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Effect of irrigation and sulphure levels on nutrients content in seed and stover as well as quality of cluster bean

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Abstract

An experiment was carried out at Navsari Agricultural University, Navsari, Gujarat during summer season to “Effect of irrigation and sulphure levels on nutrients content in seed and stover as well as quality of cluster bean (*Cyamopsis tetragonoloba* L.). The treatments comprised of 3 levels of irrigation *i.e.* I₁-0.4, I₂-0.6, I₃-0.8 IW/CPE and 4 levels of sulphure *i.e.* S₀-control, S₁-20 kg/ha, S₂- 40 kg/ha S as gypsum and S₃-30 kg/ha S as a SSP for cluster bean crop. The result showed that various levels of irrigation and sulphure did not exert significant influence on N, P, K and Sin seed as well as stover, protein and gum content of cluster bean but treatment I₃ (0.8 IW/CPE) in seed & stover numerically higher N, P, K, S and protein & gum content as compared to rest of irrigation. Application of different sulphure levels was found not significantly affect on N, P, K in seed and stover also protein content of cluster bean. However, sulphure and gum content was influenced significantly by the application of sulphure @ 40 kg/ha as a gypsum (S₂).

Keywords: Cluster bean, IW/CPE, sulphure, gum, protein, nutrient, N, P, K, seed, stover

Introduction

Clusterbean is an important arid legume crop locally known as “Guar” belongs to the family Leguminosae and sub-family Papilionaceae. Gillete (1958) [5] reported “Tropical Africa” as its center of origin. Botanically Cluster bean is known as *Cyamopsis tetragonoloba* (L.) Taub. The seed pods grow in clusters giving guar the common name cluster bean. It is rich in nutritive contents. In India, green and tender pods of cluster bean are used as a popular vegetable in many parts of the country. It is also grown as a forage crop. Sometimes it is used in reclamation of saline and alkaline soils. In recent years, this crop has assumed a great significance due to the presence of good quality gum in its seed. Due to diversified uses of cluster bean gum in textile, paper, explosive, mining industries, pharmaceuticals, cosmetic goods and food stuffs, its demand in the international market is ever increasing.

India leads among the main cluster bean producing nations of the world, contributing about 75 to 80% to the world’s total production (7.5 to 10 lakhs tones). (Argil. data at a glance, 2018-19). Agreeing to Aykroyd (1963) [1] the composition of cluster bean is 81.0 g moisture, 10.8 g carbohydrate, 23% protein, 1.4 g of fat, 1.4 g of 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). The use of guar gum has augmented extremely, as it is the natural porous. India engaged top position in the world trade for Cluster beangum. Cluster bean gum is an endosperm that contains, gum, a substance which forms a gel in water. Around three forth of the worldwide cluster bean farming extent in India.

Rajasthan, Gujarat, Haryana and the Punjab. Rajasthan alone accounts for almost 70 per cent of total clusterbean seed production, where the produce occupies an area of 20.56 lakh hectares with the production of 376 lakh tones. Though, the usual yield is only 183 kg ha⁻¹ (Vital Agriculture Statistics, 2003-04) as counter to domestic average of 1050 kg ha⁻¹ (Budhiraja *et al.*, 1998) [2].

Cluster bean has recently assumed significant role because of its gum content (35 to 40%) which is being utilized in various industries. Guar gum, also known as guarkernmehl, guaran, goma guar, gomme guar and galactomannan.

