GROWTH, YIELD AND YIELD ATTRIBUTES AS INFLUENCED BY VARIABLE RATES OF POTASSIUM APPLICATION AND VARIETIES UNDER IRRIGATED CONDITIONS OF BAHAWALPUR

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ABSTRACT

The crop nutrient management has a well defined effect on the productivity of legumes. While considering all macro-nutrients, potassium has a key role in increasing the grain yield due to translocation of nutrients. The research trial was carried out in field to examine the grain yield of guar under variable rates of potassium application and varieties at Agricultural Research Station, Bahawalpur during the years 2017 and 2018. Four different potassium levels were applied i.e. (T1) 0, (T2) 30, (T3) 60, (T4) 90 kg ha^{-1}. Two varieties (BR-2017 and S-5885) were planted. Significant differences among the potassium application rates and varieties were observed regarding growth, yield and yield parameters. The highest plant height (99 cm) with the variety BR-2017 in T_4 (90 kg ha^{-1}) while more no. of branches $plant^{-1}$(7.10) and germination percentage (85.00) were obtained where potassium was applied @ 60 kg $ha^{-1}$with the variety S-5885 which stand superior than BR-2017 considering the same growth parameters. The maximum grain yield (2830 kg ha^{-1}) was recorded with the application of potassium at the rate of 60 kg ha^{-1} following potassium application at the rate of 30 kg ha^{-1} (2790 kg ha^{-1}) in S-5885. The application of potassium significantly increased the grain yield up to 60 kg ha^{-1} but decreased with further increase in the rate of potassium application.

Keywords: Cluster bean, Potassium, Varieties, Grain yield, Irrigated conditions, Bahawalpur

INTRODUCTION

The major portion of moisture deficient areas is occupied by cluster bean in the sub-continent. Its chief uses include cattle feed, seeds for industry and green manuring (Douglas, 2005). Guar fits well in summer cropping system due to its fast growth and short duration (Ashraf *et al*., 2002). The introduction of high yielding cultivars is the way to increase their yields that are well adapted in the local climate of the area (Bilal *et al*., 2000). Genotype's grain yield significantly influenced by environment and genotypes interactions (Dehghani *et al*., 2008). The guar yield components like seed weight, no. of branches $plant^{-1}$ and plant height differed significantly among cultivars (Sortino and Gresta, 2007). The Potassium and phosphorous requirement of legumes is more than cereals as these nutrients effect the Biological Nitrogen Fixation bacteria and growth of the host plant (Ayub *et al*., 2012). The modern high yielding cultivars required more potassium that is necessary due to its effect on plant growth, yield and quality. Hence, greater return to the farmer in the form of high-quality product and more net returns (Ranpariya *et al.*, 2017). Potassium is necessary for activating more than 60 enzymes and helps in osmo-regulation (Yang *et al*., 2004; Bukhsh *et al*., 2011). The seed yield and yield components of mungbean crop were affected by the application of potassium (Ali *et al*., 1996).Considering the potassium importance previous research did not support sufficient results about the effect of potassium on the seed yield of guar. The present study was, conducted to investigate the effect of variable rates of potassium application and varieties keeping all other factors uniform on the grain yield of guar under irrigated conditions of Bahawalpur. So, that the balanced use of potassium fertilizer may be adopted by the farmers community for highest yield.

MATERIALS AND METHODS

Overview of experiment site:

The research trial was carried out during kharif, 2017 and 2018 at Farm area of Agricultural Research Station, Bahawalpur (29.390 N, 71.680 E), Punjab, Pakistan. The weather conditions are severely hot and cold both in summer and winter. Average temperature in summer lies between 30-33 ^{O}C while maximum is 45-48 ^{O}C and in winter 15-17 ^{O}C. The rainfall is very scarce measuring an average of 250-350 mm annually.

Design of Experiment and K levels:

The research trial was laid out in RCBD with split plot arrangement and three replications. The plot size used for experiment was 1.8 m x 7.2 m. Two varieties viz. BR-2017 and S-5885 were used. The seed was sown with hand drill under moist condition in tilled soil in 45cm apart single rows with 15 cm plant-plant distance. The potassium fertilizer (potassium sulphate) was used with four variable doses i.e. 0 kg ha^{-1}, 30 kg ha^{-1}, 60 kg ha^{-1}, 90 kg ha^{-1} in the form of potassium sulphate at the time of sowing according to experiment plan. The recommended rate of DAP (1bag) was also applied in the soil as basal dose. Three irrigations were applied during the crop growing period excluding *rawani* irrigation. All the agronomic measures were set aside consistent for experiment. The guar was planted on 1stJune each year. The growth (Plant height (cm), Branches$plant^{-1}$, Days to emergence, Germination percentage, Days to 50 % flowering, Days to 90 % maturity), yield parameters (Clusters $plant^{-1}$, Pods $cluster^{-1}$, Grains pod^{-1}, Pod length (cm), 1000 grain weight (g) and yield (kg ha^{-1}) were recorded.

