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Effect of foliar application of water soluble fertilizers on quality and economics of cluster bean (*Cyamopsis tetragonoloba* (L.) Taub) grown under south Gujarat condition

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Abstract
A field experiment with object to study the effect of nutrient management on growth, yield, quality and economics of cluster bean (*Cyamopsis tetragonoloba* (L.) Taub) grown under south Gujarat condition was conducted at 'B' Block, College farm, Navsari Agricultural University, Navsari during summer season, 2018. Among the seven treatments, foliar spray of cow urine (1%) at 45, 75 and 105 DAS (T_4) found to be significant with respect to protein content of cluster bean with a tune figure of 14.31%. The fibre content did not differed significantly due to foliar application of organic and inorganic water soluble fertilizers. However, the maximum gross realization of 207625 ₹ ha^{-1}, net realization of 159653.73 ₹ ha^{-1} with benefit cost ratio of 3.33 were secured under foliar application of 19-19-19 @ 1% 45, 75 and 105 DAS (T_1).

Keywords: Cluster bean, foliar application, quality and economics

Introduction
Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub] is a legume crop belonging to the family Fabaceae, commonly known as the Guar. The pods of cluster bean are used as vegetable. Guar is bushy annual herb have a deep rooted system, is a resilient and drought resilient leguminous crop grown on sandy soils of arid and semi-arid regions. Green pods of cluster bean are rich source of nutritive values as pod contains protein- 3.2 g, minerals- 1.4 g, thiamine- 0.09 mg, riboflavin- 0.09 and vitamin A- 47 mg $100g^{-1}$. The endosperm fraction of cluster bean seed is rich in galactomannan (16.80 to 30.90%), while the germ and hull portion termed as guar meal obtained after the extraction of gum is rich in protein (28.90-46.00%) and used as animal and poultry feed (Lee *et al*., 2004 and Rodge, 2008) [1, 2]. In India, Rajasthan can be termed as the largest guar producing state in the world as it dominates the Indian production scenario contributing to around 420000 tons of this crop *i.e.* over 70% of the total production in India. Haryana and Gujarat place themselves at the second and third positions regarding the production in India with 12% and 11% respectively (DES, 2009) [3]. In Gujarat cluster bean is grown about 38,397 ha of land with the production of 391248.35 MT green pods during the year 2016-17 (Anonymous, 2017) [4]. The basic concept underlying the principle of nutrient management is to maintain or adjust plant nutrient supply to achieve a given level of crop production by optimizing the benefits from all possible sources of plant nutrients. Bulky organic manures may not be able to supply adequate amount of nutrients, nevertheless their role becomes important in meeting the above objectives (Rao and Reddy, 2008) [5]. Foliar fertilization (FF) of water soluble fertilizers has become an established procedure to increase growth, yield and quality of crops (Patel, 2011) [6]. Foliar application is credited with the advantage of quick and efficient utilization of nutrients, eliminating losses through leaching, and fixation and helps in regulating the uptake of nutrients by plants (Manomani and Srimathi, 2009) [7].

Materials and Methods
A field experiment was conducted at 'B' Block, College farm, Navsari Agricultural University, Navsari during summer season, 2018. The soil of the experimental plot was non-saline (EC – 0.42 dSm^{-1}) and slightly alkaline in reaction (pH- 7.40), medium in available N (266.56 kg ha^{-1}) and P_2O_5 (31.16 kg ha^{-1}) and high in available K_2O (519.18 kg ha^{-1}) and there was no deficiency of micronutrients. An experiment was laid out in a Complete Randomized Block Design with four replications consisting of seven treatments viz., T_1: 19-19-19 (1%) at 45, 75 and 105 DAS, T_2: Urea (1%) at 45, 75 and 105 DAS, T_3: 19-19-19 (1% at 45 DAS) +

+ 0-52-34 (1% at 75 DAS) + 13-0-45 (1% at 105 DAS), T_4: Enrich banana pseudo stem sap (1%) at 45, 75 and 105 DAS, T_5: Cow urine (1%) 45, 75 and 105 DAS, T_6: Farmer practices {19-19-19 – (0.5%) + 0-52-34 – (0.5%) at 45 DAS, 0-52-34 (0.5%) + 13-0-45 – (0.5%) at 75 DAS, 19-19-19 – (0.5%) + 13-0-45 – (0.5%) at 105 DAS} and T_7: Control-Water spray. Recommended dose of fertilizer 20-40-00 Kg N: P_2O_5: K_2O given at time of sowing to all plots. The seeds of Pusa Navbhar sown manually in previously opened and fertilized furrows using recommended seed rate of 10 kg per hectare with (45×15 cm) spacing. Observations were recorded on five tagged plants in each treatment. The nitrogen content in cluster bean pod was estimated by micro Kjeldahl's method as described by Jackson (1973). The protein content of pod was computed by multiplying the nitrogen percentage with 6.25 for each treatment.

Protein content (%) = Total N content in pod (%) X 6.25

The fibre content was estimated by Sadasivam and Manikam (1992) [8] procedure. Two gram of moisture free powdered sample was boiled with 200 ml of sulphuric acid (0.255 N) for 30 min with bumping chips and then it was filtered through muslin cloth and washed with boiling water until residue was no longer acidic. The residue was again boiled with 200 ml of sodium hydroxide solution (0.313 N) for 30 minutes and filtered through muslin cloth, washed with boiling water until the residue was free from alkali, followed by washing with alcohol and ether. The residues were transferred to pre weighed crucible (W_1) and heated in a muffle furnace at 600 ^{0}C for 2 hours, cooled in a desicator and reweighed (W_2). The percentage of fiber was calculated by the following formula.

$$\text{Percentage of fiber (g 100g}^{-1}\text{)} = \frac{[100 - (\text{Moisture} + \text{Fat})] - [W_1 - W_2]}{\text{Weight of sample taken (moisture + fat free)}} X100$$

Net returns of each treatment were calculated by deducting the total cost of cultivation from the gross return. The Benefit Cost Ratio (BCR) was calculated by dividing net returns with cost of cultivation. The collected data for various parameters were statistically analyzed using Fisher's analysis of variance (ANOVA) technique and the treatments were compared at 5% level of significance.

