

Effect of Zinc and Iron on Yield and Yield Attributes of Rainfed Cowpea (*Vigna unguiculata* L. Walp)

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Abstract: A field experiment was conducted during kharif seasons of 2002, 2003 and 2005 to study the effect of zinc and iron on yield and yield attributes of rainfed cowpea (*Vigna unguiculata* L. Walp) at Main Pulses Research Station, S.D. Agricultural University, Sardarkrushinagar on loamy sand soil. The results revealed that the application of ZnSO_4 @ 25 kg ha⁻¹ through soil proved to be most effective and increased the seed yield by 43.0% when compared with control followed by the spraying of 0.5% ZnSO_4 at 25 and 45 DAS. The increase in yield was due to increase in number of pods per plant, 100-seed weight and number of branches per plant. The highest net return (Rs. 13,114 ha⁻¹) and benefit cost ratio (1.97) were obtained with soil application of ZnSO_4 @ 25 kg ha⁻¹.

Key words: Cowpea, ZnSO_4 , FeSO_4 , rainfed, net return.

The intensive cropping and injudicious use of heavy doses of N, P, K, fertilizers have induced the deficiencies of micronutrients in many parts of the country. Soil testing reports pertaining to North Gujarat indicated that soils in most of the parts are low in available zinc and iron. Zinc plays a vital role in metabolism and is known to be involved in N-fixation through nodule formation (Shukla and Yadav, 1982). Cowpea is an important pulse crop grown in Gujarat for grain and vegetable purposes. It is mostly grown under unirrigated conditions and on marginal lands hence, yield of cowpea is very low. Yield potential of legumes can be achieved by adequate supply of micronutrients. Therefore, experiment was conducted to study the response of cowpea to zinc and iron application.

Materials and Methods

A field experiment consisting of nine treatments with four replications in randomized block design was conducted during kharif seasons of 2002, 2003 and 2005 under rainfed conditions at Main Pulses Research Station, S.D. Agricultural University, Sardarkrushinagar. Experiment failed due to grazing by blue bull and pig during kharif 2004. The experimental soil was loamy sand, poor in organic carbon (0.24%), medium in available phosphorus (46 kg ha⁻¹), high in available potash (294 kg ha⁻¹), medium in DTPA-extractable Fe (4.00 ppm) and low in Zn (0.48 ppm). The rainfall was 206.5 mm in 16 rainy days, 766.8 mm in 10 rainy days and 526.6 mm in 28 rainy days during 2002, 2003 and

2005, respectively. There were nine treatments viz; T₁: control, T₂: 0.5% FeSO_4 spray at 25 DAS, T₃: 0.5% FeSO_4 spray at 45 DAS, T₄: 0.5% FeSO_4 spray at 25 and 45 DAS, T₅: 0.5% ZnSO_4 spray at 25 DAS, T₆: 0.5% ZnSO_4 spray at 45 DAS, T₇: 0.5% ZnSO_4 spray at 25 and 45 DAS, T₈: 0.5% FeSO_4 and 0.5% ZnSO_4 spray at 25 DAS, and T₉: soil application of ZnSO_4 @ 25 kg ha⁻¹. The cowpea variety GC 4 was sown at 45 cm row spacing with seed rate of 20 kg ha⁻¹. Plant protection measures were taken as and when required. Other agronomic operations were carried out as and when needed.

Results and Discussion

Plant height and number of seeds per pod were not affected significantly. Number of branches per plant, number of pods per plant and 100-seed weight were significantly affected due to different treatments (Table 1). On the basis of pooled data, number of branches per plant, number of pods per plant and 100-seed weight were significantly higher in the soil application of ZnSO_4 @ 25 kg ha⁻¹ than that in rest of the treatments, but number of pods per plant was at par with foliar spray of 0.5% ZnSO_4 at 25 and 45 DAS. Soil application of 12.5 kg ha⁻¹ zinc sulphate increased the plant height, 100-seed weight, number of pods per plant and number of seed per pod of cowpea at Bangalore in alfisols and sandy loam soils (Nagaraju and Yadahalli, 1996).

The seed yield of cowpea increased significantly with all the treatments of zinc either through soil or foliar application. On the pooled basis, the

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Table 1. Effect of zinc and iron on growth, yield and yield attributes of cowpea (Pooled data of 2002, 2003 and 2005)

