



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2018; 6(2): 3626-3629

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Received: 03-01-2018

Accepted: 04-02-2018

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## Mean performance of cluster bean (*Cyamopsis tetragonoloba*) genotypes for yield and quality parameters

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**Abstract**

The present investigation was carried out with 50 genotypes of cluster bean during summer using Randomized Block Design with three replications. Significant variations were recorded among the genotypes for growth and yield parameters. Among the 50 accessions, CT 1 (IC- 311392) was taller and recorded highest pod yield per plant, number of pods per cluster, maximum pod length and CT 21 (IC- 402299), CT 29 (IC 415153), CT 36 (IC 415162), CT 42 (IC 421812) recorded more number of branches. The quality analysis exhibited a wide range for protein content, fibre content in pod and gum content in endosperm of the seed. The crude protein content was found to be highest in CT 48 (IC- 421822) of 28.57 per cent whereas the minimum protein content was recorded by the accession CT 6 (IC- 329038) (14.53 per cent). Maximum guar gum content (41.23 per cent) was recorded in the accession CT 30 (IC- 415154), followed by CT 11 (IC- 370509) of 40.63 per cent. The least gum content of 18.67 per cent was observed in the accession CT 35 (IC- 415161).

**Keywords:** Cluster bean, plant height, quantitative characters

**Introduction**

Cluster bean (*Cyamopsis tetragonoloba* (L.) Taub) crop chromosome number  $2n = 2x = 14$  is popularly known as guar. It is a self-pollinated crop belongs to the family Fabaceae. Cluster bean originated in India and Pakistan and is characterized as a short day erect or bushy annual plant. Cluster bean is mainly cultivated for food, feed and fodder. Its young pods are used as vegetables, which also known for cheap source of energy (16 Kcal), protein (3. 2g), fat (1. 4 g), carbohydrate(10. 8 g), vitamin A (65. 3 IU), vitamin C (49 mg), calcium (57 mg) and iron (4. 5 mg) for every 100 g of edible portion. The seeds are extracted from the dried pods and used for producing guar. India is the major guar producer accounting for 80% of the world's production.

In India, guar is being grown mainly in arid and semiarid regions of North Western states of Rajasthan, Gujarat, Haryana, and Punjab, parts of Uttar Pradesh, Madhya Pradesh and Tamil Nadu. Rajasthan is the largest producer accounting for 70% of total guar production followed by Gujarat, Haryana and Punjab. Cluster bean is grown for its tender fruits to be used as vegetable and for guar production. It is also used as a nutritious fodder for livestock. Mucilaginous seed flour is used for making guar gum (galactomannan) utilized in textile, paper, cosmetic and oil industries throughout the world and is a useful absorbent for explosives. However, cluster bean varieties with high yield potential coupled with high protein and gum content are need of the hour to recommend for exploitation by rainfed community. Keeping it in mind, the present investigation was taken up to study the mean performance of the genotypes for identification of high yielding varieties possessing high gum content.

**Materials and methods**

The present investigation was carried out at Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Tamil Nadu with 50 genotypes of cluster bean during summer. The experiment was laid out in Randomized Block Design with three replications. Each genotype was sown at 45cm x 15 cm row to row and plant to plant distance, respectively. Recommended fertilizer dose and cultural practices including need-based plant protection measures were followed to raise a good crop. Observations from five randomly selected plants of each genotype in each replication were recorded on sixteen

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quantitative traits *viz.*, plant height, number of branches per plant, days taken to first flowering, number of clusters per plant, number of pods per cluster, pod length, pod girth, individual pod weight, pod yield per plant, seed yield per plant, number of seeds per pod, 100 seed weight, days taken to maturity and harvest index. Qualitative characters like

crude protein content, crude fibre and guar gum content were also analysed. Data were subjected to the analysis of variance using RBD ANOVA (Panse and Sukhatme, 1978) [1998] and given in table 1. The statistically analyzed mean data are presented in table 2.