Soil analysis:

The pre-sowing soil samples were collected from 30 cm depth and used for nutrients analysis. The soil samples were tested and results showed that the soil was silt loam and near to alkaline having pH (7.9) and Ec (1.6 dsm^{-1}). The soil was Low in organic matter (0.89), medium in available P (7.68 ppm) and medium in available K (136 ppm). These results indicated that soil required the supply of potassium.

Data Analysis:

The collected data were analyzed with the help of Statistix 10.0 software. The means were compared by $LSD_{0.05}$ probability level (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Plant growth

The results revealed that the highest plant height (99 cm) was obtained with the variety BR-2017 in T4 (90 kg. Ha^{-1} of K) while branches $plant^{-1}$ (7.10 per plant) and germination percentage (85.00%) were recorded in T_3 where potassium was applied at the rate of 60 kg ha^{-1} which was significantly higher than that in other application rates of potassium. However, it was also observed that plant height was non-significantly affected by variable rates of potassium that was almost comparable with T_2 and T_4. Days to emergence, days to 50 % flowering and days to 90 % maturity were non-significantly affected by potassium application. AS regard to the varieties, the highest growth parameters (Branches $plant^{-1}$ (7.10), germination percentage (85.00) and days to 50 % flowering (57.00) were found in the variety S-5885 compared to BR-2017 while significantly more plant height (99 cm), Days to emergence (4.67) and days to 90 % maturity (112.33) were achieved by BR-2017 that may be due to its single stem nature compared to S-5885 which has significantly more number of branches $plant^{-1}$ (Table 1). This showed that BR-2017 matured late compared to S-5885. The plant height increased with the enhancement in potassium level up to 60 kg ha^{-1} but decreased with further raise in potassium application rate. The interaction between varieties and potassium application rates was significant for germination percentage, branches $plant^{-1}$ and plant height while other parameters interaction was non-significant (Table 1). These findings get support from Anurag *et al*. (2002) and Reager *et al*. (2003) for growth parameters. The results are also supported by (Sahai, 2004), that nitrogen and phosphorous availability enhanced with the application of potassium which ultimately affected the plant growth and branches $plant^{-1}$.

Yield and Yield attributes

The highest yield attributes (Cluster $plant^{-1}$(34.56), Pods $cluster^{-1}$(6.67), Pod length (5.09 cm), grains pod^{-1} (7.22), 1000 grain weight (32.13g) and grain yield (2830 kg ha^{-1}) were found in T3 (60 kg ha^{-1}) which was significantly superior to rest of potassium application rates followed by T4 (90 kg ha^{-1}). However, further increase in potassium application rate resulted in decreased yield. Increase in yield attributes recorded in T3 (60 kg ha^{-1}) may be due to optimum supply of potassium which increased the translocation of assimilates to yield contributing attributes. Considering the varieties, maximum yield attributes (Cluster $plant^{-1}$ (34.56), Pods $cluster^{-1}$(6.67), 1000 grain weight (32.13 g) and grain yield (2830 kg ha^{-1}) were produced by S-5885 and was significantly superior to BR-2017 but grain yield and clusters per plant were non-significant. The interaction between varieties and potassium rates for Cluster $plant^{-1}$, Pods $cluster^{-1}$, Pod length, grains pod^{-1}, 1000 grain weight and grain yield was also significant (Table 1). The results of this study showed that the potassium has the promotive effects on the grain yield of guar. The application of potassium @ 60 kg ha^{-1} gave highest average grain yield (2830 kg ha^{-1}) followed by T_2 (30 kg ha^{-1}). Considering the varieties for grain yield S-5885 gave maximum grain yield (2830 kg ha^{-1}) which was significantly higher than BR-2017(2340 kg ha^{-1}). The interaction between varieties and potassium application rates was also

significant (Table 1). Ranpariya *et al*. (2017) reported that the grain and straw yield in gram was exaggerated considerably by potassium levels @ 60 kg ha^{-1} while grain yield remained at par below and above @ 60 kg ha^{-1}. The decrease in grain yield was observed with the further increase in potassium level from 60 kg ha^{-1} to 90 kg ha^{-1} which might be due to overdose of potassium (Table 1). The gradual increase in the grain yield was due the supply of optimum level of potassium in plant and soil as optimum level of potassium maintains the turgor pressure which ultimately increases the transfer of photosynthates from leaves to reproductive organs. The positive response of guar varieties was due to the sufficient availability of nutrients in soil and their effect on growth and development of plant (Ayub *et al*., 2012). These results are in line with those of Biswash *et al*. (2014) in green gram.

