



Research Article

Performance of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] genotypes for growth, yield and quality characters

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Abstract

The present investigation was carried out with 56 cluster bean genotypes during *Kharif* 2018 using Randomized Block Design with two replications. Significant variations were recorded among the genotypes for growth, yield and quality characters. Thar Bhadavi recorded higher plant height at 30 DAS whereas Chitra Gold and IC-116930 were the tallest at 60 DAS and at final harvest respectively. The genotypes; IC-52249, Thar Bhadavi and the check Pusa Navbahar were the earliest to reach flower initiation whereas IC-116779, IC-116705, IC-522399 and IC-522506 reached 50% flowering earlier. The check Pusa Navbahar recorded the highest yield per plant. Highest protein content of pods was recorded by IC-113281 while high TSS of pods was recorded by IC-116660. Hence, these genotypes can be included in breeding programme for the improvement of respective characters.

Keywords

cluster bean, earliness, pod yield, superiority, quality

INTRODUCTION

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.], popularly known as 'guar' in Hindi language, has a chromosome number of $2n=2x=14$. It is an under exploited leguminous vegetable with high nutritional and medicinal properties. It is grown as a minor vegetable in many parts of the tropical region. Diverse opinion exists regarding the origin of the crop. Guar was probably domesticated in dry regions of West Africa and Arab traders were thought to have introduced it to Asia *via* South India. The crop is widely grown in countries like India, Pakistan, Indonesia and other parts of Southern and South eastern Asia as a vegetable and fodder crop for a long time (Vavilov, 1951). 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 (Muthuselvi *et al.*, 2018).

Being a typical vegetable, cluster bean prefers a warm climate and it is a drought tolerant crop. The advantages of cluster bean include its easiness to grow, adaptation to drought, freedom from serious pests and diseases and long storage life of the harvested pods. However, cluster bean varieties with the high yielding potential coupled with high protein content are needed to be recommended for exploitation by rainfed farming communities. The present investigation was taken up to study the mean performance of cluster bean genotypes for identification of high yielding varieties possessing high protein content which would be beneficial to the farmers and the consumers.

MATERIAL AND METHODS

An investigation was carried out at College of Horticulture, Dr. Y.S.R. Horticultural University, Venkataramannagudem, West Godavari district during *Kharif* season of 2018. The experiment was laid out in Randomized Block Design with

two replications. Each genotype was sown at 45 cm x 15 cm row to row and plant to plant distance, respectively. Optimum management practices were followed uniformly for raising the crop. Observations from five randomly selected plants of each genotype in each replication were recorded on twenty characters viz., plant height, plant spread, the number of branches per plant, leaf area (cm²) at (30 DAS, 60 DAS and at final harvest), internodal length (cm), days to flower initiation, days to 50% flowering, days to first harvest, the number of clusters per plant, the number of pods per cluster, average weight of 50 pods (g), pod length (cm), pod girth (mm), the number of seeds per pod, 100 seed weight (g), pod yield per plant (g), pod yield per plot (kg) and pod yield per hectare (q). Quality characters; such as protein content of pods (%) and TSS of pods (°Brix) were also analysed.

Data were subjected to the analysis of variance using RBD ANOVA (Panse and Sukhatme, 1967).

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 levels of significance. It also revealed significant differences between genotypes for all the characters indicating the presence of sufficient amount of variability for all the twenty characters studied. Wide range of variability was observed for pod yield per plant and average weight of 50 pods indicating the scope for selection of initial breeding material for further improvement based on these characters.

