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Yield and nutrient content and uptake by clusterbean (*Cyamopsis tetragonoloba* L.) as influenced by different levels of sulphur and zinc application under light textured soil

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Abstract
A field experiment entitled "Yield and nutrient content and uptake by clusterbean (*Cyamopsis tetragonoloba* L.) as influenced by different levels of sulphur and zinc application under light textured soil" conducted during summer season of 2013 at Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The experiment encompassed three levels of sulphur *viz.*, 0, 20 and 40 kg S ha^{-1} and four levels of zinc viz. 0, 2.5, 5.0 and 7.5 kg Zn ha^{-1}. The experiment was laid out in randomized block design (Factorial) with three replications. The soil of the experimental field was loamy sand in texture, alkaline in reaction and soluble salt content under safe limit. It was low in organic carbon, available N, S and Zn medium in available P_2O_5 and K_2O. The results revealed that application of 40 kg S ha^{-1} with 5.0 kg Zn ha^{-1} gave significantly, higher seed (750.92 kg ha^{-1}) and stover yield (1163.9 kg ha^{-1}). The individual application of 40 kg S ha^{-1} and 5.0 kg Zn ha^{-1} recorded significantly higher nitrogen, phosphorus, sulphur and zinc content and uptake by seed and stover of clusterbean. Application of 40 kg S ha^{-1} recorded significantly highest sulphur status in soil after harvest while maximum DTPA-extractable zinc status was registered under the application of 7.5 kg Zn ha^{-1}.

Keywords: Clusterbean, sulphur, zinc, content, uptake

Introduction
Cluster bean, called guar is a draught tolerant annual legume crop. In India cluster bean is grown for its green fodder and for the pods that are used as food and feed. Since it is a legume, it has soil enriching properties. It is an excellent soil building crop with respect to nitrogen. Cluster bean is a good soil restorative crop which can fix about 4.0 per cent nitrogen in the soil. The primary importance of guar is considered to be the commercial value of its seed gum which is used in textiles and paper, as a thickener and in pill formation. Phosphorus stimulates early root development, growth, blooming and aids in seed formation when applied to legumes, it activates rhizobia and formation of root nodules. Thus, it helps in fixing more atmospheric nitrogen. It also improves the crop quality and resistance to disease. In general, sulphur is essential for synthesis of vitamins, sulphur containing amino acids and promotes nodulation in legumes. It helps in chlorophyll formation and encourages vegetative plant growth Cluster bean crop has high requirement of phosphorus and sulphur.

In Gujarat, clusterbean occupies 1285 ha area with 641 M.T average productions. The crop is grown for various purposes viz. vegetable, green manure and seed. In recent years it has emerged as an industrial crop due to presence of galactomnan (Guar gum) in its endosperm. By-product of guar gum industry form concentrated animal feed of immense value. Light textured soils of semi –arid agro climatic region of North Gujarat are characterized by low in organic matter content, marginal to low in secondary nutrients and micronutrients. Widespread sulphur deficiencies have been reported in soils of India (Tandon 1986) [20] as well as in those of Gujarat (Patel *et al.* 1987) [9] ranging from 15 to 56 per cent with an average of 37 per cent. Sulphur deficiency is as high as 81 per cent in light textured soils of North and North West zone of Gujarat (Sadasania, 1992) [13]. Sulphur is known to play an inevitable and imperative role in a constituent of protein, vitamins and sulphur containing amino acids i.e. cysteine, cystine and methionin.

Zinc is one of such micronutrient, its deficiency in the field crops is the global phenomenon and it has also received maximum attention in our country as compared to other micronutrients

due to its significant role in various enzymatic and physiological activity of plant system. It has catalytic function so, required for the transformation of carbohydrates. It is also important for chlorophyll formation, formation of growth hormones and promotion of protein synthesis. The available zinc in Gujarat soil ranges between 0.25 to 2.58 mg kg^{-1} (Dangarwala *et al.,* 1983) [3]. As nearly half of the Indian soils are Zn deficient and 24 per cent soils of Gujarat state are Zn deficient and 58 per cent soils of North Gujarat found deficient to medium in available zinc status. Soils of India had multiple nutrient deficiencies, mainly of N, P, K, S and Zn and their use have become essential to obtain optimum crop yield. The results of several experiments suggest that, for achieving the maximum crop yield and fertilizer use efficiency in India, balance fertilization is essential. Therefore, the study deals with the yield and nutrient content and uptake by clusterbean *(Cyamopsis tetragonoloba* L.) as influenced by different levels of sulphur and zinc application under light textured soil.