Table 1. Effect of variable rates of potassium on growth, yield and yield attributes of two guar varieties.

Treatments	**BR-2017**	**S-5885**
Plant height (cm)		
T1 (0 kg.ha^{-1})	86	89
T2 (30 kg.ha^{-1})	98	83
T3 (60 kg.ha^{-1})	92	98
T4 (90 kg.ha^{-1})	99	85
LSD $_{0.05}$ V = 3.94; T = 9.07 ns		
Branches per plant		
T1 (0 kg. ha^{-1})	0.11	5.79
T2 (30 kg. ha^{-1})	0.11	6.67
T3 (60 kg. ha^{-1})	0.11	7.10
T4 (90 kg. ha^{-1})	0.11	5.11
LSD $_{0.05}$ V = 0.78; T = 0.76		
Days to emergence		
T1 (0 kg.ha^{-1})	4.67	4.67
T2 (30 kg.ha^{-1})	4.33	4.33
T3 (60 kg.ha^{-1})	4.33	4.33
T4 (90 kg.ha^{-1})	4.67	4.33
LSD $_{0.05}$ V = 0.36; T = 0.82 ns		
Germination %		
T1 (0 kg.ha^{-1})	55.33	70.00
T2 (30 kg.ha^{-1})	60.00	77.33
T3 (60 kg.ha^{-1})	74.67	85.00
T4 (90 kg.ha^{-1})	65.00	80.00
LSD $_{0.05}$ V = 8.24; T = 10.74		
Days to 50% flowering		
T1 (0 kg.ha^{-1})	49.67	55.67
T2 (30 kg.ha^{-1})	48.33	53.00
T3 (60 kg.ha^{-1})	48.67	49.33
T4 (90 kg.ha^{-1})	48.67	57.00
LSD $_{0.05}$ V = 7.88; T = 12.06 ns		

		Cont'd……. Table 1
Days to 90% maturity		
T1 (0 kg.ha^{-1})	112.33	110.67
T2 (30 kg.ha^{-1})	106.67	109.00
T3 (60 kg.ha^{-1})	108.33	111.33
T4 (90 kg.ha^{-1})	112.33	107.33
LSD $_{0.05}$ V = 7.14ns; T = 4.20 ns		
Cluster per plant		
T1 (0 kg.ha^{-1})	21.00	22.11
T2 (30 kg.ha^{-1})	23.11	24.67
T3 (60 kg.ha^{-1})	29.67	34.56
T4 (90 kg.ha^{-1})	23.67	29.44
LSD $_{0.05}$ V = 4.07ns; T = 3.38		
Pods per cluster		
T1 (0 kg.ha^{-1})	3.56	4.11
T2 (30 kg.ha^{-1})	3.78	4.33
T3 (60 kg.ha^{-1})	4.67	6.67
T4 (90 kg.ha^{-1})	4.22	5.00
LSD $_{0.05}$ V = 0.62; T = 0.92		
Grains per pod		
T1 (0 kg.ha^{-1})	5.93	6.20
T2 (30 kg.ha^{-1})	6.16	7.60
T3 (60 kg.ha^{-1})	7.22	6.67
T4 (90 kg.ha^{-1})	6.67	6.84
LSD $_{0.05}$ V = 0.59ns; T = 1.22 ns		
Pod length (cm)		
T1 (0 kg.ha^{-1})	4.48	4.07
T2 (30 kg.ha^{-1})	4.72	4.26
T3 (60 kg.ha^{-1})	4.80	5.09
T4 (90 kg.ha^{-1})	5.03	4.48
LSD $_{0.05}$ V = 1.18; T = 0.46		
Thousand grain weight (g)		
T1 (0 kg.ha^{-1})	28.00	31.60
T2 (30 kg.ha^{-1})	27.80	31.87
T3 (60 kg.ha^{-1})	28.10	32.13
T4 (90 kg.ha^{-1})	28.10	31.70
LSD $_{0.05}$ V = 0.56; T = 0.93 ns		
		Cont'd……. Table 1

Grain yield (kg ha^{-1})		
T1 (0 kg.ha^{-1})	2015	2340
T2 (30 kg.ha^{-1})	2295	2790
T3 (60 kg.ha^{-1})	2340	2830
T4 (90 kg.ha^{-1})	2110	2620
LSD $_{0.05}$ V = 541.40ns; T = 227.86		

CONCLUSION AND RECOMMENDATIONS

The potassium application must not be skipped from the fertilization program as without the application of potassium seed quality deteriorates. The more grain yield of guar was obtained with the application of potassium at the rate of 60 kg ha^{-1}. Therefore potassium applications at the rate of 60 kg ha^{-1} and S-5885 are recommended for farmers to achieve maximum grain yield of guar under irrigated conditions.

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