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Effect of potassium application on growth, yield and quality of chickpea cultivars

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Abstract
A Field experiment was conducted during *rabi* season 2018-19 at experimental farm of Department of Soil Science and Agril. Chemistry, College of Agriculture, Badnapur using chickpea as a test crop to study effect of potassium on Chickpea varieties. The experiment was conducted in factorial randomized block design with two factors viz., four varieties (V_1-Digvijay, V_2-BDNG-797, V_3-JAKI-9218 and V_4-Phule Vikram) and four fertilizer levels (Control i.e.RDF -25:50:00 kg NPK ha^{-1}(F_1), RDF + Potassium @ 30 kg ha^{-1} (F_2), RDF+ 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage (F_3), RDF+ Potassium @ 30 kg ha^{-1} + 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage (F_4)) with 16 treatments combinations. Each experimental unit was replicated two times. Amongst different varieties Phule Vikram was effective in recording highest growth parameters, yield attributes and yield of chickpea. Digvijay recorded maximum protein and seed index. The results emerged out clearly indicated that various parameters like plant height, number of pods, number of nodules, dry matter kg ha^{-1}, protein, seed yield and straw yield was increased due to application of potassium. It was inferred from the results that application of RDF+ Potassium @ 30 kg ha^{-1} + 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage showed synergistic effects on nutrients (N, P and K) uptake. Soil fertility was also found to be improved due to application of potassium to chickpea varieties.

Keywords: Cucumber, boron, yield, quality, Konkan

1. Introduction
Chickpea (*Cicer arietinum* L.) is the third most important legume in the world. India alone contributes more than 62-67% of the total global production. However, India generally imports 2 million tonnes of pulse every year. To make up this short fully supply besides of course, further demand from a burgeoning population, 29.30 million tonnes of pulses are required by 2020 (Anonymous, 2016) [3]. Potassium application has been neglected in many countries, including India, which has resulted in soil K depletion in agricultural ecosystems and a decline in crop yields (Regmi *et al*., 2002) [10]. Higher yields and crop quality can be obtained at optimal N: K nutritional ratios. K is an essential macronutrient required for proper development of plants. Potassium has been described as the "quality element" for crop production. Pulse growing agro ecological region of India vary widely in their K supplying capacity. Light textured alluvial soils, red and lateritic soils and shallow black soils with low levels of available K and even black cotton soil needs K supplementation to enhance the productivity. Based on a number of field studies, it can be suggested that the application of 20-40 kg K_2O ha^{-1} and foliar application of 1 -2% of KNO_3 is beneficial for higher pulse production (Ali and Srinivasa Rao, 2001) [2]. Hence, the project was formulated to study the effect of potassium on chickpea varieties to achieve balance use of N, P, and K nutrients.

2. Materials and Methods
A field experiment was conducted during *rabi* season 2018-2019 at departmental Farm of Soil Science and Agril. Chemistry, College of Agriculture, Badnapur. in factorial randomized block design with two factors viz., four varieties (V_1-Digvijay, V_2-BDNG-797, V_3-JAKI-9218 and V_4-Phule Vikram) and four fertilizer levels (Control i.e.RDF -25:50:00 kg NPK ha^{-1}(F_1), RDF + Potassium @ 30 kg ha^{-1} (F_2), RDF+ 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage (F_3), RDF+ Potassium @ 30 kg ha^{-1} + 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage (F_4)) with 16 treatments combinations. Each experimental unit was replicated two times. Each treatment consisted of 15 rows with row to row spacing 30 cm. agronomic practices were carried out uniformly according to in all the treatments.

The initial physico-chemical properties of experimental soil were presented in (Table 1). Randomly 5 plants were taken from each treatment for counting of plant height, number of nodules plant^{-1}, number of pods plant^{-1}, Dry matter yield and grain yield. Protein content was estimated by seed nitrogen per cent was multiplied by the factor of 6.25 to get the percentage of protein in chickpea seed.

