (49.93 cm) was obtained when potash was applied at 90 Kg/ha. It was statistically at par to 60 and 120 Kg potash per hectare. Minimum plant height (41.33 cm) was obtained in plots where no potash was applied might be due to the reason that high root shoot ratio is associative with potassium uptake (Yang *et al*., 2004). These results are in line with Hussain (1994) and Ali *et al*. (1996) who observed significantly higher plant height in mungbean crop when fertilized at the rate of 60-100-100 NPK Kg /ha.

The variation among varieties was also significant and M-06 produce taller plants than NM-92. The results contradict the findings of Aslam *et al*., (2004) where non- significant differences were observed among mungbean genotypes. However, these contradictory results might be due to varying genetic makeup of varieties or fertility status of soil. The interaction between varieties and fertilizer are non significant.

Number of fruit bearing branches per plant: Maximum number of fruit bearing branches per plant (6.32) was recoded in 120 Kg Potash per hectare against minimum in control. However, these differences could not reach to the level of significance (Table 1). Similar finding were recorded by Tariq *et al*. (2001) reported that the number of pod bearing branches per plant was significantly increased by potassium application in mungbean. Different varieties, however, differed significantly from each other. The variety Chakwal Mung-06 produced more branches than NM-92. These results are in contrast to those of earlier studies (Aslam *et al*., 2004; Khan *et al*., 1999) where non- significant differences were observed among mungbean genotypes for number of branches. These contradictory results can be attributed to differences in climatic conditions and genetic make up of crop plant.

It is clear that from the table that the interaction between fertilizer potash and variety was highly significant. The maximum (7.07) number of pod bearing branches per plant was observed in V_2 K_4 (M-06 and 120 Kg K/ha). The minimum (5.03) number of pod bearing branches per plant was recorded in V_1 K_O (NM-06 and 0 Kg K/ha)

Number of pods per plant: Potash levels affected the no of pods/plant significantly. Maximum number of pods/plant (26.82) was obtained when potash applied at 90 Kg K per hectare (Table 1). Minimum no of pods/plant (18.77) was obtained in plots where no potash was applied. Similar findings were recoded by Ali *et al*. (1996) who studied the effect of different potassium levels (0, 25, 75,100 and 125 Kg/ha) on yield and quality of mungbean and reported that no of pods/plant, no of seeds per pod was influenced significantly by potassium application. The variation among varieties was also significant and Chakwal Mung-06 produced more no of pods/plant than NM-92. However, Khan *et al*. (1999) reported that genotypes did not differ significantly from each other. These contradictory results might have been due to differences in genetic make up or climatic conditions of crop plants.

Number of Seeds per Pod: Number of Seeds per pod was affected significantly by various K levels (Table 1). Maximum no of seeds per pod (8.32) was obtained when potash was applied at 90 Kg/ha. Minimum no of seeds per pod (6.12) was obtained in plots where no potash was applied (table). K application not only enhanced the availability of other nutrient but also increased the transportation of photosynthates; protein synthesis from source to sink might be the main reason for increase in number of seeds. Significant differences for no of seeds per pod due to potash application have also been reported earlier (8). The differences between varieties for number of seeds per pods were significant. The variety M-06 produced higher no of seeds per pod (7.49) than NM-92 (7.09) (Table 1).The interaction between variety and fertilizer is significant. The maximum (8.37) number of seeds per pod was recorded in V_2K_3 (M-6 and 90 Kg K ha^{-1}). The minimum (6.03) number of seeds per pod was observed in V_1K_0 (NM-92 and 0 Kg K/ha).These results are in line with Sandhu (1993).

1000 seeds weight (g): Significant differences for 1000 seeds weight were also noted. As for as different treatments are concerned the application of 120 Kg K/ha resulted in maximum 1000 seeds weight which was statistically at per with 90 Kg K per hectare. Minimum seed weight was recorded in plots where no potash was applied (Table 1). Hussain (1994) also concluded that the maximum 1000 seeds weight (61.85 g) was obtained when the mungbean crop was fertilized at the rate of 60-100-100 NPK Kg ha^{-1}. The differences between varieties for 1000 seeds weight were significant. The variety M-06 produced significantly higher seed weight (37.59 g) than NM-92 (34.99 g). Variation in seed weight between varieties can be attributed to genetic make up of the crop plants. Ali *et al*. (1996) have also reported that significant differences for 1000 seeds weight in mungbean genotypes. The interaction between varieties and fertilizer levels was non-significant.