**Table 1:** Analysis of variance for 16 characters in cluster bean accessions

Source	DF	PH	NBPP	DFFF	NCPP	NPPC	PL	FPY	DPY	NSPP	SYPP	HSW	DTM	HI	CF	CP	GC
Replication	2	2.37	2.00	0.08	0.40	4.00	0.04	2.06	0.56	0.04	0.56	0.03	0.05	0.03	0.04	0.02	0.29
Genotypes	49	563.15*	12.86**	22.74**	106.53**	24.00**	1.71**	9161.61**	4633.17**	2.85**	77.97**	2.43**	23.71**	9.01**	6.55**	15.77**	79.43**
Error	98	1.78	0.52	0.36	0.49	0.58	0.01	0.37	0.57	0.35	0.05	0.03	0.50	0.05	0.01	0.04	0.70

\*\* Significance at 1 per cent level

PH- Plant height, NBPP- Number of branches per plant, DFFF- Days taken to first flowering, NCPP- Number of clusters per plant, NPPC- Number of pods per cluster, PL- Pod length, FPY- Fresh pod yield, DPY- Dry pod yield, NSPP- Number of seeds per pod, SYPP- Seed yield per plant, HSW- Hundred seed weight, DTM- Days to maturity, HI- Harvest index, CF- Crude fibre content, CP- Crude protein content, GC- Gum content.

