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Quality parameters of cluster bean (*Cyamopsis tetragonoloba* L. Taub.) as influenced by organics and fertilizers

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Abstract
A field experiment was conducted during *kharif* season 2019 at Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner, to study the effect of organics and fertilizers on quality parameters and economics of cluster bean (*Cyamopsis tetragonoloba* L. Taub.) in loamy sand soil. The experiment was laid out in randomized block design with thirteen treatments replicated thrice. The results revealed that foliar spray of organics and fertilizers improved chlorophyll 'a', chlorophyll 'b' and total chlorophyll content and nitrogen, phosphorus and potassium content and uptake in seed and straw and protein content in seeds of cluster bean with application of *Panchagavya* @ 3%.

Keywords: Cluster bean, foliar spray, quality parameters

Introduction
Cluster bean (*Cyamopsis tetragonoloba* L. Taub.) adds in the fertility of soil by fixing considerable amount of atmospheric nitrogen (Singh and Usha, 2003) [8]. It can fix around 37-196 kg atmospheric nitrogen/ha/year in soil. This crop is a rich source of nourishment and is considered as protective supplementary food as it contains large quantities of minerals, vitamins and essential amino acids. Sometimes it is used in reclamation of saline and alkaline soils (Mahata *et al*., 2009) [5]. Fertilizers and organic manures plays a vital role to achieve higher 2 yield of cluster bean. Among different plant nutrients, nitrogen is the most important nutrient for plant growth and development. Nitrogen as chief constituents of plant nutrition plays an important role in synthesis of chlorophyll and amino acid (Masclaux-Daubresse *et al*., 2006) [6]. Insufficient nitrogen may reduce yield drastically and deteriorates the quality of produce specially protein content. Foliar fertilization is a simple and effective method of providing nutrients to crops (Alexander and Schroeder, 1987) [1].

Due to environmental concern, there is an urgent need to reduce the use of chemical fertilizers in agriculture and alternative to chemicals are being sought to improve crop productivity and quality. One option is the use of organic nutrients or growth regulators, which may promote plant growth through a variety of mechanisms, including supply of organic nutrients or production of plant hormones. *Panchagavya* and *Jeevamrut* are cheaper eco-friendly organic preparations made by cow products namely dung, urine, milk, curd and ghee. Foliar application of nutrients plays an important role in enhancing the production and productivity of the crop. The *Panchagavya* is an efficient plant growth stimulant and organic product to play great role for promoting growth and providing immunity in plant system. It is used to activate soil and to protect the plants from diseases and also increase the nutritional quality of fruits and vegetables. *Jeevamrut* is a liquid organic manure which is an excellent source of organic carbon, nitrogen, phosphorous, potassium and lot of other micro nutrients 3 required by crops. Cow urine has got anti-fungal properties and also good source of plant nutrients. Cow manure is rich in minerals, especially nitrogen, phosphorus and potassium. Keeping these facts in view, the above experiment was carried out to study the effect of organics and fertilizers on quality parameters of cluster bean.

