Response of cowpea (*Vigna sinensis* L.) to different levels of potassium and zinc cv. 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 (1587 kg ha^{-1}) and straw (2047 kg ha^{-1}) yields were recorded with application of 60 kg K_2O ha^{-1}. Significantly highest grain (1553 kg ha^{-1}) and stover (2010 kg ha^{-1}) yields were recorded with 40 kg zinc ha^{-1}. It 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}.

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Key words : Cowpea, Potash, Zinc

INTRODUCTION

Cowpea [*Vigna unguiculata* (L.) Walp], synonym, *Vigna sinensis* (L.) savi ex Hassk is one of the important *Kharif* pulse and grown in the India for grain, forage and green manure purpose. Cowpea is the 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.

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 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.

MATERIALS AND METHODS

A field experiment was conducted during the *Kharif* season2008 at Agronomy Farm, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat). The experiment comprised 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 of 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) were applied at the time of sowing in furrows as per treatments.

RESULTS AND DISCUSSION

The results obtained from the present investigation have been duscussed below:

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Effect of potash:

Most of the yield attributes *viz*., number of branches per plant, number of pods per plant, number of grains per pod and plant height (Table 1) and test weight (Table 2) were significantly increased by application of 60 kg K_2O ha^{-1} (K_3) over 40 kg K_2O ha^{-1} (K_2), 20 kg K_2O ha^{-1} (K_1) and no potassium application (K_0). The probable reason for the increase in the test weight due to higher level of potassium is attributed to the better filling of grains, which resulted in bold sized seeds and consequently higher test weight. Thus, the entire yield attributes were remarkably improved and gave significant response with potassium application. This was only due to balanced utilization of potassium as discussed above. The beneficial effect of potassium in growth and yield attributes were also reported by Madhavi (2000), Dudhade *et al.* (2003), Shipra and Pal (2005).

The grain and stover yields (Table 2) of cowpea were significantly influenced due to potassium levels. Significantly higher grain yield was recorded with 60 kg K_2O ha^{-1} over 40 kg K_2O ha^{-1} (K_2). The higher grain yield could be due to the cumulative effect of improvement in growth and yield attributes *viz*., number of branches per plant, number of pods per plant, number of grains per pod and test weight.

Effect of zinc:

The results presented in (Table 1) revealed that application of 40 kg zinc ha^{-1} (Zn_2) produced significantly higher plant height of cowpea at 20 DAS, 40 DAS, and at harvest in comparison to 20 kg zinc ha^{-1} (Zn_1) and no zinc application (Zn_0). Significantly the highest plant height of 53.98 cm was recorded with application of 40 kg zinc ha^{-1} (Zn_2) at harvest. Increasing trend of yield attributes was observed under this treatment. Significantly higher number of branches per plant (7.74), number of pods per plant (9.80), number of grains per pod (10.04) (Table 1) and test weight (10.35 g) (Table 2) were recorded with application of 40 kg zinc ha^{-1} (Zn_2). These are the important growth and yield attributes, which showed significant positive effect on grain yield. The probable reason for significant increase in growth and yield attributes would be the favourable effect of zinc and improving the availability of soil nutrient, which contributed to stimulate dense root and shoot development and resulted in significant influence in growth attributes due to role in regulating auxin concentration in plant and nitrogen metabolism also play role in chlorophyll synthesis, photosynthesis and in turn of accumulation of dry matter as stover yield. The findings on growth attributes are in accordance with Patil and Kotecha (2006), Kalyanaraman and Sivagurunathan (1994).

The result (Table 2) revealed that the grain yield of 1553 kg ha^{-1} was recorded under 40 kg zinc ha^{-1} (Zn_2), which was 51.69 per cent higher over no zinc application (Zn_0). Higher yield under zinc was evidently resulted from greater number of branches per plant, number of pods per plant, number of grains per pod and test weight (g) due to mineral matter content in the grains. The experimental soil was medium in available N, P_2O_5 and K_2O and, therefore, resulting in over all improvement of cowpea crop yield due to chlorophyll synthesis,

Table 1 : Plant height at harvest, no. of branches per plant, no. of pods per plant and no. of grains per pod as influenced by various treatments

Treatments	Plant height (cm) at harvest	No. of branches /plant	No. of pods / plant	No. of grains /pod
Potassium (K)				
K_0 (control)	48.38	6.24	7.96	8.03
K_1 (20 kg ha^{-1})	51.91	7.28	9.18	9.52
K_2 (40 kg ha^{-1})	53.67	7.68	9.80	10.01
K_3 (60 kg ha^{-1})	54.95	8.16	10.42	10.55
S. E. ±	0.86	0.20	0.27	0.25
C.D. (P=0.05)	2.46	0.58	0.77	0.72
Zinc ($ZnSO_4$)				
Zn_0 (control)	50.14	6.81	8.69	8.76
Zn_1 (20 kg ha^{-1})	52.56	7.47	9.53	9.78
Zn_2 (40 kg ha^{-1})	53.98	7.74	9.80	10.04
S. E. ±	0.74	0.17	0.23	0.22
C.D. (P=0.05)	2.13	0.50	0.67	0.62
C.V. %	5.68	9.48	9.91	9.06
Interaction (K x Zn)	NS	NS	NS	Sig.

NS=Non-significant

Table 2 : Test weight, grain yield and stover yield as influenced by various treatments

Treatments	Test weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
Potassium (K)			
K_0 (control)	8.39	1003	1346
K_1 (20 kg ha^{-1})	9.75	1313	1720
K_2 (40 kg ha^{-1})	10.30	1454	1885
K_3 (60 kg ha^{-1})	10.90	1587	2047
S. E. ±	0.26	45.50	57.24
C.D. (P=0.05)	0.76	131.01	164.81
Zinc ($ZnSO_4$)			
Zn_0 (control)	9.10	1024	1330
Zn_1 (20 kg ha^{-1})	10.06	1441	1908
Zn_2 (40 kg ha^{-1})	10.35	1553	2010
S. E. ±	0.23	39.40	49.57
C.D. (P=0.05)	0.66	113.46	142.73
C.V. %	9.27	11.77	11.34
Interaction (KxZn)	NS	Sig.	NS

NS=Non-significant Sig. = Significant

photosynthesis and in turn of accumulation of dry matter as stover yield also play role in biosynthesis of indole acetic acid (IAA) and especially due to its role in initiation of primordia for reproduction parts and portioning of photosynthesis towards them which result in better flowering and fruting. The results are in agreement with those reported by Nagaraju and Yadahalli (1996) and Dadhich and Gupta (2005).

Interaction effect:

While presenting the results, the interaction effect between 60 kg ha^{-1} potassium (K_4) and zinc 40 kg ha^{-1} (Zn_3) was found significant in respect of grain yield (Table 3). The increase in number of grains per pod and grain yield ascribed attributed to the reason that potassium along with zinc possibly increased the concentrations of N, P and K ions of soil solution and ultimately affected the vigorous root development, better K_2O fixation and better growth and development of plant leading to higher photosynthetic activity and translocation of photosynthesis to the sink which in turn resulted in better development of yield attributes and finally resulted in higher grain yield. The results corroborate with the findings by Singh *et al.* (2001) and Patel and Karelia (1994).

Table 3: Interaction effects of potassium and zinc (Zn) levels on grain yield (kg ha^{-1}) of cowpea

Treatments	Zn_0	Zn_1	Zn_2
K_0	518	1094	1397
K_1	1049	1430	1461
K_2	1244	1520	1597
K_3	1283	1722	1757
S. E. ±		78.81	
C.D. (P=0.05)		226.91	
C.V. %		11.77	

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