**Table 2:** Mean performance of cluster bean accessions for qualitative and quantitative characters

Acc. No.	Plant height (cm)	Number of branches/plant	Days taken to first flowering	Number of clusters per plant	Number of pods per cluster	Pod length (cm)	Fresh pod yield (kg)	Dry pod yield (kg)	Number of seeds per pod	Seed yield per plant (g)	100 Seed weight (g)	Days taken to maturity	Harvest index (%)	Crude fibre content (%)	Crude protein content (%)	Gum content (%)
CT 1	147.*	3.33	25.67*	18.67	16.00*	6.34*	3.58*	2.77*	8.67	41.53*	6.80*	55.67*	20.80	21.21	18.70	34.23*
CT 2	95.67	5.33	32.00	17.67	5.33	5.86*	1.80	1.51	7.33	26.47	4.16*	62.00	21.87	21.52	15.20	20.37
CT 3	122.00*	4.33	26.67*	17.67	12.33*	5.93*	3.06*	2.26*	7.67	37.50*	3.75	56.67*	23.67*	21.50	19.57*	24.27
CT 4	117.67*	4.67	27.67*	17.67	12.00*	6.03	2.89*	2.11*	8.67	36.20*	3.95	57.67*	24.47*	22.87	16.73	21.47
CT 5	117.00*	4.33	32.00	32.33*	6.33	5.86*	1.98	1.50	8.33	27.07	4.78*	62.00	21.40	23.15	22.27*	19.70
CT 6	96.00	9.00*	32.33	27.33*	5.33	3.39	1.62	1.52	8.33	27.33	3.65	62.33	21.70	24.11*	14.53	24.27
CT 7	98.67	5.00	27.67*	25.67	6.67	5.58	2.86*	2.06*	8.33	35.53*	4.65*	57.67*	21.43	23.65*	18.27	21.63
CT 8	131.67*	8.33*	33.33	32.00*	5.33	5.75*	2.10	1.57	7.67	27.83	2.14	63.33	20.30	24.80*	15.57	24.43
CT 9	98.67	6.33	32.67	27.67*	5.33	6.13*	1.92	1.53	7.33	27.43	4.78*	63.67	19.50	21.12	17.87	20.23
CT 10	97.33	8.33*	31.33	32.67*	5.00	5.89*	2.13	1.66	9.00*	27.27	3.08	61.33	22.43	24.10*	20.23*	19.23
CT 11	128.33*	4.67	25.67*	18.67	14.00*	5.97*	3.35*	2.55*	8.67	39.80*	4.23*	55.67*	21.20	22.13	19.13*	40.63*
CT 12	117.00*	8.33*	31.33	30.33*	5.33	5.92*	2.28	1.67	8.33	27.40	3.55	62.00	24.33*	24.17*	18.43	21.70
CT 13	132.33*	6.33	24.67*	17.67	12.67*	6.24*	3.19*	2.41*	7.67	36.83*	6.14*	54.67*	20.47	23.73*	21.70*	22.83
CT 14	93.33	6.33	31.67	17.67	6.00	5.33	2.46*	1.65	7.67	27.50	3.44	61.67	19.43	22.66	16.50	21.27
CT 15	107.00	4.67	33.67	32.33*	5.33	5.53	2.09	1.28	7.67	25.47	4.32*	64.33	24.83*	23.98*	17.53	22.37
CT 16	107.00	5.67	28.67*	30.67*	6.33	5.98*	2.64*	1.83	7.33	32.53*	3.67	58.67*	24.50*	22.10	19.33*	20.33
CT 17	111.67	5.33	30.33*	30.33*	6.33	5.84*	2.20	1.71	8.67	28.20	4.03	60.33*	24.13*	24.20*	21.40*	21.73
CT 18	123.00*	5.00	25.33*	20.67	12.00*	6.15*	3.43*	2.64*	8.67	40.23*	4.76*	55.33*	23.73*	23.29*	14.57	22.23
CT 19	106.00	7.33*	32.33	22.67	5.00	4.95	1.93	1.54	7.33	26.47	4.78*	62.33	24.67*	18.92	22.37*	27.93*
CT 20	116.33*	5.67	25.33*	25.67	10.33*	5.18	3.48*	2.68*	7.67	39.83*	3.80	55.33*	22.43	23.02	18.73	19.33
CT 21	96.67	9.33*	30.67*	28.67*	6.33	5.75*	2.40	1.61	7.67	26.93	4.87*	60.67*	24.70*	22.23	23.50*	31.60*
CT 22	127.67*	8.33*	29.00*	31.33*	5.00	6.29*	2.62*	1.81	8.67	33.20*	3.90	59.33*	20.30	21.24	17.33	20.77
CT 23	125.67*	5.67	32.33	21.33	5.67	3.21	1.90	1.58	8.33	26.93	3.70	62.33	24.07*	24.42*	15.00	24.20
CT 24	126.00*	2.33	27.67*	17.67	10.33*	6.14*	2.93*	2.12*	8.67	37.17*	4.56*	57.67*	23.23*	21.60	16.73	22.47
CT 25	95.33	8.33*	31.00*	25.33	6.00	5.96*	2.00	1.67	7.33	27.87	4.34*	61.00*	20.40	26.10*	17.30	19.27

## Results and Discussion

Analysis of variance (Table 1) revealed significant differences among the genotypes with respect to all the characters studied at one percent and five percent level of significance. It also revealed significant differences between genotypes for all the characters indicating the presence of sufficient amount of variability for all the 16 characters studied. Wide range of variability was observed for fresh and dry pod yield per plant (9161.61 & 4633.17) and plant height (563.15) indicating the scope for selection of initial breeding material for further improvement based on these characters.

Plant height is considered as one of the important traits for growth and vigour of the plants. In the present investigation, the accessions exhibited significant differences for plant height (Table 2). Among the 50 accessions CT 1 (IC- 311392) was taller (147 cm) and CT 45 was shorter (90 cm). Rai *et al.* (2012) also reported the significant difference among the cluster bean genotypes for plant height at 90 DAS, which

ranged between 32.10 and 100.85 cm (Pusa Navabhar) with a general mean of 42.86 cm. These results are in line with Vikas and Ram, 2015. Number of branches per plant is another yield increasing trait in cluster bean. Here the accession CT 21 (IC- 402299), CT 29 (IC- 415153), CT 36 (IC- 415162), CT 41 (IC- 421812), recorded more number of branches (9.33) followed by CT 6 (IC- 329038) (9.00). The results are in accordance with Anandhi and Oommen (2007) and Reddy *et al.* 2017 [9].