Table 1. Analysis of variance for different characters in cluster bean genotypes

S.No.	Characters	Mean sum of squares		
		Replications df= 1	Treatments df= 55	Error df= 55
1	Plant height (cm)	5.99	12935.65 **	1305.46
2	Plant spread (cm)	10.78	11345.61 **	210.50
3	Number of branches per plant	0.0027	178.19 **	1.23
4	Leaf area (cm ²)	17.004	48135.68 **	1135.00
5	Internodal length (cm)	0.065	102.59 **	15.14
6	Days to flower initiation	0.009	70.06 *	43.49
7	Days to 50 % flowering	0.57	119.96 **	59.43
8	Days to first harvest	0.08	522.56 **	29.42
9	Number of clusters per plant	0.0013	12.24 **	5.83
10	Number of pods per cluster	0.0063	12.26 **	0.34
11	Average weight of 50 pods (g)	70.72	165194.78 **	8365.78
12	Pod length (cm)	0.041	242.88 **	10.76
13	Pod girth (mm)	44.13	1556.75 *	939.96
14	Number of seeds per pod	0.000057	4.66 **	0.040
15	100 seed weight (g)	0.000072	27.73 **	0.0053
16	Pod yield per plant (g)	1391.67	167535.80 **	32512.89
17	Protein content of pods (%)	0.0053	1064.49 **	0.28

* Significant at 5 % level of significance ** Significant at 1 % level of significance

Mean performance was worked out and presented in Table 2 to Table 6. The tallest plant height at 30 DAS was recorded in Thar Bhadavi (30.26 cm) whereas, the shortest plant height was recorded in IC-113376 (7.40 cm). Chitra Gold (112.40 cm) was the tallest at 60 DAS while IC-113376 (55.89 cm) was the shortest. The tallest plant height at final harvest was recorded in IC-116930 (116.34 cm) whereas, the shortest was recorded in IC-116660 (67.70 cm). Plant height is considered as one of the important traits for growth and vigour of the plants. These results are in line with the findings of Vikas and Ram (2015) and Muthuselvi *et al* (2018) who recorded different plant heights of the genotypes studied.

Plant spread at 30 DAS was wider in IC-384986 (41.75 cm) whereas, the lowest was recorded in IC-113277 (13.53 cm). The genotype IC-51063 (50.63 cm) had the widest plant spread at 60 DAS whereas, the lowest was

recorded in IC-113272 (17.98 cm). The widest plant spread at final harvest was recorded in IC-51063 (53.10 cm). The lowest was recorded in IC-113272 (20.30 cm). These results are in line with the findings of Rishita (2018). Genotypes were categorized as branching and non-branching types. Among the branching types, the number of branches per plant at 30 DAS was the highest in IC-522389 (4.80) which was on par with IC-113395 (4.30), IC- 52249 (4.50) and IC-116626 (4.50). More number of branches per plant at 60 DAS were recorded in IC-522389 (10.10) which was on par with IC-52249 (8.90). Genotype IC-522389 (13.00) recorded more number of branches per plant at final harvest which was on par with thirteen genotypes. The results are in accordance with the findings of Reddy *et al.* (2017) and Muthuselvi *et al.* (2018) who also studied the number of branches per plant and recorded different variations from the genotypes studied.