Material and Methods

The field experiment was carried out during *kharif*, 2019 to study the effect of organics and fertilizers on quality parameters and economics of cluster bean at Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner (28° 10' N, 73° 35' E and at an altitude of 235 meters above mean sea level). The soil was loamy sand in texture and slightly alkaline in reaction. The soil was poor in organic carbon (0.07%), very low in available nitrogen (89.25 kg/ha) and low in phosphorus (19.5 kg/ha) and medium in available potassium (190.35 kg/ha). The experiment comprised of thirteen treatments and three replications. The treatments included in the study were, T_1- control, T_2- water spray, T_3- urea @ 2%, T_4- DAP @ 2%, T_5- NPK @ 1%, T_6- *Panchagavya* @ 3%, T_7- *Panchagavya* @ 5%, T_8- cow urine @ 5%, T_9- cow urine @ 10%, T_{10}- *Jeevamrut* @ 10%, T_{11}- *Jeevamrut* @15%, T_{12}- cow dung extract @ 5% and T_{13}-cow dung extract @ 10% applied as foliar spray at 40 and 55 DAS. *Panchagavya* was prepared by utilizing cow dung (5 kg), cow urine (3 litres), cow milk (2 litres), curd (2 kg), ghee (1 kg) Jaggery (1 kg) and banana (1 dozen). The *panchagavya* was prepared by mixing of cow dung and ghee in a wide mouth plastic container for 72 hours. After that add remaining ingredients and fermented for 15 days. The contents were stirred daily clockwise and anticlockwise during morning and evening. The prepared *panchagavya* was filtered with cloth and used for foliar spray @ 3% and 5% in the allotted plots. Fresh cow urine from indigenous cows was collected and used for spray @ 5% and 10%. *Jeevamrut* was prepared by using fresh cow dung (10 kg), cow urine (5 litres), jaggery (2 kg), gram flour (2 kg), garden/live soil (1 kg) and water (200 litres). To prepare the stock/mother solution of *jeevamrut*, water, cow dung and cow urine were added in a wide mouth plastic drum and mixed all these content properly with wooden stick. After that add crushed jaggery, gram flour, live soil into drum and mix all these content properly. Cover it with lid and pack tightly. The contents were stirred daily clockwise and anticlockwise during morning 24 and evening for 13 days. After 13 days, mixture is ready to use. The prepared *jeevamrut* was filtered with cloth and used for foliar spray @ 10% and 15% in the allotted plots. Cow dung extract was prepared with Cow dung. Cow dung was taken into an earthen pot and water added into until it's become completely saturated. Muslin cloth was spread on a bucket and saturated cow dung paste was pour on it. Now muslin cloth was hanged at a height and bucket was kept under it for 4 to 5 hours so that the extract was collected into bucket. Now the extract was ready to use. A solution containing 2% urea was prepared and sprayed. Solution of desired concentration of DAP (2%) was prepared and sprayed. Water soluble NPK (19:19:19) was used to prepare 1% solution and sprayed. The experimental data recorded were subjected to statistical analysis in accordance with the "Analysis of variance" technique suggested by Fisher (1950) for RBD. The critical difference (CD) for the treatment comparisons were worked out wherever the variance ratio (F test) was found significant at 5% probability level.

Results and Discussion

Chlorophyll content

Foliar application of organics and fertilizers significantly increased the chlorophyll 'a', chlorophyll 'b' and total chlorophyll content in cluster bean at 60 DAS (Table 1). Highest values of Chlorophyll "a" (3.25 mg/g), Chlorophyll "b" (1.56 mg/g) and Total chlorophyll content (4.81 mg/g) was observed when cluster bean crop was sprayed with Panchagavya @ 5% and it was significantly higher in comparison to control and foliar spray of water, 2% Urea, 2% DAP, 1% NPK, 5% Cow urine, 10% Cow urine, 5% Cow dung extract and 10% Cow dung extract. The increased chlorophyll content with application of organics and fertilizers through foliar sprays might be due to the better availability of nutrients at the site of photosynthesis. Enhanced chlorophyll content due to application of organics and fertilizers may be ascribed to improvement in nutrient supply. The present result are in agreement with the earlier findings of Gunasekar *et al*., 2018 [4] in blackgram.

