Available online at www.ijpab.com

ISSN: 2320 – 7051
Int. J. Pure App. Biosci. SPI: **6 (3):** 544-549 (2018)

International Journal of Pure & Applied Bioscience

Research Article

OPEN ACCESS

Productivity and Quality of Clusterbean (*Cyamopsis tetragonoloba* (L.) Taub.) As Influenced by Zinc and Sulphur

Sunil, Seema Dahiya*, M.S. Bhattoo, Rajbir Singh Khedwal[1] and Rajesh Kathwal
Chaudhary Charan Singh Haryana Agricultural University, Hisar- 125001, India
[1]Department of Agronomy, Punjab Agricultural University, Ludhiana–141004, India
*Corresponding Author E-mail: dahiyaseema18@gmail.com
Received: 15.07.2018 | Revised: 22.08.2018 | Accepted: 30.08.2018

ABSTRACT

A field experiment was conducted during Kharif 2015 at cotton research station, Sirsa, CCS HAU, Hisar (India). The experiment was conducted in RBD with three replications. The experiment consist of 16 treatments in which N and P were applied as per recommended dose (N= 20 kg/ha, P_2O_5= 40 kg/ha) along with different doses of Zn (10, 20 and 30 kg/ha) and S (20, 30 and 40 kg/ha) and their combinations. Based on the research investigation it was found that the application of T_{16} (N@20 kg + P_2O_5 @40 kg+ $ZnSO_4$ @30 kg + S @40 kg/ha) recorded highest grain, straw, gum and protein yield as compared to other nutrient treatments. Quality parameters viz. gum content and protein content were recorded highest in T_{16}. It may be concluded that T_{16} resulted in highest yields and quality parameters. Further study can be explored to optimize the nutrient requirement for yield maximization, profitability and sustainability.

Key words: *Clusterbean, N, P, S and Zn doses, Quality, Gum and Protein yield*

INTRODUCTION

Clusterbean (*Cyamopsis tetragonoloba L.Taub.)* popularly known as guar, belongs to the family *Leguminaceae* and subfamily *Papilinaceae.* The guar plant produces a cluster of flowers and pods, therefore, it is also known as cluster bean. It is a drought hardy and deep rooted legume crop grown for feed, fodder, green manure and vegetable purpose. Being a legume crop, it has the capacity to fix atmospheric nitrogen by its effective root nodules[9]. It is generally 50-100 cm tall and bears 4 to 10 branches (branch type). However, non-branch type varieties have main stem only, which is heavily clustered with pods.

According to Aykroyd[4] the composition of clusterbean is 8.10 g moisture, 10.8 g carbohydrate, 23% protein, 1.4 g fat, 1.4 g minerals, 0.09 mg thiamine, 0.03 mg riboflavin, 47 I.U. vitamin C, 316 I.U, vitamin A (per 100 g of edible portion). India leads among the major guar producing countries of the world, contributing around 75 to 80% to the world's total production (7.5 to 10 lakhs tonnes)[2].

Cite this article: Sunil, Dahiya, S., Bhattoo, M.S., Khedwal, R.S., and Kathwal, R., Productivity and Quality of Clusterbean (*Cyamopsis tetragonoloba* (L.) Taub.) As Influenced by Zinc and Sulphur, *Int. J. Pure App. Biosci.* SPI: **6(3):** 544-549 (2018).

It is an important cash crop of south-west (SW) Haryana as it is second largest producer of clusterbean having area 2.15 lakh ha, with production of 2.9 lakh tones and productivity of 1348 kg/ha which is maximum in the country[3]. The potential yield of most of the varieties ranges from 18-20 q/ha but the average yield productivity of the country is less than potential average. This may be ascribed to many reasons but inadequate and imbalanced fertilization is the major factor. Sulphur plays an important role in synthesis of S containing amino acid and thus not only increases the crop yield but also improves the crop quality. Clusterbean is highly responsive crop to micronutrients. The micronutrient in general and zinc in particular. Zinc (Zn) is required for plant growth, as an activator of several enzymes and is directly involved in the biosynthesis of growth regulators such as auxin which promotes production of more plant cells and biomass that will be stored in the plant organs especially in seeds and their deficiencies may be one of the important reasons of poor yields in light textured soils[14]. The work undertaken on these aspects in Clusterbean is very meagre. Therefore keeping this in view a study was conducted on effect of zinc and sulphur on growth and yields of Clusterbean.

