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Soil Nutrient Status of Chickpea (*Cicer arietinum* L.) as Influenced by Potassium and Zinc Application in Vertisol

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A B S T R A C T

A field experiment was planned and conducted during *Rabi* 2012-13 to evaluate the "Soil nutrient status of chickpea (*Cicer arietinum* L.) as influenced by potassium and zinc application in Vertisol". The field experiment was conducted at the Departmental Research Farm of Vasantrao Naik Marathwada Agricultural University, Parbhani, was laid out in Randomized Block Design with three replications. There were eight treatments comprising of K levels and zinc viz ; T_1- Absolute control, T_2- Only RDF through soil (25:50:0 NPK kg ha^{-1})T_3 –RDF + 15 kg K_2O ha^{-1},T_4- RDF + 30 kg K_2O ha^{-1}, T_5- RDF+45 kg K_2O ha^{-1}, T_6- RDF+15 kg K_2O ha^{-1}+25 kg $ZnSO_4$ ha^{-1}, T_7- RDF + 30 kg K_2O ha^{-1} + 25 kg $ZnSO_4$ ha^{-1}, T_8- RDF + 45 kg K_2O ha^{-1} + 25 kg $ZnSO_4$ ha^{-1}.The results indicated that application of RDF+15or30 kg K_2O ha^{-1}+25 kg $ZnSO_4$ ha^{-1}. Available N and P status at various growth stages of chickpea found to be increased up to pod development stage and thereafter N and P available status was decreased. While, potassium availability was decreased from flowering to harvesting stage, where as sulfur availability was increased till harvesting. In respect of micronutrients, no specific trend was noted. However, the application of zinc to chickpea maintained the higher Zn availability throughout the crop growth.

Introduction

Pulses are the second most important group of crops after cereals. India, China, Brazil, Canada, Myanmar and Australia are major pulse producing countries with relative share of 25 %, 10 %, 5 %, 5 % and 4%, respectively. India ranks first in production of chickpea in world contributing 25-28 % world's total crop production. Area under chickpea production during 2010-2011 was 7.37 M ha and total production was 5.89 MT. Average productivity of chickpea in India (823 kg ha^{-1}) and Maharashtra (614 kg ha^{-1}) is very low. Low productivity of chickpea in India is mainly attributed to improper and inadequate nutritional supply to plant. Use of fertilizers in appropriate quantities and in balanced proportion is absolutely essential for good productivity of crop. The soil potassium reserves are depleted and crop yields found to be reduced. It is reported that high clay Vertisol once upon a time suppose to be having very high potassium content now responding for K application, which shows that the K content has been depleted. In the region of Marathwada, it is observed that in the recommended fertilizer schedule of pulses particularly green gram, black gram, chickpea and red gram do not have potassium. Under this situation, it is necessary to test the response of K application in these crops. Zinc deficiency is wide spread. In Marathwada region, it varies between 62 to 89 % (Patil, 2013). Zinc is one of the seven plant micronutrients, involved in many enzymatic activities of plants. Besides increasing crop yield it increases the crude protein content, amino acids, energy value and total lipid in chickpea, soybean, black gram etc. with zinc application.

Materials and Methods

A field experiment was carried out during *Rabi* 2012-13 using chickpea (var. *Akash*) at the Departmental Research Farm of Vasantrao Naik Marathwada Agricultural University, Parbhani. The experiment was laid out in Randomized Block Design with three replications. There were eight treatments comprising of K levels and zinc viz ; T_1- Absolute control, T_2- Only RDF through soil (25:50:0 NPK kg ha^{-1})$\cdot T_3$ –RDF + 15 kg K_2O ha^{-1},T_4- RDF + 30 kg K_2O ha^{-1}, T_5- RDF+45 kg K_2O ha^{-1}, T_6- RDF+15 kg K_2O ha^{-1}+25 kg $ZnSO_4$ ha^{-1}, T_7- RDF + 30 kg K_2O ha^{-1} + 25 kg $ZnSO_4$ ha^{-1}, T_8- RDF + 45 kg K_2O ha^{-1} + 25 kg $ZnSO_4$ ha^{-1}.All fertilizers were applied at the time of sowing below the seed. The experimental soil was fine, smectitic calcareous, Iso-hyperthermic Typic Haplusterts. It was alkaline in reaction (pH 7.84), safe in soluble salt concentration (EC 0.61 dSm^{-1}) and low in organic carbon content (0.43 %) (Walkly and Black, 1934). The free calcium carbonate was 4.69 %. Potassium permanganate oxidisable available N (197.76 kg/ha) Subbiah and Asija (1956), Olsen`s available P (12.57 kg/ha) Olsen *et al.,* (1954), 1M ammonium acetate exchangeable available K (701.76 kg/ha) (Piper, 1966). And DTPA extractable Zn (0.8860 mg/kg) Lindsay and Norvell (1978) at the commencement of the experiment.