Nutrient content and uptake

Nitrogen content in seed and straw were found to improve with foliar application of 1% NPK, 3% *Panchagavya*, 5% *Panchagavya*, 10% *Jeevamrut* and 15% *Jeevamrut*, by 20.49, 26.86, 27.21, 25.09, 27.21% and 7.89, 10.23, 10.43, 7.89, 8.09% significantly over control, respectively (Table 2). Nitrogen uptake by seeds and straw as well as total uptake were found to improve with application of *Panchagavya* @ 3% significantly increased total nitrogen uptake to the tune of 75.9, 61.6, 21.4, 16.6, 36.0, 25.7, 15.1, 41.1 and 33.1% over control and application of water, 2% urea, 2% DAP, 5% cow urine, 10% cow urine, 10% *Jeevamrut*, 5% Cow dung extract and 10% Cow dung extract, respectively (Table 3). Phosphorus content in seed was significantly enhanced with the application of *Panchgavya* @ 3% and 5%, NPK @ 1%, and *Jeevamrut* @ 10% and 15% tended to increase phosphorus content in seed significantly over control and water spray by 24.64, 25.00, 18.93, 23.57, 23.93%, 23.32, 23.67, 17.67, 22.26, 22.61% respectively (Table 2). Phosphorus uptake by seeds and straw as well as total uptake were significantly enhanced by application of *Panchagavya* @ 3%, and it was 67.6 and 51.7% higher over control and water spray, respectively (Table 3). Potassium content in seed was significantly improved by application of organics and fertilizers (Table 2). Application of *Panchagavya* @ 3% significantly improved the potassium content in seed over control and water spray by 10.7 and 8.8% respectively. Foliar application of organics and fertilizers showed slight improvement in potassium content in straw. Potassium uptake by seed and straw and its total uptake was significantly increased by application of *Panchagavya* @ 3% was to the tune of 62.3, 43.9, 31.5, 30.4, 31.9 and 22.5% over control and water spray, 2% urea, 5% Cow urine, 5% Cow dung extract and 10% Cow dung extract, respectively (Table 3). The positive influence of foliar fertilization on Nitrogen, Phosphorus and Potassium contents of the crop appears to be due to improved nutritional environment both at the photosynthetic sites and plant system. Increased availability of these nutrients in the root zone stimulated the uptake of these nutrients by crop plants, which translocated to various plant parts due to increased metabolic activities at cellular level. Since nutrient uptake is a function of nutrient content of plant parts and total dry mass of the crop in terms of seed and straw yield, foliar fertilization increased the uptake of Nitrogen, Phosphorus and Potassium at harvest significantly. Significant improvement in nutrient contents and/or their uptake due to application of organics and fertilizers were also observed by Gore and Sreenivasa 2011 [3].

Table 1: Chlorophyll content (mg/g) at 60 DAS in cluster bean as influenced by organics and fertilizers

Treatments	Chlorophyll 'a'	Chlorophyll 'b'	Total Chlorophyll
Control	2.44	1.30	3.74
Water spray	2.53	1.32	3.85
Urea spray @ 2%	2.87	1.41	4.28
DAP spray @ 2%	2.88	1.43	4.31
NPK spray @ 1%	2.94	1.45	4.39
Panchagavya spray @ 3%	3.19	1.51	4.70
Panchagavya spray @ 5%	3.25	1.56	4.81
Cow urine spray @ 5%	2.79	1.41	4.20
Cow urine spray @ 10%	2.83	1.43	4.26
Jivamrut spray @10%	2.99	1.47	4.46
Jivamrut spray @15%	3.06	1.47	4.53
Cow dung extract spray @ 5%	2.85	1.42	4.26
Cow dung extract spray @ 10%	2.91	1.45	4.35
S.Em.±	0.09	0.02	0.09
C.D. (P=0.05)	0.27	0.05	0.28

Table 2: Nutrient and protein content in seed and straw of cluster bean as influenced by organics and fertilizers