MATERIAL AND METHODS

A field experiment was conducted during *kharif* 2015 at cotton research station, Sirsa, CCS HAU, Hisar (India) situated at 29°25′ N latitude, 74°40′ E longitude and at an altitude of 202 meters above mean sea level. The soil of the experimental field was loamy sand, slightly alkaline in reaction, low in organic carbon and nitrogen, medium in phosphorus, low in zinc and sulphur. The values of available N (kg/ha), P (kg/ha), Zn (mg/ha) and S (kg/ha) were 137, 13.4, 1.2, 9.82 and 133, 10.8, 1.01, 8.9 before sowing and 137, 13.4, 1.3, 11.6 and 133, 10.8, 1.07, 10.5 after harvest at 0-15 and 15-30 cm soil depth respectively.

During the crop growing period, the mean weekly temperature values ranged between 30 to 43 ºC and 13 to 27 ºC for maximum and minimum temperatures. The rainfall received was 205.07 mm during the crop growing period. The experiment was conducted in RBD with three replications. The experiment consist of 16 treatments in which N and P were applied as per recommended dose (N= 20 kg/ha, P_2O_5= 40 kg/ha) along with different doses of Zn (10, 20 and 30 kg/ha) and S (20, 30 and 40 kg/ha) and their combinations. The sowing of clusterbean variety HG-2-20 was done on 14th July, 2015 using seed rate of 15 kg/ha. Other agro-practices were as per package of practices, CCS HAU, Hisar. The cropping history of the experimental field for the five years period prior to the present investigation is as under:

Table 1: Cropping history of the experimental field

Year	***Kharif***	***Rabi***
2010-2011	Clusterbean	Wheat
2011-2012	Cotton	Wheat
2012-2013	Cotton	Wheat
2013-2014	Cotton	Wheat
2014-2015	Clusterbean	Wheat
2015-2016	Clusterbean (Experimental crop)	-

For estimating the gum content the most reliable and accurate method involve extraction and purification of galactomannan, which is then alcohol precipitated, dried and weighed. A rapid and accurate method developed by Das *et al*.[6], and improved by Joshi[7] was used.

For this, seed sample were grinded by using Cyclotec Grinding Mill (0.2 mm screen), 0.1 g grind sample was weighed in 100 ml conical flask and 40 ml of 0.01 m $HgCl_2$ solution was added. Cotton plug and aluminium foil was placed on the mouth of flask and autoclaved at 15 psi for one hour. The samples were cooled and 100 ml volume was made using 0.01 m $HgCl_2$ solution. After shaking, the samples were centrifuged at 5000 rpm using REMI centrifuge (R & C). 0.5 ml of supernatant was taken in a centrifuge tube and 4.4 ml ethyl alcohol was added to make it 90 per cent alcohol. The solution was kept overnight. Next day, it was centrifuged at 5000 rpm and supernatant was removed. The residue was dissolved in 0.01 m $HgCl_2$ (5ml) by boiling in water bath for 1 hr and estimation of sugar was done as described by Das *et al*.[6]. Samples were cooled and volume made to 5 ml. 1ml of extract was taken and 2 ml of 2 per cent phenol was added, finally 5 ml concentrated sulphuric acid (GR) was added. Samples were shaked and cooled for 30 min. Standard and blank was run simultaneously. The absorbance was measured at 490 nm. Standard curve was prepared using galactose: mannose (1:2) ratio.

TMS (Tri methyl silyl) derivatives of guar gum was prepared and separated by GLC, but the method did not give good results. However, the method as detailed above i.e precipitation of gum by alcohol and estimation of gum by colorimetric method gave concordant and reliable results. So, the gum content was estimated by method as detailed above.

The protein content in grain was calculated by multiplying percent Nitrogen content in grain with the factor 6.25[1].

RESULTS AND DISCUSSION

Effect of Zn and S on quality of clusterbean

Significantly higher protein content (28.37%) was observed with application of T_{16} (RNP + $ZnSO_4$ @30 kg + S @ 40 kg/ha) as compared to control (23.00%), but at par with T_{13} (RNP + $ZnSO_4$ @20 kg + S @ 40 kg/ha) (28.31%), (Table 2). Further, 40 kg S/ha significantly improved the protein content and gum content of seed. The increased protein content may be due to synthesis of sulphur containing amino acids by sulphur like cystine, cysteine and methionine[11,15,18]. The increase in protein content due to zinc addition might be attributed to its involvement in nitrogen metabolism of plants. Among the various sulphur levels, application of 40 kg/ha produced higher protein content (30.61 %) over control. Sulphur of chloroplast protein resulted in greater photosynthetic efficiency which in turn translated in terms of increase in yield Karche *et al.*[8]. Simiar results were also reported by Singh *et al.*[15], Singh and Mann[16] and Baviskar *et al.*[5].