Treatments	Plant height (cm)	No. of branches plant ⁻¹	No. of pods plant ⁻¹	No. of seeds pod ⁻¹	100-seed weight (g)	Yield (kg ha ⁻¹)		Gross income (Rs. ha ⁻¹)	Cost (Rs ha ⁻¹)	Net return (Rs. ha ⁻¹)	BCR
						Seed	Straw				
T ₁ : Control	48.2	1.8	8.3	9.6	14.20	802	938	13552	6006	7576	1.26
T ₂ : 0.5% FeSO ₄ spray at 25 DAS	49.3	2.1	9.5	9.7	14.64	862	1442	14946	6231	8410	1.35
T ₃ : 0.5% FeSO ₄ spray at 45 DAS	50.1	2.2	9.6	9.9	14.86	902	1080	15696	6231	9160	1.47
T ₄ : 0.5% FeSO ₄ spray at 25 and 45 DAS	50.5	2.2	10.6	10.3	14.91	952	1626	16533	6456	9467	1.47
T ₅ : 0.5% ZnSO ₄ spray at 25 DAS	49.5	2.3	11.3	10.0	14.99	963	1644	16723	6241	10123	1.62
T ₆ : 0.5% ZnSO ₄ spray at 45 DAS	50.4	2.3	11.5	10.3	15.01	988	1694	17163	6241	10563	1.69
T ₇ : 0.5% ZnSO ₄ spray at 25 and 45 DAS	52.0	2.5	12.1	10.4	15.10	1052	1695	18172	6478	10978	1.69
T ₈ : 0.5% FeSO ₄ and 0.5% ZnSO ₄ spray at 25 DAS	51.3	2.5	11.7	10.4	15.14	1031	1877	17998	6466	11038	1.70
T ₉ : Soil application of ZnSO ₄ @ 25 kg ha ⁻¹	52.9	2.9	13.5	10.6	15.32	1147	1773	19770	6656	13114	1.97
S.E.m±	1.1	0.1	0.5	0.3	0.18	34	104	--	--	--	
CD at 5%	NS	0.3	1.5	NS	0.51	95	294	--	--	--	
CV%	8.1	17.2	17.1	9.0	4.40	12.8	22	--	--	--	

Input price: FeSO₄: Rs.22 kg⁻¹, ZnSO₄: Rs. 26 kg⁻¹. Selling price: Cowpea seed: Rs.16 kg⁻¹, Straw: Rs. 0.80 kg⁻¹.

highest yield (1147 kg ha⁻¹) was obtained with soil application of 25 kg ha⁻¹ ZnSO₄, although, it was not significantly higher than the foliar spray of 0.5% ZnSO₄ at 25 and 45 DAS where the yield was 1025 kg ha⁻¹. Soil application of ZnSO₄ @ 25 kg ha⁻¹ and foliar spray of 0.5% ZnSO₄ at 25 and 45 DAS increased the seed yield by 43 and 31%, respectively, compared to control. The improvement in seed yield could be attributed to the combined effect of significantly higher number of pods per plant and 100-seed weight in these treatments (Table 1). Beneficial effects of foliar application of Zn and Fe in cowpea crop were also reported by Anitha *et al.* (2005) and Patel *et al.* (2008).

Influence of single spray of 0.5% FeSO₄ either at 25 or 45 DAS and two sprays of 0.5% FeSO₄ both at 25 and 45 DAS did not differ significantly. These treatments increased the seed yield of cowpea by 7.5, 12.5 and 18.7%, respectively, compared to control. Similar effect of foliar spray of iron was observed on cowpea crop in sandy loam soil of Kerala by Anitha *et al.* (2005).

Single spray of 0.5% ZnSO₄ either at 25 or 45 DAS and two sprays of 0.5% ZnSO₄ both at 25 and 45 DAS were found equally effective. These treatments increased the seed yield of cowpea by

20, 23 and 31%, respectively, compared to control. Gupta and Mittal (1981) also reported an increase in yield of legumes due to zinc application in zinc deficient soil. Zinc application increased the grain yield of pea owing to its influence on auxin synthesis, nodulation status and N-fixation, which promoted plant growth and development, thereby influenced the grain yield favorably (Kasthurikrishna and Ahlawat, 2000). The increase in seed yield due to zinc application could possibly be due to the enhanced synthesis of carbohydrates and protein and their transport to the site of seed formation (Mali *et al.*, 2003).

Spraying of 0.5% FeSO₄ and 0.5% ZnSO₄ at 25 DAS gave significantly higher straw yield of cowpea over control, 0.5% FeSO₄ spray at 25 DAS and 0.5% FeSO₄ spray at 45 DAS but was at par with the remaining treatments.

The highest net return of Rs.13,114 per ha was obtained when the crop was fertilized with soil application of 25 kg ZnSO₄ per ha followed by the foliar spray of 0.5% FeSO₄ and 0.5% ZnSO₄ at 25 DAS (Rs. 11,038 ha⁻¹) and 0.5% ZnSO₄ at 25 and 45 DAS (Rs. 10,978 ha⁻¹). These treatments recorded Rs. 5,538, Rs. 3,462 and Rs. 3,402 per ha more net return, respectively, compared to control. Benefit

cost ratio also had the same trend. The highest net return and BCR with the combined spraying of 0.5% FeSO₄ and 0.5% ZnSO₄ at 45 DAS in the cowpea crop was recorded (Anitha *et al.*, 2005).

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