Results and Discussion

Effect of available N, P, K on Pod yield and Biomass yield of chickpea

Treatment T_4 comprises recommended dose of N and P with 30 kg K_20 ha^{-1} produced 14.08 q ha^{-1} pod yield and showed significant increase over absolute control and application of 15 and 45 kg K_2O ha^{-1}. Further addition of zinc to growing media enhanced the chickpea yield. (Table 1) The chickpea crop receiving RDF + 15 or 30 kg K_2O with 25 kg $ZnSO_4$ ha^{-1} recorded the highest yield (14.56 and 15.40 q ha^{-1}) and found at par with RDF + 45 kg K_2O ha^{-1}+25 kg $ZnSO_4$ ha^{-1}. The biomass yield was in the range of 18.33 to 33.14 q ha^{-1}. Maximum biomass yield was observed in treatment T_7 (RDF+30 kg K_2O ha^{-1} +25 kg $ZnSO_4$ ha^{-1}). It is significantly superior over absolute control but at par with rest of the treatments excluding T_2 and T_3 respectively (i.e. RDF and RDF + 15 kg K_2O ha^{-1}) (Table.1).This may be due fact that potassium and zinc are reported to enhance the absorption of native as well as added major nutrient such as N and P which might have been attributed to improvement of yield. Increase rate of photosynthetic and symbiotic activity following balanced application of NPK stimulated better vegetative and reproductive growth of the crop resulting in higher green pod yield due to the effect of both potassium and micronutrients. Similar findings were reported by Jat *et al.,* (2013); Patil and Dhonde (2009); Khrogamy and Farnia (2009) in case of chickpea.

Effect of available N, P, K on soil fertility status of chickpea

The data presented revealed that available N content was lowered down at harvest might be because its utilization for grain formation. Chickpea being a pulse crop require more N for protein synthesis. Further it was noticed that available N content was increased in the treatment receiving potassium and zinc. This might be because of synergy between N, K and Zn.

Table.1 Soil nutrient status of chickpea (*Cicer arietinum* L.)

Treatment details	Pod yield (qha^{-1})	Biomass yield (qha^{-1})	Available N ($kg\ ha^{-1}$)	Available P_2O_5 ($kg\ ha^{-1}$)	Available K_20 ($kg\ ha^{-1}$)	Available Zn ($mg\ kg^{-1}$)
Absolute Control	8.75	18.83	177.85	11.42	628.69	0.91
Only RDF (25:50 NP kg ha^{-1})	9.75	20.61	166.52	11.53	665.28	0.90
RDF+ 15 kg K_2O ha^{-1}	10.57	22.75	179.99	12.70	704.85	0.86
RDF+ 30 kg K_2O ha^{-1}	14.08	30.30	221.43	12.97	758.05	0.89
RDF +45 kg K_2O ha^{-1}	12.87	28.39	185.02	13.85	797.76	0.80
RDF+ 15 kg K_2O ha^{-1} +25 kg $ZnSO_4$ ha^{-1}	14.56	31.34	199.38	14.51	758.8	1.00
RDF+ 30 kg K_2O ha^{-1} +25 kg $ZnSO_4$ ha^{-1}	15.40	33.14	208.57	13.51	711.89	0.98
RDF +45 kg K_2O ha^{-1} +25 kg $ZnSO_4$ ha^{-1}	13.75	29.04	198.61	13.51	713.51	0.99
SEm (±)	0.75	2.9	8.01	0.64	12.57	0.011
CD at 5%	2.3	8.85	NS	NS	38.09	0.036

Available phosphorus was found to be non significant. In case of Available K_20 ($kg\ ha^{-1}$) maximum value was recorded in treatment T_5 (RDF+45 kg K_2O ha^{-1}) i.e. 797.76 kg ha^{-1}which was found to be highly significant over rest of the treatments. The data presented revealed that the treatment comprising zinc (Treatment T_6, T_7, T_8) were able to maintain higher available zinc status irrespective of stage of crop. Further available Zn content was decreased with advancement of growth. Treatment T_6 (RDF+15 kg K_2O ha^{-1}+25 kg $ZnSO_4$ ha^{-1}) showed maximum iron. Treatment T_6 (RDF + 45 kg K_2O ha^{-1} + 25 kg $ZnSO_4$ ha^{-1}) showed maximum value with at all three stages and at par with rest of the treatment except T_1 (Absolute Control) and T_2 (RDF only).

Soil fertility status (available N, P, K, and S) and micronutrients were higher in the treatment receiving potassium. The total uptake nutrients significantly increased with graded dose level of potassium and zinc @; RDF + 30 kg K_2O ha^{-1} and RDF + 30 kg K_2O ha^{-1} +25 kg $ZnSO_4$ ha^{-1}.

"Even under high potassium content of soil for pulses in general and chickpea in particular it is essential to include potassium in fertilizer application schedule in the Vertisols of Marathwada region."

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