Materials and Methods

A field experiment was conducted during summer season of 2013-14 at the Agronomy Instructional Farm, C.P. College of Agriculture, S.D. Agricultural University, Sardarkrushinagar. This experiment was conducted with three levels of sulphur viz. 0, 20 and 40 kg S ha^{-1} and four levels of zinc viz. 0, 2.5, 5.0 and 7.5 kg Zn ha^{-1} which comprised of 12 combinations in factorial randomized block design, which was replicated three times and clusterbean variety Gujarat guar 2 was sown on second week of February. The seeds were sown at the rate of 18 kg/ha with inter and intra row spacing of 45 cm and 10 cm, respectively. The seeds were uniformly sown manually 3-4 cm depth in a previously opened furrow as per treatment. A common dose of well decomposed FYM was applied to the experimental field @ 10 t ha^{-1}. Furrows were opened manually in each plot by keeping 45 cm spacing in between two rows. A uniform application of nitrogen (20 kg ha^{-1}) and phosphorus (40 kg ha^{-1}) through urea and DAP, respectively were applied for each plot in soil just before sowing of seeds in previously opened furrows. As per treatment, S was applied through gypsum and Zn was applied through zinc chloride at the time of sowing.

The soil of the experimental field was loamy sand in texture, alkaline in reaction and soluble salt content under safe limit. It was low in organic carbon, available N, S and Zn, medium in available P_2O_5 and K_2O. The data of seed yield and stover yield recorded from net plot and converted on hectare basis. The representative dry samples of shoots and seeds were analyzed for ascertaining the nutrient (N, P, S and Zn) content and uptake. The N, P, S and Zn contents were analyzed by micro-Kjeldahl, Vanadomolydo phosphoric acid yellow-colour, flame Photometric method, Turbidimetric and DTPA extraction methods, respectively. Available N, P_2O_5, S and Zn content in soil were analyzed by alkaline permanganate, Olsen's method, Flame photometric, Turbidimetric method and DTPA extraction methods, respectively. The collected data for various parameters were statistically analyzed using Fishers' analysis of variance (ANOVA) technique and the treatments were compared at 5% level of significance.

Results and Discussion

Seed and stover yield

The significant response in seed (750.92 kg /ha) and stover (1163.9 kg /ha) yield of clusterbean (Table 1) were obtained under the application of 40 kg S/ha. The higher yields with sulphur application could be ascribed to accelerated nutrient uptake helped the plant to put optimum growth. As these growth and yield attributes as well as nutrients uptake showed significant increase in seed yield, evidently resulted in higher yields with sulphur fertilization. Seed yield of clusterbean is chiefly product of yield attributing characters. Similar results were reported by Shakhela *et al.* (2003) [14], Sharma and Singh (2004) [16], Baviskar *et al.* (2011) [1] and Ramawatar *et al.* (2013) [11].

The significant response in seed (750.92 kg /ha) and stover (1163.9 kg /ha) yield of cluster bean were obtained under application of 5 kg Zn /ha (Table 1). The higher yields with zinc application could be ascribed to accelerated nutrient uptake helped the plant to put optimum growth. As these growth and yield attributes as well as nutrients uptake showed significant increase in seed yield, evidently resulted in higher yields with zinc fertilization. Seed yield of cluster bean is chiefly product of yield attributing characters. These characters were significantly improved due to zinc application. Similar results were reported by Sharma *et al.* (2004) [5] in cluster bean.

