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Effect of potassium levels on performance of chickpea (*Cicer arietinum* L.) under different genotypes

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Abstract
Pulses have emerged as the most important crop which has been cultivated by human being since the time immortal. Therefore, an experiment was conducted during *Rabi* season of 2013 -14 at SIF of CSAUT Kanpur. Twelve treatments under which 4 Potassium levels *viz.*, K_1, K_2, K_3 and K_4 (0, 30, 60 and 90 kg ha^{-1}) and Three Varieties (Udai, Avarodhi and KWR-108) were tested in factorial randomized block design with three Replications. Significantly highest plant height, yield contributing characters viz. number of pods per plant, number of seed per plant seed weight per plant and weight of 100 seed, grain yield (18.66 q ha^{-1}), and straw yield were recorded under potassium level K_4 (90 kg potassium per ha). The minimum plant height, yield attributes and yields were obtained in control treatment K_1 (0 kg potassium per ha). Thus, chickpea variety KWR-108 should be fertilized with 90 kg potassium per ha for harvesting higher yields.

Keywords: chickpea, plant height, potassium levels, varieties and yields

Introduction
On the global basis chickpea is the third most important crop after dry bean (*Phaseolus vulgaris* L.) and dry peas (*Pisum sativum* L.). In India chickpea is the premier *Rabi* pulse followed by lentil, field pea and lathyrus. It has the first rank in area (10.22 mha), production (9.88 mt) with average productivity of 967 kg ha^{-1} in India. The major Chickpea producing states are Madhya Pradesh has the first rank in area (3.48 mha) and production (3.82 mt), Rajasthan (1.92 mha and production 1.64 mt), Maharashtra (1.82 mha and production 1.62 mt) and Uttar Pradesh has the sixth place in area (0.58 mha) and production (0.48 mt).While Andhra Pradesh has the first place in productivity (1449 kg ha^{-1}) and Uttar Pradesh has the ninth place in productivity (824 kg ha^{-1}). (Anonymous, 2015) [2].

Gram being a leguminous crop endowed with the capacity to fix the atmospheric nitrogen for meeting it nitrogen requirement. The major pulses grown in India are Chickpea, Pigeonpea, Urdbean, Mungbean, and lentil. Through individual crop has undergone significant change with respect to area, production and productivity. The decreasing per capita availability of pulse from 69g in 1961 to 37g in 2012 in the country has been a serious concern with assured supply of cereals at an affordable price. The main focus of policy makers and researchers is now on nutritional security in the country. To alleviate protein energy malnutrition's a minimum of 50 g pulse per capita per day should be available in addition to other sources of protein such as cereals, milk, meat and eggs. This is much below the recommended quantity of 80 g by WHO. To make up this short fully supply besides of course, further demand from a burgeoning population, at least 23.38 million tones of pulses are required by 2015 which is expected to touch 29.30 million tons by 2020. This necessitates an annual growth rate of 4.2 per cent in pulse production.

Potassium influences the water economy and crop growth through its effects on water uptake, root growth, maintenance of turgor, transpiration and stomatal regulation (Nelson, 1980) [5]. Although potassium unlike N and P, does not enter into the composition of any product, yet literature on K reveals that it has an important role either direct or indirect, under different environments, in major plant processes such as photosynthesis, respiration, protein synthesis, enzyme activation, water uptake, osmoregulation, growth and yield of plant (Sharma *et al.* 2006 and Singh and Jagdish, 1997) [8, 10].

This shows the importance of potassium in legume nutrition. However, the work done on legumes with potassium application is not well recognized in comparison to cereals and other crops. It is not a constituent of organic structures, but regulates enzymatic activities (over 60 enzymes require K for activation), translocation of photosynthates and considerably improves seed yield of Chickpea. If applied as a fertilizer (Samiullah and Khan, 2003) [7]. Therefore, the present study was carried out to investigate the effect of potassium levels on performance of chickpea under different genotypes.