Earliness is considered as one of the most important character in any crop improvement programme and most of the genotypes or varieties are preferred when higher yield is coupled with earliness. The accession CT 13 (IC- 373467) recorded the earliest flowering (24.67 days). Also 27 accessions out of 50 recorded earlier flowering. Dabas *et al.* (1982) and Pathak *et al.* (2009) also observed similar trend of results for days taken to flowering. Number of clusters per plant is an important character to be considered to select a

cluster bean genotype exhibiting high yield indirectly. Highest number of clusters per plant (35.00) was observed in the accession CT 27 (IC- 415142) followed by CT 28 (IC- 415145) (34.33), CT 30 (IC- 415154) (33.33), CT 10 (IC- 370502) and CT 41 (IC- 421812) (32.67) same trend of results was recorded by Shabarishrai *et al.*, 2012<sup>[11]</sup>.

Pod yield per plant is the prime criteria for any crop improvement programme. In respect of fresh pod yield per plant (Table 3), the accession CT 1 (IC- 311392) recorded the highest pod yield per plant (358.33 g), followed by CT 20 (IC- 402298) (348.33 g), CT 18 (IC- 402295) (343.67 g), and CT 49 (IC- 421823) (343.33 g). The similar pattern of result was reported by Henry and Krishna (1990)<sup>[4]</sup>, Gipson and Balakrishnan (1990) and Anandhi and Oommen (2007)<sup>[5, 4, 1]</sup>. For dry pod yield, CT 1 (IC- 311392) recorded highest yield (277.00 g), followed by CT 20 (IC- 402298) (268.33 g) and CT 18 (CT- 402295) (264.33). In respect of seed yield per plant the accession CT 1 (IC- 311392) excelled all other accessions (41.53 g) followed by CT 31 (IC- 415156) (40.43 g), CT 18 (IC- 402295) (40.23 g) and CT 20 (IC- 402298) (39.83 g). The least yield (25.33 g) was recorded by CT 34 (IC- 415160).

Number of seeds per pod is considered as one of the important character in any crop improvement programme. The present study also brought out certain accessions with significant number of seeds per pod. The accession CT 10 (IC- 370502) recorded highest number of seeds per pod (9.00). The least number of seeds was observed in the accessions CT 29 (IC- 415153) and CT 35 (IC- 415161) (4.33). This is in accordance with the findings of Singh *et al.* (2003 b).

The trait 100 seed weight is an important character in cluster bean (Table 3). For this trait CT 1 (IC- 311392) recorded the highest value for 100 seed weight (6.80 g). The least (2.14 g) value was recorded in the accession CT 8 (IC- 369789). Similar trend of result was observed by Renugadevi *et al.* (2006)<sup>[6]</sup> in cluster bean.

Days taken to maturity is an important character, contributing to early maturity in cluster bean. For this trait, totally 27 accessions were considered to be earlier for maturity. The earliness was also reported by Dabas *et al.* (1982) and Singh and Mishra (2008)<sup>[2, 12]</sup>.

Harvest index is also an important character with respect to increasing yield. For this trait CT 36 (IC-415162) recorded the highest harvest index (26.50%), followed by CT 15 (IC- 373557) (24.83%), CT 49 (IC- 421823) (24.80%), CT 47 (IC- 421821) (24.77%) and CT 21 (IC- 402299) (24.70%). Similar trend of highest harvest index was observed by Singh and Mishra (2008)<sup>[12]</sup>.

From the nutrient point of view, quality is considered as an important factor in any vegetable crop. The accession CT 41 (IC- 421812) recorded the highest crude fibre content (26.86%) followed by CT 31 (IC- 415156) (26.48%), CT 25 (IC- 415135) (26.10%). The least content (18.92 g) was recorded in the accession CT 19 (IC- 402296). This is in conformity with the findings of Solanki and Chaudhary, (1996)<sup>[13]</sup>.