Table 1: Initial physico-chemical properties of experimental soil

Sr. No.	Particulars	Content
1.	Soil pH	7.79
2.	Elecrical conductivity (dSm^{-1})	0.24
3.	Organic carbon (%)	0.73%
4.	$CaCO_3$ (%)	5.15%
5.	Available Nitrogen (N Kg ha^{-1})	176.14
6.	Available Phosphorus (P_2O_5 Kg ha^{-1})	16.79
7.	Available Potassium (K_2O Kg ha^{-1})	739.28

3. Results and discussion

3.1 Plant height

The height of chickpea varieties were monitored at harvesting stage of crop are presented in table 2. It was observed that there was increase in plant height due to application of potassium. Amongst the varieties, Phule Vikram recorded superiorly significant more plant height (43.18 cm) however it was at par with Digvijay (41.70 cm) at harvest. Significantly lowest plant height was recorded by JAKI-9218 (35.24 cm) and BDNG-797(37.50 cm) than Phule Vikram (43.18 cm) at harvest. Amongst fertilizer levels significantly maximum plant height (41.50 cm) was observed under fertilizer level (F_4) RDF + Potassium @ 30 kg ha^{-1} + 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage which was at par with fertilizer level (F_2) (39.50 cm) RDF + Potassium @ 30 kg ha^{-1} and (F_3) (40.30 cm) RDF+ 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage. Significantly lowest plant height (36.31 cm) was recorded with fertilizer level (F_1) Control (RDF-25:50:00 kg NPK ha^{-1}). Similar findings were obtained by Kumar *et al.*, (2018) [7] in chickpea.

3.2 Number of nodules plant^{-1}

The data presented in table 2 indicates significant impact of potassium on number of nodules. It was recorded at 45 and 60 DAS of chickpea crop. Amongst the varieties, Phule Vikram recorded significantly more nodules than JAKI-9218, however, it was at par with Digvijay and BDNG-797 variety at 45 and 60 DAS. Significantly lowest nodules were recorded by JAKI-9218 than Phule Vikram at 45 and 60 DAS. Amongst fertilizer levels significantly maximum nodules at 45 DAS were observed under fertilizer level (F_4) RDF+ Potassium @ 30 kg ha^{-1} + 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage and were at par with fertilizer level (F_2) RDF + Potassium @ 30 kg ha^{-1} and at 60 DAS significantly maximum nodules were observed under fertilizer level (F_3) RDF+ 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage and were at par with fertilizer level (F_2) RDF + Potassium @ 30 kg ha^{-1}. Lowest nodules were counted with fertilizer level (F_1) Control (RDF-25:50:00 kg NPK ha^{-1}) at 45 and 60 DAS. These results also confirmed with the findings of Baulbaba *et al.*, (2005) obtained maximum nodules with the application of 50 kg K_2O ha^{-1} in chickpea.

3.3 Dry matter kg ha^{-1}

The data presented in table 2 indicates total dry matter kg ha^{-1} were significantly influenced due to different varieties at harvest. Among different varities significantly highest total dry matter was recorded in Phule Vikram variety than Digvijay, BDNG-797 and JAKI-9218 for Kg ha $^{-1}$. Lowest dry matter were recorded due to JAKI-9218 and were comparable with BDNG-797 and Digvijay varieties at harvest. Amongst fertilizer levels significantly maximum dry matter was recorded under fertilizer level (F_4) RDF + Potassium @ 30 kg ha^{-1} + 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage had recorded maximum dry matter (kg ha^{-1}) however it was at par with fertilizer level (F_2) RDF + Potassium @ 30 kg ha^{-1} and (F_3) RDF+ 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage. Significantly lowest dry matter was recorded by (F_1) Control (RDF-25:50:00 kg NPK ha^{-1}) at harvest. This is due to effect of K nutrition on cell elongation, turger potential in leaves. Such results were also recorded by Patil and Dhonde (2009) [9] in green gram.

3.4 Number of Pods plant^{-1}

The data presented in table 2 indicates significant impact of potassium on number of pods plant^{-1}. Amongst all the varieties, Phule Vikram recorded significantly more number of pods plant^{-1} (49.38) than Digvijay (42.90) and JAKI-9218 (43.58) however, it was at par with BDNG-797 (45.23) variety at harvest. Significantly lowest number of pods plant^{-1} was recorded by Digvijay than Phule Vikram at harvest. Amongst various fertilizer levels significant maximum pods plant^{-1} (49.53) were observed under fertilizer level (F_4) RDF + Potassium @ 30 kg ha^{-1} + 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage than fertilizer level (F_3) (43.74) and (F_1) (39.94) however which was at par with fertilizer level (F_2) (47.88) RDF + Potassium @ 30 kg ha^{-1}. Significantly lowest number of pods plant^{-1} (39.94) were recorded due to fertilizer level (F_1) Control (RDF -25:50:00 kg NPK ha^{-1}). The results are also confirmity with the findings of Gaud *et al*., (2014) in chickpea