Materials and Methods

Site description

The present experiment was carried out during *Rabi* 2013-14 at Students' Instructional Farm (SIF), Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.), India. The field was well leveled and irrigated by tube well. The farm is situated in the west Northern part of Kanpur city under sub tropical zone in 5th Agro-climatic zone (Central Plain Zone). Farm is falling in alluvial belt of Gangetic plain of U.P. between 25056' N to 28058' N latitude and 79031' E to 80034' E longitudes and at an elevation of 125.9 meter from maean sea level. The total rainfall received during the crop period was 23.3 mm. The soil of experimental field was slightly alkaline in reaction with 7.9 pH, low in organic carbon (0.32%) and low in available nitrogen (180.4 kg ha^{-1}), phosphorus (18.4 kg ha^{-1}) and medium in potassium (290 kg/ha). All the soil properties were analyzed as per the standard procedures.

Experimental details

The experiment consist of 12 treatments combinations which were laid out in Randomized Block Design with three replications. The investigation retained four potassium level (0, 30, 60, 90 kg ha^{-1}) and 3 varieties (Udai, Awarodhi and KWR-108). The sowing of chickpea was done on November 21, 2013 at a row spacing of 40 cm apart with depth 8-10 cm and harvested at second week of April, 10 2014. Nitrogen was applied @ 20 kg per ha and phosphorus was applied @ 50 kg per ha and different quantity of Potassium as per treatment of 0, 30, 60 and 90 kg per ha was given at sowing in furrow with the help of seeding sprout attached in country plough. As per treatment well rotted FYM @ 10 t ha^{-1} was applied by broadcasting method and then mixed with soil there after sowing was done. Weeds are emerged sharply in chickpea, in order suppress them two hand weeding was done first weeding at 30-35 days after sowing and second weeding at 70-72 days after sowing of the crop with the help of *Khurpi* to control the weeds. To provide proper space to each extra plant were removed and wide spaces were filled by sowing the plant at each vacant place. As winter showers occurred at pre flowering and pod filling stages, hence no irrigation.

Data collection

The various observations on plant height at 60 DAS and harvest, yield attributes (number of pods per plant, number of seed per plant seed weight per plant and weight of 100 seed) were recorded as per standard procedure. Moreover, yields viz., grain and straw was worked out in different plot of the experimental field.

Statistical analysis

The data on various parameters were exposed to statistically analyze as drew by Panse and Sukhatme (1967) [6]. The treatment variances were tested by using "F" test and critical differences (at 5 per cent probability).

Results and Discussion

Plant height

Plant height was significantly maximum in the level where 90 kg potassium ha^{-1} applied at all stage of growth, whereas short height was noted under the treatment which not received potassium. The increment of plant height may be due to availability of nutrients than reduced doses of potassium. Almost similar results were reported Deolenkar (2005) [3] and Ahmad *et al.* (2015). Moreover, the plant height recorded at 60 DAS and maturity stage and it is clear from Table 1 that highest plant height with the variety KWR-108 (22.58 cm) and (36.91 cm) over the variety Udai (21.91 cm) and (36.33 cm). These plant heights are varied due to varieties wise nutrients uptake efficiency with potassium. These results were also in consonance of Kumar *et al*. (2005) [4].

Table 1: Plant height, yield attributes and yields as influenced by various treatments

