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Research Article

Effect of potassium and zinc on yield, quality and economics of cowpea (*Vigna sinensis* L.) var. GC-4

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Abstract : A field experiment was conducted on medium black calcareous soil of the Instructional Farm, Junagadh Agricultural University, Junagadh (Gujarat) during the season of *Kharif*-2008. Significantly higher grain yield (1587 kg ha^{-1}) was recorded with application of 60 kg K_2O ha^{-1}. Significantly highest grain yield (1553 kg ha^{-1}) was recorded with 40 kg zinc ha^{-1}. The maximum grain protein content of 23.59 per cent as well as the higher net realization Rs.21725 ha^{-1} with BCR (3.43) was accrued under the application of 60 kg K_2O ha^{-1}. The higher net realization of Rs.20545 ha^{-1} with 3.18 BCR was realized under the application of 40 kg zinc ha^{-1}. Considering the treatment combinations, K_3Zn_2 (60 kg K_2O ha^{-1} + 40 kg zinc ha^{-1}.) recorded the highest net realization of Rs. 24344 ha^{-1} with BCR 3.54. It is indicated that the potential production and profit from *Kharif* season cowpea (cultivar GC-4) can be secured by fertilizing the crop with 60 kg K_2O ha^{-1} along with 40 kg zinc ha^{-1}.

Key Words : Cowpea, Potash, Zinc

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INTRODUCTION

Cowpea is the most versatile *Kharif as* well as summer pulse, because of its smothering nature, drought tolerant character, soil restoring properties and multipurpose uses. It covers the ground and checks soil erosion and works as mulch to reduce the evaporation losses apart from being a leguminous crop. Cowpea can fix about 80 to 90 kg N ha^{-1} under ideal condition. At present India is passing through a shortage of protein where the people are predominantly vegetarian, pulses are the main source of protein and thus are of vital importance in daily diet. However, requirement of pulses are going up due to population explosion while its production is not increasing to that extent consequently, the price of pulses has increased exorbitantly and common man can not afford to purchase the same. Hence, the production of pulses have to be increased either by increasing the land or by increasing productivity.

Amongst the nutrients N and P are given the prority and very little attention is paid towards the K and micronutrients which are of prime importance for the nutrition of cowpea from the nutrition point of view.

The potassium is one of the major plant nutrient for the growth and development of plants. The major functions are associated with enzyme involved in photosynthesis, metabolism of carbohydrate and physiological processes, such as root growth, water uptake and utilization efficiency, synthesis of protein and amino acids, enzyme activation and yield determining process *viz.*, drought, pest and disease tolerance.

Zinc plays vital role in plant growth and development. Zinc also catalyses the biosynthesis of indole acetic acid (IAA), acting as metal activator of the enzyme, there by ultimately

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increasing crop yield. Moreover, it controls the equilibrium between CO_2, water and carbonic acid in plant metabolism and helps in synthesis of nucleic acids, proteins and stimulates seed formation. Its deficiency retards photosynthesis and nitrogen metabolism.

Thus, arriving at an optimum combination of potassium and zinc chemical fertilizers would result in boosting the production of cowpea, particularly that of newly developed variety, Gujarat Cowpea-4.

With the background and inspite of adequate evidence on its productive capabilities the information on agro-techniques for cowpea production, especially its nutrient requirements for medium black soil of Saurashtra region in *Kharif* season is lacking. A proper understanding of the nutrient management of cowpea crop especially in *Kharif* season is an urgent need to enhance production. So far there is no practically systematic research work done to evaluate the effect of potassium and zinc on growth, yield attributes, quality and nutrient uptake of cowpea crop in this region.

EXPERIMENTAL METHODS

A field experiment was conducted during the *Kharif* season2008 at Agronomy farm, college of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat). The experiment compresses of twelve treatment combinations consisting of four levels of potassium *viz*., no potassium application (K_0), 20 kg K_2O ha^{-1} (K_1), 40 kg K_2O ha^{-1} (K_2), 60 kg K_2O ha^{-1} (K_3) and three levels of zinc *viz*., no zinc application (Zn_0), 20 kg zinc ha^{-1} (Zn_1) and 40 kg zinc ha^{-1} (Zn_2) were framed in Factorial Randomized Block Design (FRBD) with four replications. The soil experimental site was on medium black calcareous soil with pH of 7.9 which was free from any kind of salinity or sodicity hazards. The gross and net plot sizes were 5.00 m x 3.6 m and 4.00 m x 2.4 m, respectively. Potash in the form of murate of potash (60% K_2O) and zinc in the form of zinc sulphate (21% Zn) was applied at the time of sowing in furrows as per treatments.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Effect of potash:

A perusal of data given in Table 1 revealed that the grain yield was significantly influenced by potassium levels. Significantly the highest grain yield of 1587 kg ha^{-1} was recorded with 60 kg K_2O ha^{-1} as compared to K_2 (40 kg K_2O ha^{-1}), K_1 (20 kg K_2O ha^{-1}) and K0 (no potassium application) which recorded grain yield 1454, 1313 and 1003 kg ha^{-1}, respectively. The results are in agreement with findings of Cheng *et al*. (1999), Swaroop and Rathore (2002), Gill and Kamprath (1990), Patra *et al.* (1995) and Ghatak *et al.* (1997).