Significantly higher gum content (30.65%) was observed with application of T_{16} (RNP + $ZnSO_4$ @30 kg + S @40 kg/ha) as compared to control (26.58%), but at par with T_{13} (RNP + $ZnSO_4$ @20kg + S @40 kg/ha) (30.62%), (Table 2). The increase in gum content of seed might be due to increased boldness of seed and endosperm thereby more accumulation of carbohydrates[13]. The significant increase in gum content is a function of sulphur dosages because it has a role in synthesis of gum and participation in carbohydrate metabolism. Similar reports were given by Shakhela and Gandhi[12] for cluster bean. Among the various sulphur levels, application of 40 kg/ha produced higher gum content (30.58%) over control. Sulphur of chloroplast protein recorded in greater photosynthetic efficiency, which in turn translated in terms of increase in yield Karche *at el.*[8]. Simiar results were also reported by Singh *et al.*[15], Singh and Mann[16] and Baviskar *et al.*[5].

Effect of Zn and S on yields (Grains, gum and protein yield)

Application of higher doses of Zn and S increased grain, straw, gum and protein yield (Table 2). Significantly higher grain (1062 kg/ha), gum (325.51 kg/ha) and protein (301.40 kg/ha) yield was recorded with application of T_{16} (RNP + $ZnSO_4$ @30 kg + S @40 kg/ha) than other nutrient treatment, while these were at par with T_{15} (RNP + $ZnSO_4$ @30 kg + S @30 kg/ha and T_{13} (RNP +

$ZnSO_4$ @20 kg + S @40 kg/ha) treatments. Clear disparity in gum and protein yield was noticed between zinc and sulphur treatments. Among all the zinc treatments tried, $ZnSO_4$ @30 kg resulted in higher gum (257.62 kg/ha) and protein (212.83 kg/ha) yield irrespective of zinc management practices, S (40 kg/ha) resulted in higher gum (300.3 kg/ha) and protein (275.95 kg/ha) yield. All nutrient treatments provided significantly higher straw yield compared to the treatment of control. Straw yield among the different treatments was significantly higher in T_{16} (RNP + $ZnSO_4$ @30kg + S @40 kg/ha) (3145 kg/ha) as compared to other nutrient treatments, which was at par with T_{13} (RNP + $ZnSO_4$ @20 kg + S @40 kg/ha). Sulphur of chloroplast protein resulted in greater photosynthetic efficiency which in turn translated in terms of increase in yield[8]. Similar results were also reported by Singh and Mann[16] and Baviskar *et al.*[5]. Zinc play an important role in biosynthesis of indole acetic acid which is responsible for intitiation of primordial for reproductive parts and partitioning of photosynthesis towards them which resulted in better yield[17,10].

Application of $T_{16,}$ T_{15}, T_{13} and T_{12} treatments increased the gum content by 15.31, 14.9, 15.01 and 14.71 percent and protein content by 23.39, 23.09, 23.09 and 22.78 percent, respectively over control i.e T_1 treatment **(Fig.1**). Even in treatment T6 and T7 where sulphur is applied @ 30 and 40 kg/ha (along with recommended dose of N and P) respectively, gave 12.83 and 13.21 percent higher gum content and 19.22 and 20.22 percent higher protein content respectively over control. So application of sulphur increases the gum and protein content in clusterbean.

Table 2: Effect of different nutrient treatments on yields and quality of clusterbean