Nutrient content and uptake

Nitrogen content and uptake by seed and stover was significantly influenced by sulphur application (Table 1 and 2). Maximum nitrogen content in seed and stover was reflected at 40 kg S/ha. This increase in nitrogen content might be due to favorable effect on availability of nitrogen at higher level of sulphur and due to leguminous crop. The highest uptake of nitrogen by seed (33.86 kg /ha) and stover (18.51 kg /ha) was obtained under 40 kg S /ha. The increase in uptake of nitrogen in seed and stover of clusterbean due to application of sulphur @ 40 kg/ha could be attributed to favorable effect of sulphur application on growth and yield attributes which resulted in higher seed and stover yield (Table 1) and consequently more removal of nitrogen by seed and stover. The findings are in close agreements with those obtained by Kaprekar *et al.* (2003) [6] in chickpea and Sharma and Singh (2004) [16] in clusterbean. Application of sulphur caused significant increase in P content and uptake by seed and stover (Table 1 and 2). Fertilized the clusterbean with 40 kg S/ha appreciably influenced to P content and uptake by seed and stover. Sulphur might have shown the synergistic effect in increasing the P uptake by seed and stover. The increase in P content in seed and stover (Table 1) as well as higher seed and stover yield (Table 1) with sulphur supply might have nullified the effect of reduced P content on uptake of P by plants. The findings are in close agreement with those obtained by Kaprekar *et al.* (2003) [6] in chickpea, Sharma and Singh (2004) [16] in clusterbean and Singh and Chauhan (2005) [17] in lentil.

Crop fertilized with 40 kg S/ha appreciably increased S content and uptake by both seed and stover (Table 1 and 2). This might be due to higher uptake of S under higher application of sulphur might have increased their concentration in soil solution, which increased the availability and uptake by plant. More over increasing trend of seed and stover yield as well as sulphur content in seed and stover were noticed with sulphur application. The results are in the close conformity with the work of Bhadoria *et al.* (1997) [2], Kumawat and Khangarot (2002) [7], Sharma and Singh (2004) [16] and Naagar and Meena (2004) [8] in clusterbean. Maximum zinc content and uptake by seed and stover (Table 1 and 2) were recorded under the application of 40 kg S/ha. The positive effect of sulphur on zinc uptake might be due to more

solubilization and mobilization of Zn in presence of sulphate ions. Similar results were also reported by Singh and Chauhan (2005) [17] in lentil and Togay *et al.,* (2008) [21] in chickpea. The nutrient content of N, P, S and Zn (in seed and stover) and their uptake (Table 1 and 2) by seed and stover were significantly improved due to addition of zinc. The significantly higher content and uptake of N, P, S and Zn by seed and stover were recorded due to application of zinc @ 5.0 kg/ha.

The beneficial effect of zinc addition on nutrient content in the present study could be attributed to higher uptake of all nutrients on account of correlation of deficiencies like zinc resulting in elimination of factor, which was limiting the growth and uptake of nutrient in the control. The significant increase in uptake of nutrient by the addition of zinc related with increase in concentration of nutrients in seed and stover as well as due to significant increase in seed and stover yield of clusterbean. Positive effect of zinc application on its content and uptake by clusterbean might be due to increase in concentration of zinc in soil solution with the application of zinc resulting in more absorption of zinc by plant. Low initial status of DTPA-extractable zinc (0.44 ppm) of experimental plot responded positively to zinc application. Findings are in close agreement with earlier finding of Premkumar *et al.* (2002) [10] in cowpea and Sunder *et al*. (2003) [19] in clusterbean.

Nutrients availability

The data in table 2 reveal that the nitrogen content in post-harvest soil was significantly influenced by sulphur application. Addition of sulphur significantly increased available nitrogen content of soil, may be due to better root development and nodules formation and higher atmospheric nitrogen fixation in soil. Similar results were also observed by Singh and Chauhan (2005) [17] in lentil and Deshbhratar *et al.*, (2010) [4] in pigeonpea. The available N, P and S (Table 2) status of soil after harvest were not significantly influenced due to application of zinc, but DTPA-extractable Zn content of soil (Table 4.18) was increased significantly due to addition of zinc. The maximum status of DTPA-extractable Zn (0.60 ppm) was observed with the level of 7.5 kg Zn/ha. Number of workers reported that addition of zinc increased its availability in soil (Singh and Rattan (1999) [18] and Ranparia (2001) [12].