Crude protein is an important character, which is present highly in all peas and beans. The present study also confirms the above concept. The crude protein content was higher (28.57 g) in the accession CT 48 (421822), followed by CT 21 (IC- 402299) (23.50%), CT 28 (IC- 415145) (23.27%), CT 19 (IC- 402296) (22.37%). Similar trend of higher crude protein content was observed by Dwidivi (2009) and Reddy *et al.* 2017<sup>[9]</sup>.

Measuring gum content is imperative in cluster bean since it has economic importance in many of the industries. Among the 50 accessions studied, CT 30 (IC- 415154) recorded the highest gum content (41.23%) followed by CT 11 (IC- 370509) (40.63%), CT 1 (IC- 311392) (34.23%) whereas, lower gum content (18.67%) was recorded in the accession CT 35 (IC- 415161). The highest level of guar gum content was also reported by Vijay and Leela (1989)<sup>[14]</sup> in cluster bean.

Table 3: Contd

Acc. No.	Plant height (cm)	Number of branches/plant	Days taken to first flowering	Number of clusters per plant	Number of pods per cluster	Pod length (cm)	Fresh pod yield (kg)	Dry pod yield (kg)	Number of seeds per pod	Seed yield per plant (g)	100 Seed weight (g)	Days taken to maturity	Harvest index (%)	Crude fibre content (%)	Crude protein content (%)	Gum content (%)
CT 26	133.33*	2.33	33.33	18.33	7.67	6.18*	2.28	1.48	8.67	26.13	3.13	63.33	21.57	23.06	18.47	23.98
CT 27	118.67*	5.33	33.33	35.00*	5.33	5.78*	2.25	1.44	8.33	25.97	3.49	63.33	23.43*	22.99	20.73*	23.27
CT 28	119.33*	8.33*	32.00	34.33*	5.33	5.85*	2.08	1.65	5.33	27.77	4.81*	62.00	24.10*	23.57*	23.27*	22.53
CT 29	103.33	9.33*	31.33	18.67	7.67	4.46	2.09	1.65	4.33	27.57	3.27	60.67*	21.50	22.69	18.87*	20.80
CT 30	102.33	5.33	32.67	33.33*	6.00	5.57*	2.13	1.51	7.67	26.20	3.44	62.67	24.23*	23.80*	17.17	41.23*
CT 31	108.33	5.33	25.33*	24.00	11.67*	5.94*	3.31*	2.52*	7.33	40.43*	4.91*	55.33*	22.57	26.48*	22.33*	21.60
CT 32	118.00*	8.33*	28.67*	25.33	5.00	6.29*	2.66*	1.86*	8.67	32.83*	3.77	58.67*	21.75	21.71	16.47	31.63*
CT 33	127.33*	4.33	29.33*	18.67	7.00	5.98*	1.86	1.50	8.67	26.87	4.32*	59.33*	19.64	22.80	18.77*	23.13
CT 34	113.00	3.33	36.00	18.33	5.67	5.87*	1.55	1.18	8.67	25.33	3.91	66.67	24.43*	22.80	21.83*	19.37
CT 35	132.33*	5.33	32.67	28.67*	5.33	5.91*	1.97	1.52	4.33	35.83*	4.64*	62.67	21.75	24.76*	16.47	18.67
CT 36	132.33*	9.33*	31.00*	30.33*	6.67	5.82*	2.56*	1.78	7.33	28.27	6.43*	61.33	26.50*	22.73	18.83*	21.47
CT 37	98.00	8.33*	27.33*	32.33*	8.00	5.98*	3.05*	2.24*	7.33	37.33*	4.78*	57.33*	24.53*	23.77*	17.10	22.80
CT 38	106.00	7.00	31.33	28.67*	5.33	6.03*	2.01	1.67	7.33	27.73	3.49	61.33	21.58	21.80	17.67	32.67*
CT 39	103.67	8.67*	32.33	19.33	5.67	3.89	1.78	1.52	8.67	26.10	3.87	62.33	22.17	24.12*	18.17	21.87
CT 40	104.67	5.33	32.33	27.67*	5.33	3.97	1.88	1.53	7.67	26.47	2.24	62.67	23.57*	23.99*	16.87	22.43
CT 41	126.00*	9.33*	27.33*	32.67*	6.33	5.59	3.00*	2.20*	8.33	35.93*	4.62*	57.33*	20.30	26.86*	17.23	22.27
CT 42	123.33*	7.67*	28.33*	28.67*	6.00	5.72*	2.83*	2.02*	8.00	34.53*	3.86	58.33*	24.54*	21.77	18.63	19.13
CT 43	112.33	6.33	30.67*	28.33*	6.00	5.51	2.21	1.78	8.33	28.33	3.93	60.67*	23.53*	24.76*	15.30	31.53*
CT 44	113.33	7.33*	30.33*	30.67*	6.33	3.76	2.55*	1.77	8.67	29.53	3.02	60.33*	23.05	22.45	17.27	19.73
CT 45	90.00	2.67	28.33*	18.67	8.67	5.68*	2.80*	2.01*	8.67	33.33*	4.66*	58.33*	21.88	21.88	21.33*	20.20
CT 46	91.33	7.00	33.33	22.67	8.67	6.32*	1.97	1.56	7.67	26.33	4.46*	63.33	22.26	24.62*	16.77	21.33
CT 47	123.00*	3.00	31.67	17.67	8.33	5.46	1.78	1.60	7.67	26.83	3.65	61.67	24.77*	23.68*	17.17	24.63
CT 48	109.67	4.00	30.67*	30.67*	6.33	5.07	2.57*	1.77	8.33	29.67	2.97	60.67*	24.27*	22.92	28.57*	21.60
CT 49	127.33*	4.00	26.00*	17.67	11.67*	6.32*	3.43*	2.62*	8.00	39.60*	4.85*	56.00*	24.80*	22.52	16.87	20.60