It is primarily the ground endosperm of guar. The guar seeds are dehusked, milled and screened to obtain the guar gum. It is typically produced as a free-flowing, pale, off-white colored, coarse to fine ground powder. India has become a leading exporter of cluster bean gum, especially to U. S. A. Cluster bean meal, the byproduct of cluster bean industries is used as concentrate food for animal which contains 42% crude protein. Like other legume crop cluster bean has potential to fix atmospheric nitrogen as a starter dose. It also requires phosphorus for their proper growth and root development. Gill *et al.* (1974)^[4] reported that if number of irrigations reduced from 3 to 1, drastic reduction was observed in seed yield of Cluster bean. Water need of cluster bean crop may vary with the climatic conditions and type of soil. Hence, scheduling of irrigation at an appropriate time and in right amounts is one of the most important factors for realizing high yield of summer cluster bean, especially under scarce and costly irrigation water. Sulphur is now recognized as the fourth ranked nutrient followed by nitrogen, phosphorus and potash. It is also needed in large amount by pulse crops (Saraf, 1988)^[9]. It's deficiency in India is widely spread particularly in high intensive cropping system. Sulphur is essential for synthesis of protein formation of chlorophyll and glycosides and nutritive quality of forages; vitamins and sulphur containing essential amino acids viz., methionine (21%), cysteine (27) (Singh *et al.*, 2004)^[11]. Sulphur also markedly enhanced the content of phosphorus, sulphur and gum in grain. Phosphorus and sulphur are reported to have synergistic effect on productivity of crops (Singh and Ram, 1989)^[10]. Sulphur is generally called the fourth major nutrient as it is required slightly less than phosphorus. Sulphur nutrition has been found the major limiting factor in guar production. In Andhra Pradesh, Anantapur, Chittoor and some regions have been recognized as having 73–95% shortage of sulphur. Increases in seed produce of cluster bean have been found with use of 40-60 kg sulphur ha⁻¹.

Materials and Methods

The experiment was conducted during the summer season at Soil and Water Management Research Unit Farm, Navsari Agricultural University, Navsari to study the "Effect of irrigation and sulphur levels on nutrients content in seed and stover as well as quality of cluster bean (*Cyamopsis tetragonoloba* L.) under South Gujarat condition". Geographically Navsari is situated at 20°57' N latitude, 72°54' E longitude and an altitude of about 10m above MSL. The experiment was laid out in Factorial Randomized Block Design (FRBD) with twelve treatments combination and three replications viz., (A) Irrigation levels-I₁ - 0.4 IW/CPE, I₂ - 0.6 IW/CPE, I₃ - 0.8 IW/CPE (B) Sulphur levels-S₀ - Control, S₁ - 20 kg/ha S as gypsum, S₂ - 40 kg/ha S as gypsum, S₄ - S as SSP (30 kg/ha). The seed of the cluster bean cv. Gujarat Guar-2 were used for sowing. Before sowing seeds were treated with *Phosphate Solubilizing Bacteria* and *Rhizobium* culture. Nitrogen from plant sample was determined after cutting and recorded in percentage using modified Kjeldhal's method (Jackson, 1973)^[6] and protein percentage was then worked out by multiplying nitrogen with a factor of 6.25. Phosphorus, potassium and sulphur contents were estimated by using Vandomolybdo phosphoric acid yellow colour method in HNO₃, flame photometric method as described by Jackson (1973)^[6] and heat soluble method by Kanwar and Chopra (1980)^[7] respectively. Gum can be estimated by a method developed by Das *et al.* (1977)^[3].

Results and Discussion

Effect of irrigation and Sulphur levels on nutrients content in seed & stover cluster bean

The results with respect to N, P, K, S content (%) in seeds as influenced by various levels of irrigation and sulphur are presented in Table 1. The perusal of data revealed that various levels of irrigation, sulphur and their interaction did not exert any significant influence on N, P, K content (%) in seeds. While, in cluster bean sulphur content (%) in seeds was remain unaffected due to various levels of irrigation. However, it was influenced significantly by different sulphur levels. Application of 40 kg/ha sulphur resulted significantly higher S content (0.17%) which was at par with S₃. Interactive effect between irrigation and sulphur levels was found non-significant.

The result summarized in Table 1 indicated that N, P, K content (%) in stover of cluster bean crop was not affected significantly due to individual effect of irrigation and sulphur as well as their interaction effect. But while, different irrigation levels did not influence the significant effect on sulphur content (%) in stover of cluster bean crop. However, the sulphur treatments exerted their significant influence on sulphur content (%) in stover of cluster bean. Significantly the higher values i.e. 0.24% registered under application of 40 kg S/ha (S₂) which was at par with S₃. Significantly the lowest sulphur content (0.13%) was recorded under S₀ (Control). The interaction effect of irrigation and sulphur found to be non-significant in case of sulphur content (%) in stover.