Treatments	Gum content (%)	Protein content (%)	Grain yield (kg/ha)	Straw yield (kg/ha)	Gum yield (kg/ha)	Protein yield (kg/ha)
T_1 (RNP)	26.58	23.00	801	2498	212.90	184.23
T_2 (RNP + $ZnSO_4$ @10 kg/ha)	27.91	23.46	841	2586	234.72	197.29
T_3 (RNP + $ZnSO_4$ @20 kg/ha)	28.58	24.15	857	2641	244.93	206.97
T_4 (RNP + $ZnSO_4$ @30 kg/ha)	29.51	24.38	873	2656	257.62	212.83
T_5 (RNP + S* @20 kg/ha)	28.31	25.78	958	2753	271.21	246.97
T_6 (RNP + S* @30 kg/ha)	29.99	27.42	988	2893	296.30	270.91
T_7 (RNP + S* @40 kg/ha)	30.09	27.65	998	2960	300.3	275.95
T_8 (RNP + $ZnSO_4$ @10 kg + S @20kg/ha)	28.84	26.27	978	2798	282.06	256.92
T_9 (RNP + $ZnSO_4$ @10 kg + S @30 kg/ha)	30.39	27.95	1017	3035	309.07	284.25
T_{10} (RNP + $ZnSO_4$ @10 kg + S @40 kg/ha)	30.52	27.99	1034	3075	315.57	289.41
T_{11} (RNP + $ZnSO_4$ @20 kg + S @20 kg/ha)	29.08	26.52	980	2821	284.98	259.89
T_{12} (RNP + $ZnSO_4$ @20 kg + S @30 kg/ha)	30.49	28.24	1036	3115	315.87	292.56
T_{13} (RNP + $ZnSO_4$ @20 kg + S @40 kg/ha)	30.57	28.31	1059	3142	323.74	299.80
T_{14} (RNP + $ZnSO_4$ @30 kg + S @20 kg/ha)	29.13	26.75	984	2873	286.64	263.22
T_{15} (RNP + $ZnSO_4$ @30 kg + S @30 kg/ha)	30.54	28.31	1060	3120	323.73	300.09
T_{16} (RNP + $ZnSO_4$ @30 kg + S @40 kg/ha)	30.65	28.38	1062	3145	325.51	301.40
SEm±	0.02	0.02	1.97	2.34	1.65	1.46
CD at 5%	0.05	0.06	5.72	6.78	4.79	4.24

Note: In all treatments, N and P_2O_5 doses are as per recommendation (RNP: N= 20 kg/ha, P_2O_5= 40 kg/ha), *= source of S was gypsum (19 % S) and one plot = 27 m^2.

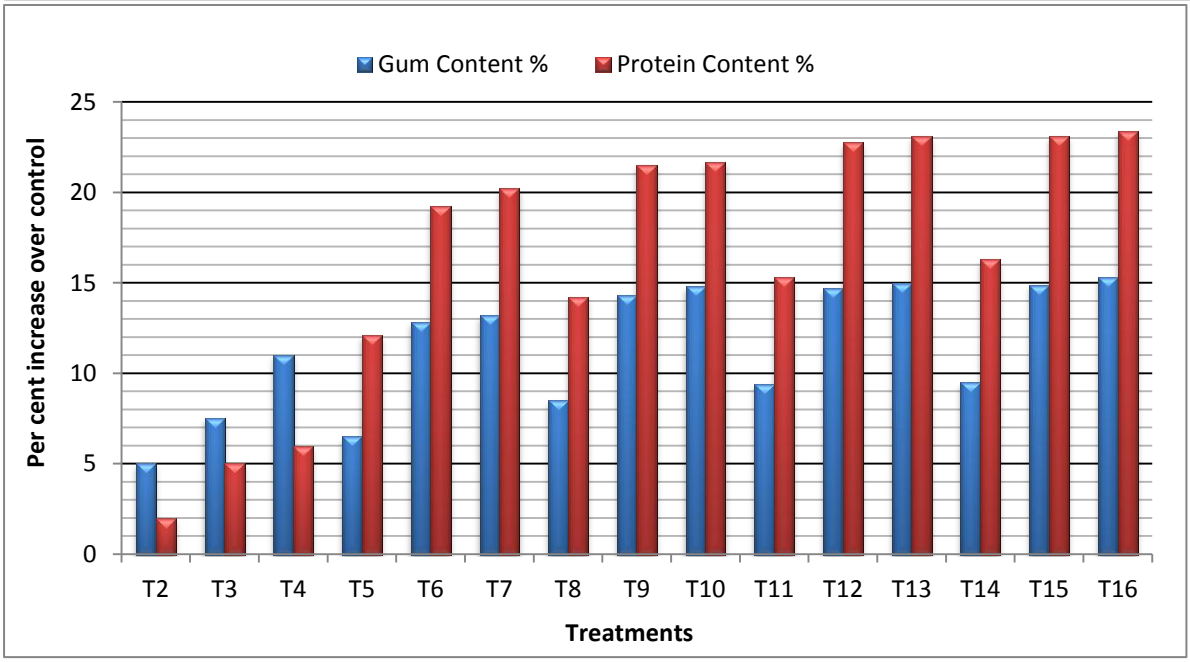

Fig. 1: Per cent increase in gum and protein content % with the application of Zn and S

CONCLUSION

Based on the results of experiment, it can be concluded that T_{16} (RNP + $ZnSO_4$ @30 kg + S @40 kg/ha) resulted in better grain, gum and protein yield and quality parameters. So clusterbean crop has shown immense potential to respond toward Zn and S fertilization. Application of Zn and S with recommended dose of N and P improved the yields and quality parameters of clusterbean.