Result and Discussion

Protein content

The data presented in Table 1 revealed that foliar application of organic and inorganic WSF had significant effect on protein content in cluster bean. The results revealed that significantly higher protein content was recorded with foliar application of cow urine (1%) at 45, 75 and 105 DAS (T_5) with respective value of 14.31 per cent. The results further revealed that T_5 statistically remained at par with T_1 and T_3 with corresponding value of protein content was 12.78and 14.00 per cent, respectively. However, significantly lowest protein content was recorded in control with a tune value of 7.88 per cent.

This might be due to favorable effect of organic fertilizers on microbial activity and better availability of nitrogen on foliage resulted in higher supply of nitrogen throughout the growth period and resulted in higher protein content in pods. These results are agreement with Thakare *et al*. (2006) [9] who reported significantly higher protein content with foliar spray of inorganic WSF along with 50 per cent RDF.

Fibre content

The fibre content of cluster bean did not differ significantly due to foliar application of different organic and inorganic WSFs (Table 2). The results further indicated that the fibre content of cluster bean was ranged from 2.23 to 2.41 g 100g^{-1}. The maximum fibre content was recorded with T_5: cow urine (1%) at 45, 75 and 90 DAS) with corresponding measured value of 2.41 g 100g^{-1}. Where, absolute control (T_7) recorded the lowest fibre content (2.23 g 100g^{-1}).

Economics of different treatments

The data on economics of various treatments indicating gross realization, net realization, BCR and total cost of cultivation per hectare were worked out are presented in Table 3.

An appraisal of data given in Table 3 revealed that the maximum gross realization of 207625 ₹ ha^{-1}, net realization of 159653.73 ₹ ha^{-1} and BCR of 3.33 were secured with foliar application of 19-19-19 (1%) at 45, 75 and 105 DAS (T_1). Whereas, the minimum gross realization of 148400 ₹ ha^{-1}, net realization of 108051.73 ₹ ha^{-1} were obtained under control as water spray (T_7).

This was mainly due to increase in pod yield in proportion to cost of production. Similar views in direction of present finding were also expressed by Chaurasia *et al*. (2005) [10], Pradeep and Elamathi (2007) [11], Premsekhar and Rajashree (2009), Roy *et al*. (2016) [13], Singhal *et al*. (2016) [14].

Table 1: Effect of nutrient management on quality parameters of cluster bean

Treatments		Protein (%)	Fibre (g 100 g^{-1})
T_1	19-19-19 (1%) at 45, 75 and 105 DAS	12.78	2.37
T_2	Urea (1%) at 45, 75 and 105 DAS	11.81	2.28
T_3	19-19-19 (1% at 45 DAS) + 0-52-34 (1% at 75 DAS) + 13-0-45 (1% at 105 DAS)	14.00	2.32
T_4	Enrich banana pseudo stem sap (1%) at 45, 75 and 105 DAS	9.81	2.38
T_5	Cow urine (1%) 45, 75 and 105 DAS	14.31	2.41
T_6	Farmer practices {19-19-19 – (0.5%) + 0-52-34 – (0.5%) at 45 DAS, 0-52-34 (0.5%) + 13-0-45 – (0.5%) at 75 DAS, 19-19-19 – (0.5%) + 13-0-45 – (0.5%) at 105 DAS}	12.02	2.30
T_7	Control: Water spray	7.88	2.23
S. Em. ±		0.76	0.04
CD at 5%		2.27	NS
CV%		12.92	3.69

Table 2: Effect of nutrient management on economics of cluster bean

Treatment		Pod Yield (kg ha^{-1})	Gross Return (₹ha^{-1})	Cost of production (₹ha^{-1})			Net realization (₹ ha^{-1})	BCR
				Fixed cost	Variable cost	Total		
T_1	19-19-19 (1%) at 45, 75 and 105 DAS	20762.00	207625.00	21124.27	26847.00	47971.27	159653.73	3.33
T_2	Urea (1%) at 45, 75 and 105 DAS	16080.00	160800.00	21124.27	23576.40	44700.67	116099.33	2.60
T_3	19-19-19 (1% at 45 DAS) + 0-52-34 (1% at 75 DAS) + 13-0-45 (1% at 105 DAS)	19612.00	196125.00	21124.27	27192.00	48316.27	147808.73	3.06
T_4	Enrich banana pseudo stem sap (1%) at 45, 75 and 105 DAS	19265.00	192650.00	21124.27	25206.00	46330.27	146319.73	3.16
T_5	Cow urine (1%) 45, 75 and 105 DAS	16285.00	162850.00	21124.27	23010.00	44134.27	118715.73	2.69
T_6	Farmer practices {19-19-19 – (0.5%) + 0-52-34 – (0.5%) at 45 DAS, 0-52-34 (0.5%) + 13-0-45 – (0.5%) at 75 DAS, 19-19-19 – (0.5%) + 13-0-45 – (0.5%) at 105 DAS}	15822.00	158225.00	21124.27	25056.00	46180.27	112044.73	2.43
T_7	Control: Water spray	14840.00	148400.00	21124.27	19224.00	40348.27	108051.73	2.68

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