Table 1: Yields and nutrient content in seed and stover as affected by sulphur and zinc application in clusterbean

Treatments	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	N content (%)		P content (%)		S content (%)		Zn content (mg kg^{-1})	
			Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover
Sulphur										
S_0 : 00 kg S/ha	518.00	780.5	4.22	1.40	0.251	0.120	0.115	0.091	29.84	22.21
S_1 :20 kg S/ha	641.33	981.3	4.32	1.52	0.257	0.124	0.126	0.102	30.40	22.85
S_2 :40 kg S/ha	750.92	1163.9	4.50	1.59	0.262	0.129	0.138	0.112	30.80	23.20
S.Em±	10.74	13.8	0.06	0.01	0.008	0.003	0.001	0.001	0.25	0.12
C.D at 5 %	31.51	40.5	0.17	0.03	0.002	0.001	0.006	0.006	0.72	0.34
Zinc										
Zn_0: 00 kg Zn/ha	537.22	805.8	4.15	1.47	0.255	0.122	0.120	0.091	26.98	21.26
Zn_1: 2.5 kg Zn/ha	637.11	971.0	4.34	1.49	0.257	0.125	0.125	0.104	29.84	22.94
Zn_2 :5.0 kg Zn/ha	721.89	1176.5	4.52	1.51	0.259	0.126	0.132	0.106	32.72	23.50
Zn_3 :7.5 kg Zn/ha	650.78	1006	4.46	1.51	0.257	0.125	0.127	0.105	31.84	23.08
S.Em±	12.40	16.0	0.07	0.01	0.009	0.004	0.002	0.003	0.28	0.14
C.D at 5 %	36.38	46.8	0.20	0.02	0.003	0.001	0.006	0.007	0.83	0.40
Interaction										
S× Zn	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	5.84	4.9	4.67	1.54	1.02	0.89	5.01	6.51	2.80	1.79

Table 2: Seed and stover uptake and available nutrients in soil as affected by sulphur and zinc application in Clusterbean

Treatments	N uptake (kg/ha)		P uptake (kg/ha)		S uptake (kg/ha)		Zn uptake (g/ha)		Available nutrient			
									kg ha^{-1}		mg kg^{-1}	
	Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover	N	P_2O_5	S	Zn
Sulphur												
S_0 : 00 kg S/ha	22.07	11.79	1.30	0.94	0.600	0.714	15.61	17.39	227.92	37.67	7.9	0.53
S_1 :20 kg S/ha	28.12	14.91	1.65	1.22	0.804	1.00	19.60	22.58	230.00	37.90	8.7	0.55
S_2 :40 kg S/ha	33.86	18.51	1.97	1.51	1.038	1.302	23.29	27.12	234.58	38.11	9.6	0.57
S.Em±	0.64	0.25	0.03	0.02	0.02	0.01	0.40	0.26	1.22	0.01	0.23	0.02
C.D at 5 %	1.87	0.75	0.08	0.05	0.05	0.06	1.17	0.78	3.57	NS	0.7	NS
Zinc												
Zn_0: 00 kg Zn/ha	22.49	11.94	1.37	0.99	0.657	0.742	14.55	17.13	229.67	37.42	8.2	0.54
Zn_1 : 2.5 kg Zn/ha	27.79	14.63	1.64	1.22	0.805	1.022	19.06	22.35	230.78	37.96	8.6	0.55
Zn_2 : 5.0 kg Zn/ha	32.69	17.03	1.87	1.42	0.962	1.200	23.66	26.37	231.56	38.12	9.1	0.59
Zn_3 : 7.5 kg Zn/ha	29.08	15.34	1.67	1.26	0.836	1.064	20.72	23.60	231.33	38.07	8.9	0.61
S.Em±	0.74	0.29	0.03	0.02	0.02	0.03	0.46	0.31	1.41	0.25	0.17	0.02
C.D at 5 %	2.16	0.86	0.10	0.06	0.06	0.07	1.36	0.90	NS	NS	NS	0.05
Interaction												
S× Zn	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	7.89	5.98	6.09	4.99	7.72	6.60	7.11	4.10	1.83	1.99	9.35	9.97

Conclusion

Based on the results of the present study, it can be concluded that higher yields of summer clusterbean crop and net return can be secured by application of 40 kg S/ha and 5.0 kg Zn/ha in sulphur and zinc deficient light textured soil of North Gujarat.