3.5 Protein content

The data presented in table 2 indicates significant impact of potassium on protein (%) in chickpea seed. Amongst the varieties, Digvijay recorded maximum protein (19.15%) however which was at par with Phule Vikram (19.03%).significantly lowest protein was recorded due to JAKI-9218 (18.11%). Amongst various fertilizer levels significantly maximum protein (20.86%) was observed under fertilizer level (F_4) RDF + Potassium @ 30 kg ha^{-1} + 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage which was followed by fertilizer level (F_2) and (F_3). Significantly lowest protein (15.88%) was recorded with fertilizer level (F_1) Control (RDF-25:50:00 kg NPK ha^{-1}).Similar finding also recorded by Farhad *et al*.,(2010) concluded that application of potassium @ 40 kg ha^{-1} produced the highest protein content in soybean.

3.6 Grain yield kg ka^{-1}

The data presented in table 2 indicates significant impact of potassium on grain yield plant^{-1}. It was recorded at harvesting stage of chickpea crop. Amongst the varieties, Phule Vikram recorded maximum grain yield (1062.76 kg ha^{-1}) which was significantly superior over Digvijay (978.07 kg ha^{-1}), BDNG-797 (963.85 kg ha^{-1}) and JAKI-9218 (924.23 kg ha^{-1}). Amongst fertilizer levels (F_4) RDF + Potassium @ 30 kg ha^{-1} + 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage recorded significantly highest yield (1022.88 kg ha^{-1}) than fertilizer level (F_1) Control (RDF-25:50:00 kg

NPK ha^{-1}) (909.72 kg ha^{-1}) and was at par with fertilizer level (F_2) RDF + Potassium @ 30 kg ha^{-1} (1005.87 kg ha^{-1}) and fertilizer level (F_3) RDF+ 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage (990.47 kg ha^{-1}). Significantly lowest grain yield was recorded with fertilizer level (F_1) Control (RDF-25:50:00 kg NPK ha^{-1}) (909.72 kg ha^{-1}) at harvest. The positive effect of K on crop yield might also be due to its requirement in carbohydrate synthesis and translocation of photosynthesis and also may be due to improved yield attributing characters, shoot growth and nodulation. These results also confirmed with the findings of Adsure *et al*., (2018) [1] in black gram

Table 2: Effect of different varieties and fertilizer levels on growth parameters, yield attributes, quality and grain yield of chickpea

Treatments		Plant height at harvest	No. of nodules		Dry matter kg ha^{-1}	Pods plant^{-1}	Protein %	Grain yield kg ha^{-1}
			45 DAS	60 DAS				
Varieties								
V_1	Digvijay	41.70	24.41	27.90	2229.74	42.90	19.15	978.07
V_2	BDNG-797	37.50	24.58	28.48	2188.97	45.23	18.50	963.85
V_3	JAKI-9218	35.24	22.55	24.61	2097.91	43.58	18.11	924.23
V_4	Phule Vikram	43.18	25.73	28.65	2578.80	49.38	19.03	1062.76
SE ±		0.72	0.58	0.63	54.73	1.41	0.08	23.19
CD at 5%		2.17	1.75	1.90	164.94	4.26	0.24	69.90
Fertilizer levels								
F_1	Control (RDF-25:50:00 kg NPK ha^{-1})	36.31	22.78	25.95	2148.77	39.94	15.88	909.72
F_2	RDF + Potassium @ 30 kg ha^{-1}	39.50	24.84	28.53	2306.56	47.88	19.88	1005.87
F_3	RDF+ 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage	40.30	23.31	26.31	2247.76	43.74	18.18	990.47
F_4	RDF + Potassium @ 30 kg ha^{-1} + 2 Foliar spray of KNO_3 @ 1% at flowering and pod formation stage	41.50	26.34	28.85	2392.32	49.53	20.86	1022.88
SE ±		0.72	0.58	0.63	54.73	1.41	0.08	23.19
CD at 5%		2.17	1.75	1.90	164.94	4.26	0.24	69.90
Interaction (VXF)								
SE ±		1.43	1.15	1.26	109.46	2.82	0.15	46.38
CD at 5%		NS	NS	NS	NS	NS	NS	NS
General Mean		39.40	24.31	27.40	2273.85	45.26	18.69	982.23

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