Table 1. Growth and yield response of two cultivars of mungbean to different potassium levels

S. No	Treatments	Plant Height (cm)	No. of branches $plant^{-1}$	No. of pods $plant^{-1}$	No of seeds pod^{-1}	No of plants $Plot^{-1}$	1000 Seeds weight (g)	Protein contents (%)	Seed Yield kg ha^{-1}
				Varieties (V)					
1	V_1- NM-92	42.91b	5.41b	23.05b	7.09b	232.0	34.99b	25.47b	618.0
2	V_2- M-06	51.15a	6.13a	25.39a	7.49a	232.0	37.59a	25.86a	641.0
				Potassium Levels (K)					
4	K_0	41.33 c	5.28d	18.77c	6.12e	232.0	29.15d	25.02c	442.7e
5	K_1	47.00 b	5.55c	24.48b	7.12d	233.0	32.07c	25.62b	572.4d
6	K_2	47.67 ab	5.78b	25.23ab	7.32c	232.0	37.27b	25.63b	661.3c
7	K_3	49.93 a	5.92b	26.82a	8.32a	233.0	41.33a	25.32bc	753.7a
8	K_4	49.20 ab	6.32a	25.80ab	7.57b	232.0	41.62a	26.74a	720.4b
				Interaction (K levels x Varieties)					
7	V_1x K_0	37.80	5.03f	18.13	6.03e	233.0	28.73	23.95e	430.0
8	V_1 x K_1	44.40	5.40de	22.97	6.87d	232.0	30.13	25.78bcd	556.0
9	V_1 x K_2	43.07	5.33ef	32.93	7.00d	232.0	36.57	25.79bcd	644.0
10	V_1 x K_3	44.67	5.73c	25.67	8.27a	233.0	39.60	25.46cd	760.0
11	V_1 x K_4	44.60	5.57cde	24.53	7.27c	232.0	39.90	26.38b	703.0
12	V_2 x K_0	44.86	5.53cde	19.40	6.20e	231.0	29.57	26.09bc	456.0
13	V_2 x K_1	49.60	5.70cd	26.00	7.37c	234.0	34.00	25.46cd	589.0
14	V_2 x K_2	52.26	6.23b	26.53	7.63b	233.0	37.97	25.47cd	678.0
15	V_2 x K_3	55.20	6.10b	27.97	8.37a	233.0	43.07	25.18d	748.0
16	V_2 x K_4	53.80	7.07a	27.07	7.87b	232.0	43.33	27.11a	737.0

Means sharing the same letter in a column do not differ statistically at $P \leq 0.05$ by LSD test.

Seed Yield (Kg/ha): Seed yield was also affected significantly by potassium levels. Maximum seed yield (753 Kg/ha) was recorded when potash was applied at the rate of 90 Kg ha^{-1}. Minimum seed yield (442 Kg/ha) was observed in plot where no potash fertilizer was applied. The results are in agreement to those of Ali *et al*. (1996) and Hussain (1994). The difference between varieties was non-significant. The interaction between varieties and fertilizer levels were also depicted non-significant.

Protein Contents (%): Protein contents of mungbean seed were affected significantly by different K levels. As for different treatments are concerned, the application of 120 Kg K ha^{-1} resulted in maximum seed protein contents (26.74 %) and minimum in control (25.02 %) (Table 1). Chanda *et al*. (2002) concluded that the application of higher level of K also increased the protein content of mungbean. The variety M-06 produced higher seed protein contents (25.86 %) than NM -92 (25.47 %).While Khan *et al*. 1999 reported that genotypes did not differ significantly from each other The variation in mungbean genotypes might be due to difference in genetic make up of the varieties. The interaction between varieties and fertilizer levels was significant. The maximum seed protein contents (27.11 %) was recoded in V_2 K_4 (M-06 and 120 Kg K/ha) and minimum seed protein contents (23.95 %) was observed in V_1 K_0 (NM-92 and 0 Kg K/ha).

Conclusion: It is concluded that among other macronutrients, Potash (K) has equal importance and must be applied to mungbean crop. The experiment depicted notable response in growth and yield due to potassium application level of 90 Kg/ha and is recommended for farmers**.**

Acknowledgement: We deeply appreciate the mungbean growing farmers in all over the province and acknowledge them. We shall be pride on the Agricultural Scientists working on agronomic aspects of mungbean and its breeding. Heartfelt thanks go to the editorial staff for their response and processing in publication of this manuscript.

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