References

1. Baviskar VS, Damane HS, Raj VC, Shete PG. Effect of organic fertilizer and different levels of sulphur on growth, yield and quality of clusterbean. Journal of Green Farming. 2011; 2(5):546-547.
2. Bhadoria RBS, Tomar RAS, Khan H, Sharma MK. Effect of phosphorus and sulphur on yield and quality of clusterbean. Indian Journal of Agronomy. 1997; 42(1):132-134.
3. Dangarwala RT, Trivedi BS, Patel MS, Mehta PM. Ed. Micronutrient Research in Gujarat-Gujarat Agric Uni. Anand, 1983.
4. Deshbhratar PB, Singh PK, Jambhulkar AP, Ramateke DS. Effect of sulphur and phosphorus on yield, quality and nutrient status of pigeonpes (*Cajanus cajan*). Journal of environmental Biology. 2010; 31(6):933-937.
5. Gupta PK, Vyas KK. Effect of phosphorus, zinc and molybdenum on the yield and quality of soybean. Legume Research. 1994; 17(1):5-7.
6. Kaprekar N, Sasode DS, Ajay Patil. Yield, nutrient uptake and economics of gram (*Cicer arietinum*) as influenced by P and S levels and PSB inoculation under irrigated condition. Legume Research. 2003; 26(2):125-127.
7. Kumawat PD, Khangarot SS. Response of sulphur, phosphorus and Rhizobium inoculation on content and uptake of nutrient of clusterbean. Journal of Environment and Ecology. 2002; 20(4):803-805.
8. Naagar KC, Meena NL. Effect of phosphorus, sulphur and phosphate solubilizing bacteria on yield and components, yield and quality of clusterbean. Journal of Legume Research. 2004; 27(1):27-31.
9. Patel MS, Yadav BS, Golakia BA. Sulphur research in Gujarat. Paper presentation in international Symposium on Fertilizer sulphur requirement and Sources in developing ceuntires of Asia and the Pacific held at Bangalore, 1987.
10. Premkumar C, Nagaraju AP, Yogananda SB. Studies on sources of phosphorus and zinc levels on cowpea in relation to nodulation, quality and nutrient uptake. Crop Res. 2002; 24(2):299-302.
11. Ramawtar AC, Yadav BL. Effect of NP fertilizers, vermocompost and sulphur on growth, yield and quality of clusterbean and their residual effect on grain yield f succeeding wheat. Legume Res. 2013; 36(1):74-78.
12. Ranaparia LB. Nutrition of groundnut in relation to sulphur, zinc and FYM in mediumblack calcareous soil of western Gujarat. Doctoral Thesis, GAU, Campus-Junagadh, 2001.
13. Sadasania RM. Studies on sulphur availability in soil of North West Gujarat. M.Sc. Thesic, GAU, Sardarkrushinagar, 1992.
14. Shakhela RR, Patel KI, Patel JA. Advance in arid legumes research, 2003, 96-98.
15. Sharma Kavita, Jain KK, Sharma SK. Yield component of clusterbean as influenced by zinc and thiourea. Journal of annals of Agricultural Research. 2004; 25(1):169-171.
16. Sharma OP, Singh GD. Effect of sulphur and growth substances on yield, quality and nutrient uptake of clusterbean. Journal of Environment and Ecology. 2004; 22(4):746-748.
17. Sing YP, Chauhan CPS. Effect of sulphur, phosphorus and *Rhizobium* inoculation on yield, content of micronutrients and phosphorus utilization of lentil. Indian Journal of Pulses Res. 2005; 18(2):211-213.
18. Singhhan SK, Rattan RK. Zinc nutrition of soyabean and mustard in relation to source of zinc. Annal of Agric. Res. 1999; 20(1):4-8.
19. Sundar S, Pareek BL, Sharma SK. Effect of phosphorus and zinc on dry matter, uptake of nutrients and quality of clusterbean Annual Agric. Res. New Series. 2003; 24(1):195-196.
20. Tandon HLS. Sulphur Research and Agricultural production in India: A guide book, e.d2, 1986, 8-9, 33-43.
21. Togay Necat, Yesim Togay, Kerim Mesut. Effect of rhizobium inoculation, sulphur and phosphrous application on yield, yield components and nutrient uptakes in chickpea (*Cicer arietinum* L.). African Journal of Biotechnology. 2008; **7**(6):776-782.