Treatments	Nitrogen (%)		Phosphorus (%)		Potassium (%)		Protein (%)
	Seed	Straw	Seed	Straw	Seed	Straw	
Control	2.83	1.026	0.280	0.143	0.741	0.989	17.66
Water spray	2.86	1.028	0.283	0.146	0.754	1.019	17.89
Urea @ 2%	3.21	1.098	0.294	0.149	0.758	1.027	20.05
DAP @ 2%	3.32	1.106	0.317	0.150	0.757	1.092	20.74
NPK @ 1%	3.41	1.107	0.333	0.152	0.806	1.093	21.33
Panchagavya @ 3%	3.59	1.131	0.349	0.155	0.820	1.130	22.42
Panchagavya @ 5%	3.60	1.133	0.350	0.158	0.825	1.197	22.48
Cow urine @ 5%	3.25	1.051	0.317	0.150	0.761	1.093	20.30
Cow urine @ 10%	3.27	1.074	0.321	0.151	0.764	1.094	20.45
Jeevamrut @10%	3.54	1.107	0.346	0.152	0.805	1.120	22.15
Jeevamrut @15%	3.60	1.109	0.347	0.158	0.817	1.126	22.49
Cow dung extract @ 5%	3.22	1.074	0.317	0.150	0.760	1.100	20.14
Cow dung extract @ 10%	3.25	1.076	0.325	0.151	0.768	1.102	20.31
S.Em.±	0.06	0.012	0.008	0.005	0.011	0.062	0.40
C.D. (P=0.05)	0.19	0.035	0.022	NS	0.032	NS	1.16

Table 3: Nitrogen, phosphorus and potassium uptake (kg/ha) in cluster bean as influenced by organics and fertilizers

Treatments	Nitrogen			Phosphorus			Potassium		
	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total
Control	24.1	19.6	43.7	2.3	2.7	5.0	6.1	18.9	25.0
Water spray	25.6	21.9	47.6	2.5	3.1	5.6	6.5	21.7	28.2
Urea @ 2%	38.8	24.5	63.3	3.0	3.3	6.3	7.8	23.1	30.9
DAP @ 2%	39.1	26.8	65.9	3.4	3.7	7.1	8.1	26.6	34.7
NPK @ 1%	42.5	28.5	71.0	3.8	3.9	7.8	9.3	28.2	37.5
Panchagavya @ 3%	46.2	30.7	76.8	4.2	4.2	8.4	10.0	30.7	40.6
Panchagavya @ 5%	48.1	31.1	79.2	4.5	4.3	8.8	10.5	33.0	43.5
Cow urine @ 5%	33.3	23.2	56.5	2.9	3.3	6.3	7.0	24.1	31.2
Cow urine @ 10%	35.0	26.2	61.2	3.1	3.7	6.8	7.5	26.7	34.2
Jeevamrut @10%	38.6	28.2	66.8	3.9	3.9	7.8	9.1	28.4	37.4
Jeevamrut @15%	39.7	28.7	68.4	4.0	4.1	8.1	9.5	29.0	38.5
Cow dung extract @ 5%	31.5	22.9	54.5	3.0	3.2	6.2	7.2	23.6	30.8
Cow dung extract @ 10%	32.7	25.0	57.7	3.2	3.5	6.7	7.6	25.6	33.2
S.Em.±	1.9	1.7	2.8	0.2	0.3	0.4	0.4	2.3	2.4
C.D. (P=0.05)	5.6	4.8	8.3	0.6	0.8	1.1	1.2	6.8	7.0

Protein content

Protein content was increased with foliar application of organics and fertilizers (Table 2). Maximum protein content (22.49%) was recorded under Jeevamrut @ 15% which was closely followed by *Panchagavya* @ 5%, *Panchagavya* @ 3% and *Jeevamrut* @ 15% which was found significantly superior over control (17.66%), foliar spray of water (17.89%), 2% Urea (20.05), 2% DAP (20.74%), 5% Cow urine (20.30%),10% Cow urine (20.45%), 5% Cow dung extract (20.14%) and 10% Cow dung extract (20.31%). Crude protein content of seed is essentially a manifestation of Nitrogen content, the increased seed Nitrogen content under the influence of organics and fertilizers led to higher crude protein content in seed. These findings confirm the results of Patel *et al*., 2018 [7].

Conclusion

Based on the results of one year experimentation, it may be

inferred that application of *Panchagavya* @ 3% found to be equally effective in improving quality parameters of cluster bean over control and water spray.

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