Table 2. Mean performance of cluster bean genotypes for growth characters

Accession no.	Plant height (cm)			Plant spread (cm)		
	30 Days After Sowing	60 Days After Sowing	Final harvest	30 Days After Sowing	60 Days After Sowing	Final harvest
IC-113272	12.38	89.14	94.91	16.11	17.98	20.30
IC-113277	12.48	78.85	86.67	13.53	20.38	22.03
IC-113278	10.54	68.30	82.15	30.20	38.63	40.80
IC-113281	15.21	63.76	77.31	28.40	38.88	43.03
IC-113308	16.56	86.03	88.93	16.04	18.08	23.15
IC-113374	17.57	84.64	89.17	35.15	40.80	43.88
IC-113376	7.40	55.89	73.38	29.53	37.00	42.83
IC-113377	15.97	95.19	96.87	17.07	22.75	24.15
IC-113378	16.16	98.89	103.87	14.92	19.58	21.10
IC-113379	16.34	93.43	97.33	17.45	19.48	21.23
IC-113380	16.90	71.77	85.04	30.88	38.83	42.53
IC-113382	12.85	68.24	73.89	29.02	37.15	43.38
IC-113383	16.61	101.19	106.71	21.20	23.50	25.38
IC-113390	18.31	69.37	79.79	35.97	45.33	49.95
IC-113393	23.30	100.51	104.70	19.18	22.00	25.93
IC-113394	18.62	102.92	105.75	23.50	25.98	28.98
IC-113395	19.30	87.67	90.36	37.20	48.63	50.13
IC-113396	15.25	98.44	101.68	20.00	24.25	25.98
IC-113399	19.86	94.12	98.24	33.03	42.18	45.68
IC-113503	13.94	87.56	90.19	36.10	48.53	49.48
IC-113506	13.30	100.26	105.68	31.08	43.00	47.30
IC-113523	16.56	77.56	91.32	28.98	43.45	46.90
IC-113568	13.85	84.81	97.21	30.83	46.03	49.45
IC-113513	23.42	80.71	83.64	21.85	27.35	29.05
IC-116569	15.95	86.21	95.14	33.63	45.38	47.93
IC-116607	12.47	84.23	89.08	33.50	42.39	47.25
IC-116608	12.33	79.95	87.27	26.83	42.37	49.75
IC-116619	13.36	83.17	85.66	33.59	43.64	42.40
IC-116626	20.53	86.52	89.93	34.78	45.50	44.13
IC-116652	15.59	68.78	85.76	32.08	43.80	40.08
IC-116660	16.76	62.22	67.70	34.00	43.33	47.15
IC-116779	13.33	85.16	89.52	34.15	44.65	46.85
IC-116705	19.46	74.28	87.15	33.25	41.85	44.10
IC-116825	16.69	79.30	81.72	34.15	43.80	45.25
IC-116925	14.78	63.94	75.81	31.25	43.33	45.65
IC-116930	14.53	112.29	116.34	26.03	29.35	30.28
IC-116932	22.43	101.85	105.73	20.50	23.95	29.93
IC-384974	14.69	89.21	99.37	29.43	40.35	44.43
IC-384986	18.68	86.16	98.98	41.75	50.08	52.30
IC-522399	24.99	86.29	89.87	35.50	44.90	50.25
IC-522389	20.86	90.88	98.05	34.13	42.30	46.80
IC-522511	18.69	87.50	93.30	34.00	43.28	48.50
IC-522421	22.94	85.39	93.86	34.75	43.81	44.83
IC-522487	24.46	94.45	99.29	35.88	43.75	51.33
IC-522506	20.87	96.49	101.79	21.25	27.75	28.73
IC-52249	22.43	100.06	105.82	34.08	43.15	47.65
RGC-986	15.93	70.58	78.10	36.88	45.98	47.88
PLG-85	27.63	94.18	98.05	21.75	26.50	29.88
RGC-1038	21.50	77.12	84.39	31.50	42.83	47.60
IC-421850	19.68	79.98	90.93	21.50	24.10	25.55
IC-421855	17.72	72.77	80.51	33.32	42.98	49.48
IC-51063	21.54	93.54	98.29	41.33	50.63	53.10
Thar Bhadavi	30.26	84.73	99.39	23.00	26.73	31.28
MDU-1	28.96	92.37	97.60	24.25	27.60	29.60
Chitra Gold	25.07	112.40	116.02	25.25	30.63	32.43
Pusa Navbahar (Check)	30.03	110.33	116.15	26.75	31.85	33.58
Mean	18.18	85.92	92.88	28.77	36.65	39.61
SEm±	1.79	3.73	3.45	1.29	1.51	1.38
CD (P=0.05)	5.06	10.57	9.76	3.66	4.28	3.92