Table 1 : Effect of different treatments on grain and protein content of cowpea

Treatments	Grain yield (kg ha^{-1})	Protein content (%)
Potassium (K)		
K_0 (control)	1003	19.31
K_1 (20 kg ha^{-1})	1313	22.54
K_2 (40 kg ha^{-1})	1454	23.82
K_3 (60 kg ha^{-1})	1587	24.85
S.E. ±	45.50	0.65
C.D. (P=0.05)	131.01	1.86
Zinc ($ZnSO_4$)		
Zn_0 (control)	1024	21.05
Zn_1 (20 kg ha^{-1})	1441	23.26
Zn_2 (40 kg ha^{-1})	1553	23.59
S.E. ±	39.40	0.56
C.D. (P=0.05)	113.46	1.61
C.V. %	11.77	9.88
Interaction–K x Zn	Sig.	NS

NS=Non-significant Sig.=Significant

An appraisal of data presented in Table 1 showed that significantly higher protein content of 24.85 per cent was recorded when crop was fertilized with 60 kg K_2O ha^{-1} (K_3), which remained at par with 20 kg K_2O ha^{-1} (K_1), and no potassium application (K_0) which recorded 22.54 and 19.31 per cent, respectively. The results are in accordance with those reported by Nanjundappa and Manure (2002) and Bansal *et al.* (2001).

There was considerable increase in net realization due to potassium application as given in Table 2. The highest net return of Rs.21725 was obtained with 60 kg K_2O ha^{-1} (K_3) followed by Rs.19262 with (K_2) 40 kg K_2O ha^{-1} and Rs.16677 with 20 kg K_2O ha^{-1} (K_1). The lowest net realization of Rs.10816 ha^{-1} was noted with K_0 (no potassium application). The results are in accordance with those reported by Nanjundappa and Manure (2002)and Bansal *et al.* (2001).

Effect of zinc:

An appraisal of results in Table 1 showed that the effect of zinc on grain yield was found significant. Significantly the highest grain yield by 1553 kg ha^{-1} was observed with application of zinc 40 kg ha^{-1} (Zn_2) as compared to 20 kg zinc ha^{-1} (Zn_1) and Zn_0 (no zinc application). The grain yield obtained under Zn_1 and Zn_0 were 1441 and 1024, respectively. The results are in agreement with those reported by Ved Ram *et al*. (2002), Patil *et al.* (2006), Jain and Dhama (2006), Sakal (2001), Dadhich and Gupta (2005), Subramaniyan *et al.* (2002), Choudhary *et al.* (2005) and Deosarkar *et al.* (2001).

Table 2 : Effect of different treatments on GMR, NMR and B:C ratio of cowpea

Treatments	Gross realization (Rs. ha^{-1})	Net realization (Rs. ha^{-1})	Benefit: cost ratio
Potassium (K)			
K_0 (Control)	19395	10816	2.218
K_1 (20 kg ha^{-1})	25360	16677	2.908
K_2 (40 kg ha^{-1})	28051	19262	3.184
K_3 (60 kg ha^{-1})	30616	21725	3.430
Zinc ($ZnSO_4$)			
Zn_0 (Control)	19755	11698	2.443
Zn_1 (20 kg ha^{-1})	27853	19117	3.183
Zn_2 (40 kg ha^{-1})	29959	20545	3.180

The results in Table 1 indicated that protein content in grain was significantly affected due to varying zinc levels. Significantly higher protein content 23.59 per cent was noted under zinc 40 kg ha^{-1} (Zn_2), which remained statistically at par with 20 kg zinc ha^{-1} (Zn_1), which recorded 23.26 per cent protein content. Significantly the lowest protein content 21.05 per cent was recorded under Zn_0 (no zinc application). The present findings are in agreement with those reported by Ved Ram *et al*. (2002), Shelge *et al.* (2000) and Jain and Dahama (2006).

There was considerable increase in net realization due to potassium application as given in Table 2. The highest net return of Rs.21725 was accrued with 60 kg K_2O ha^{-1} (K_3) followed by Rs. 19262 with (K_2) 40 kg K_2O ha^{-1} and Rs.16677 with 20 kg K_2O ha^{-1} (K_2). The lowest net realization of Rs.10816 ha^{-1} was realized with K_0 (no potassium application).

The economics presented in Table 2 revealed that there was a considerable increase in net realization up to Zn_2 level (40 kg $ZnSO_4$ ha^{-1}). The maximum net realization of Rs. 20545 ha^{-1} was obtained with Zn_2 level, which was higher than Rs.19117 ha^{-1} and Rs.11698 ha^{-1}, obtained in 20 kg $ZnSO_4$ ha^{-1} (Zn_1) and no zinc application (Zn_0), respectively. The results are in accordance with those reported by Nanjundappa and Manure (2002) and Bansal *et al.* (2001).

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