Treatments	Plant height		Yield attributes					Yields	
	At 60 DAS	At maturity	Number of pods $plant^{-1}$	Pods weight $plant^{-1}$ (g)	Number of seeds per plant	Grain weight per plant (g)	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
Potassium level									
K_1	20.33	34.33	47.99	14.76	66.22	11.17	16.91	11.60	13.19
K_2	21.66	35.85	50.06	16.55	72.99	12.27	17.41	13.58	14.30
K_3	23.01	37.55	55.09	18.13	75.99	13.28	17.95	14.99	15.33
K_4	23.99	38.86	60.88	19.55	80.88	14.55	17.99	18.66	19.22
SE (d) ±	0.13	0.08	0.24	0.13	0.065	0.098	0.147	0.262	0.015
CD at 5%	0.28	0.18	0.50	0.28	0.13	0.205	0.308	0.54	0.032
Varieties									
V_1	21.91	36.33	52.62	16.85	71.91	12.55	17.42	13.94	14.89
V_2	22.25	36.70	53.50	17.36	73.99	12.84	17.52	14.87	15.51
V_3	22.58	36.91	54.40	17.54	76.16	13.06	17.75	15.32	16.13
SE(d) ±	0.11	0.07	0.21	0.11	0.056	0.085	0.128	0.227	0.013
CD at 5%	0.24	0.16	0.44	0.24	0.112	0.177	0.267	0.473	0.028

Yield contributing character

The various yield contributing characters viz. number of pods per plant, number of seed per plant seed weight per plant and weight of 100 seed were recorded significantly maximum in 90 kg potassium ha^{-1} at all stage of growth observations due to availability of plant nutrients increased with combination of potassium. Almost similar results were reported by Kumar *et al*. (2005) [4], Tomar *et al.* (2001) [11] and Sharma (2001) [9]. The yield attributes were significantly higher increased by variety to variety. The variety KWR-108 was bears maximum yield attributes and the minimum value was recorded in Udai

variety. These results were also in consonance of Kumar *et al*. (2005) [4].

Yields

Significantly maximum grain and straw yield were obtained in treatment K_4 (90 kg potash ha^{-1}) followed by with application of 60 kg potassium (K_3). However, skip of potassium showed least yields. Reduction of potassium doses reduced these yield may be supported by growth and yield parameter like plant population, plant height, number of branches, dry matter per plant, seed per plant, seed weight per plant and 100 seed weight which are maximized at 90 kg potassium ha^{-1}. Thus this dose performed better in the respect of growth, yield attributes and yield of chickpea. Similar finding have been reported by Kumar *et al.* (2005) [4] and Ahmad *et al.* (2015). Furthermore, grain yield (15.32 q ha^{-1}) and straw yield (16.13 q ha^{-1}) was significantly higher achieved in KWR-108 variety. However the minimum grain (13.94 q ha^{-1}) and straw (14.89 q ha^{-1}) yield were achieved in Udai variety. The similar findings were also put forward by Ahmad *et al.* (2015).

Interaction effect on biological yields

Biological yield (q ha^{-1}) significantly differ under different potassium levels and varieties (Table 2). The significantly highest biological yield (40.36 qha^{-1}) was found in interaction $K_4 \times V_3$ (90 kg potassium ha^{-1} × KWR-108) followed by interaction $K_4 \times V_2$ (38.00 qha^{-1}) which was significantly superior to interaction $K_4 \times V_1$ (35.36 q ha^{-1}). While the minimum biological yield (23.66 q ha^{-1}) was recorded in interaction $K_1 \times V_1$ (0 kg potassium ha^{-1} × Udai). Similar finding have been reported by Kumar *et al.* (2005) [4].

Table 2: Interaction effect of potassium levels and varieties on biological yield

Varieties	Biological yield (q per ha)				
	Level of potassium				
	K_1	K_2	K_3	K_4	Mean
V_1	23.66	26.90	29.33	35.36	28.81
V_2	24.56	28.00	30.00	38.00	30.14
V_3	26.19	28.66	30.66	40.36	31.47
Mean	24.80	27.85	30.00	37.91	
Factors	SE(d)±			C.D.	
Factor(A)	0.03			0.06	
Factors(B)	0.03			0.05	
Factor(A×B)	0.05			0.11	

Conclusion

On the basis of present experiment, it can be concluded that better growth, yield attributes and yield were achieved with application 90 kg potash per ha of potassium doses. Likewise, KWR-108 variety proved to be better in order to obtained maximum growth, yield attributes and yield. Thus, chickpea variety KWR-108 should be fertilized with 90 kg potassium per ha for harvesting higher yields.

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