The present study revealed that various levels of irrigation did not exert any significant influence on nitrogen, phosphorus, potassium and sulphur content (%) in seeds and stover. But treatment I₃ i.e. 0.8 IW/CPE ratio recorded numerically higher N, P, K and S content in seeds and stover as compared to rest of irrigation levels. Also, the different levels of sulphur did not exert any significant influence on Nitrogen, Phosphorus and Potassium content (%) in seeds and stover. But in case of sulphur content, it was found significant by the individual effect of sulphur.

Effect of irrigation and Sulphur levels on quality parameters of cluster bean

The mean value of the crude protein content in seeds of cluster bean crop remained unaffected due to main effect of irrigation and sulphur as well as their interaction (Table 1). The results regarding gum content in cluster bean seeds as affected by irrigation and levels of sulphur as well as their interaction are presented in Table 1. The results revealed that significantly the highest (29.19%) and the lowest (26.10%) gum content were obtained under irrigation treatment I₃ (0.8 IW/CPE) and I₁ (0.4 IW/CPE) respectively. While in case of sulphur treatment, significantly higher (28.47%) gum content was noticed under 40 kg S/ha (S₂) which was remained at par with source of sulphur as SSP (S₃). Significantly the lower gum content (26.58%) was produced under control (S₀). The interaction effect between irrigation and sulphur levels on gum content of cluster bean crop was failed to achieve their significant level.

Protein content (%) in seeds of cluster bean was found non-significant due to various levels of irrigation whereas, gum content (%) was influenced significantly by the different irrigation treatments. Highest value of gum content was found under 0.8 IW/CPE ratio (I₃). Beneficial effect on gum content is due to the increase in carbohydrate synthesis. Protein content (%) in seeds of cluster bean was found non-significant due to various levels of sulphur whereas, gum content (%) was influenced significantly by the different sulphur treatments.

Higher value of gum content was found under 40 kg S/ha (S_2) but it was statically at par with treatment S_3 (S as SSP). The beneficial effect of sulphur in gum content of seed to be result of low initial status in soil and sulphur application @ 40 kg/ha as a

source of gypsum and S as SSP to the crop could be more advantageous for profuse vegetative and root growth which activate higher absorption of nutrient from the soil and improved metabolic activities inside the plant.

Table 1: Effect of irrigation and Sulphur levels on nutrients content in seed & stover and quality parameters of cluster bean

Treatments	N content (%)		P content (%)		K content (%)		S content (%)		Protein content (%)	Gum content (%)
	Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover		
A. Irrigation levels (I)										
I_1 : 0.4 (IW/CPE ratio)	4.06	3.38	0.63	0.33	1.77	0.500	0.15	0.22	25.38	26.10
I_2 : 0.6 (IW/CPE ratio)	4.15	3.41	0.64	0.33	1.79	0.510	0.15	0.22	25.97	27.49
I_3 : 0.8 (IW/CPE ratio)	4.25	3.45	0.66	0.34	1.81	0.522	0.16	0.23	26.69	29.19
S.Em. \pm	0.06	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.36	0.43
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.25
B. Sulphure levels (S)										
S_0 : Control	4.04	3.39	0.63	0.32	1.75	0.499	0.13	0.20	25.23	26.58
S_1 : 20 kg/ha S as gypsum	4.15	3.41	0.64	0.33	1.79	0.510	0.15	0.21	25.96	27.00
S_2 : 40 kg/ha S as gypsum	4.24	3.43	0.65	0.34	1.81	0.518	0.17	0.24	26.38	28.47
S_3 : S as SSP	4.22	3.43	0.65	0.34	1.81	0.516	0.16	0.23	26.48	28.31
S.Em. \pm	0.07	0.05	0.01	0.01	0.02	0.007	0.01	0.01	0.41	0.49
C.D. at 5%	NS	NS	NS	NS	NS	NS	0.01	0.01	NS	1.44
Interaction										
(I x S)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C. V. %	4.75	4.59	4.65	4.64	2.58	4.12	5.09	4.91	4.75	5.34

Conclusion

Based on one-year study, it is concluded that highest value of gum content was found under 0.8 IW/CPE ratio (I_3) and application of 40 kg S/ha (S_2) to obtain higher S nutrient content by cluster bean as compared to other sulphur of south Gujarat, India.

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