REFERENCES

1. A.O.A.C., Official methods of analysis. 9th Ed. Association of Official Agricultural Chemists, WASHINGTON DC. P: 119 (1960).
2. Anonymous, Directorate of Economics and statistics, Department of Agricultural and Cooperation New Delhi. *India, Annual progress report*. (2012).
3. Anonymous, All India coordinated Research Project on Arid Legumes, NBPGR, New Delhi. *Annual progress report*. (2013).
4. Aykroyd, W.R., Gopalan, C., & Balasubramanian, S. C., The nutritive value of Indian Foods and the planning of satisfactory diets. (6th revised ed). Special report No. **42.** *Indian Council of Medical Research, New Delhi*. (1963).
5. Baviskar, V.S., Shete, P.G. and Daspute, R.A., Response of summer clusterbean [Cyamopsis tetragonoloba (L.) Taub.] to organic fertilizers and different levels of sulphur for vegetable purpose. *International Journal of Agricultural Sciences*. **6(2):** 456-458 (2010).
6. Das, B., Arora, S. K. and Luthra, Y. P., A rapid method for determination of gum in guar (Cyamopsis tetragonoloba (L.) Taub). *Proceedings of Ist ICAR Guar Research Workshop, Jodhpur, pp:* 117-123 (1977).
7. Joshi, U.N., Advances in chemistry, biochemistry and industrial utilization of guar seed. In: Guar (Eds.: Singh, J.V., Dahiya, B.S.). *Indian Society of Forage Research, India. pp*.197-229 (2004).
8. Karche, R.P., Dalwadi, M.R., Patel, J.C., Hirparaand, B.V. and Panchal, D.B., Response of phosphorus and sulphur application on yield quality, nutrient content and nutrient status of soil by cluster bean grown on typic ustochrept of Anand. *Asian Journal of Soil Science.* **7(2):** 249-252 (2012).
9. Kumhar, M.K., Patel, I.C. and Shaukat, Aliz., Integrated nutrient management in clusterbean (*Cyamopsis tetragonoloba* L.). *Legume Research*. **35:** 350-353 (2012).

10. Ram, S. and Katiyar, T.P.S., Effect of sulphur and zinc on the seed yield and protein content of summer mungbean under arid climate. *I.J.S.N.,* VOL. **4(3):** 563-566 (2013).
11. Shakhela, R. R., Patel, K. I., Patel, J. A., Henry, A. (ed.) and Singh, N. B., Influence of N, P and S on yield and chemical composition of rainfed clusterbean. *Legumes Reseach,* 196-198 (2003).
12. Shakhela, R.R. and Gandhi, T., The effect of phosphorus and sulphur and their interaction on yield, protein content and gum content of clusterbean (*Cyamopsis tetragonoloba* L.). *GAU Research Journal*, **30(12):** 40 42 (2005).
13. Sharma, O. P. and Singh, G. D., Effect of sulphur and growth substances on yield, quality and nutrient uptake of clusterbean [Cymopsis tetragonoloba (L.)Taub.]. *Environment and Ecology*, **22(4):** 746 - 748 (2004).
14. Singh, K. and Raj Effect of micronutrients application on the yield of Clusterbean in a type torrpsamment. *Legume Res***. 24(1):** 67-68 (2001).
15. Singh, R.N. Singh, S. and Singh, B., Interaction effect of sulphur and boron on yield,nutrient uptake and quality characters of soybean [*Glycine Max* (L.) Meril] grown in acidic upland soil. *Journal of Indian Society of Soil Sciences,* **54(4):** 516-518 (2006).
16. Singh, Y.P. and Mann, J.S., Interaction effect of sulphur and zinc in groundnut and their availability in Tonk district of Rajasthan. *Indian Journal of Agronomy*. **52(1):** 70-73 (2007).
17. Srivastava, A.K., Tripathi, P.N., Singh, A.K. and Singh, R., Effect of *Rhizobium* inoculation, sulphur and zinc on growth, yield, nutrient uptake and quality of summer green gram (*Phaseolus aureus* L.). *Indian Journal of Agricultural Sciences*, **2(1):** 190-192 (2006).
18. Tiwari, A.S., Dabhi, B.M., Chouksey, H. and Singh, A., Effect of fertility and sulphur levels on quality parameter of summer clusterbean (*Cyamopsis tetragonoloba* L.) under south saurastra region. *ISSN: 2319-7706* Vol **3:** 330-334 (2014).