CT 50	130.33*	3.00	28.67*	17.67	12.33*	5.36	2.92*	2.12*	7.67	34.33*	3.35	58.67*	21.23	21.02	18.23	19.30
G.mean	114.05	6.05	30.10	25.17	7.49	5.59	2.45	1.83	7.87	30.99	4.12	60.15	22.68	23.11	18.42	23.52
S.Ed	1.09	0.59	0.49	0.57	0.62	0.09	0.50	0.61	0.49	0.18	0.01	0.57	0.19	0.02	0.16	0.68
C.D	2.16	1.17	0.98	1.14	1.23	0.01	0.99	1.22	0.97	0.36	0.02	1.14	0.39	0.05	0.32	1.35

### Conclusion

In the present investigation, based on *per se* performance of the accessions, CT 1 (IC- 311392) was adjudged as the best one since, it recorded superior performance for seven characters *viz.*, plant height, number of pods per cluster, pod length, fresh pod yield, dry pod yield, seed yield per plant, and hundred seed weight. Accession CT 13 (IC- 373467) took minimum days to flower and mature. CT 27 (IC- 415142) recorded superior performance for number of clusters per plant. Other accessions recorded superior performance for one character *viz.*, CT 10 (IC- 370502) for number of seeds per pod, CT 36 (IC- 415162) for harvest index, CT 41 (IC- 421812) for crude fibre, CT 48 (IC- 421822) for crude protein, and CT 30 (IC- 415154) for gum content. Hence these accessions could be better utilized for further breeding programme for the improvement of pod yield, quality and gum content.

### Acknowledgement

The authors are thankful to Pandit Jawaharlal Nehru College of Agriculture and Research Institute for providing necessary facilities in carrying out the present investigation.

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