Table 3. Mean performance of cluster bean genotypes for growth characters

Accession no.	Number of branches per plant			Leaf area (cm ²)			Internodal length (cm)
	30 Days After Sowing	60 Days After Sowing	Final harvest	30 Days After Sowing	60 Days After Sowing	Final harvest	
IC-113272	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	235.05	487.87	452.79	3.65
IC-113277	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	231.34	489.21	455.05	4.40
IC-113278	1.90 (1.55)	5.00 (2.34)	8.30 (2.96)	231.23	487.54	452.37	4.90
IC-113281	2.20 (1.64)	5.70 (2.45)	9.60 (3.17)	228.48	490.98	456.58	4.50
IC-113308	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	234.34	490.93	456.50	4.80
IC-113374	2.10 (1.61)	5.50 (2.44)	10.30 (3.28)	233.17	490.16	455.75	5.35
IC-113376	2.30 (1.67)	5.50 (2.44)	10.30 (3.29)	233.82	487.85	453.31	4.90
IC-113377	0.00 (0.70)	0.00 (0.70)	0.00 (0.07)	232.26	492.75	458.54	4.05
IC-113378	0.00 (0.70)	0.00 (0.70)	0.00 (0.07)	230.82	493.26	458.88	4.65
IC-113379	0.00 (0.70)	0.00 (0.70)	0.00 (0.07)	231.10	492.91	458.60	5.25
IC-113380	3.50 (2.00)	7.00 (2.74)	11.30 (3.43)	230.66	491.73	457.35	5.50
IC-113382	2.80 (1.81)	6.40 (2.62)	11.10 (3.41)	233.00	492.59	458.97	6.40
IC-113383	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	239.57	492.22	457.97	9.25
IC-113390	3.10 (1.90)	6.30 (2.60)	10.90 (3.38)	239.59	490.90	456.28	7.15
IC-113393	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	241.27	491.49	456.79	4.90
IC-113394	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	239.37	491.02	457.08	4.60
IC-113395	4.30 (2.19)	8.00 (2.91)	12.60 (3.62)	227.78	489.33	455.30	6.20
IC-113396	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	238.92	489.02	454.57	4.50
IC-113399	4.10 (2.14)	7.70 (2.86)	11.70 (3.49)	228.22	488.24	454.27	5.30
IC-113503	3.10 (1.89)	6.40 (2.62)	10.40 (3.30)	230.96	487.91	453.90	7.30
IC-113506	1.30 (1.23)	3.30 (1.76)	6.20 (2.52)	238.03	489.57	455.75	4.20
IC-113523	2.80 (1.81)	6.10 (2.56)	10.00 (3.24)	233.76	499.32	465.01	6.30
IC-113568	3.60 (2.02)	7.80 (2.88)	11.40 (3.45)	229.70	501.03	466.46	4.75
IC-113513	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	234.77	503.88	470.45	5.10
IC-116569	4.00 (2.12)	7.90 (2.89)	11.80 (3.50)	232.20	499.29	465.02	5.20
IC-116607	2.80 (1.81)	6.20 (2.58)	10.30 (3.29)	230.77	490.77	456.47	5.10
IC-116608	3.70 (2.05)	7.40 (2.81)	11.50 (3.46)	235.00	501.12	467.65	4.55
IC-116619	3.60 (2.02)	7.30 (2.79)	11.70 (3.49)	230.91	498.30	464.44	5.55
IC-116626	4.50 (2.23)	8.10 (2.93)	11.90 (3.52)	232.82	498.89	465.31	5.05
IC-116652	3.90 (2.10)	7.30 (2.79)	11.50 (3.46)	229.45	503.06	468.82	4.05
IC-116660	3.10 (1.89)	6.00 (2.54)	10.10 (3.25)	234.63	490.94	456.37	4.45
IC-116779	1.20 (1.30)	3.70 (2.05)	7.20 (2.77)	234.18	489.06	454.53	4.05
IC-116705	1.60 (1.44)	4.80 (2.30)	8.50 (3.00)	239.40	498.99	464.25	5.00
IC-116825	1.80 (1.51)	5.20 (2.38)	9.90 (3.22)	238.97	498.41	464.43	5.15
IC-116925	3.40 (1.97)	7.40 (2.81)	11.70 (3.49)	233.18	497.65	463.62	5.25
IC-116930	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	238.34	505.13	471.02	5.35
IC-116932	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	240.77	499.72	466.32	4.70
IC-384974	3.70 (2.05)	8.50 (3.00)	12.60 (3.62)	239.54	503.08	469.32	5.45
IC-384986	4.00 (2.12)	7.90 (2.90)	12.20 (3.56)	233.85	493.60	459.45	6.85
IC-522399	2.50 (1.73)	6.20 (2.58)	10.30 (3.28)	235.41	498.14	463.83	6.40
IC-522389	4.80 (2.30)	10.10(3.25)	13.00 (3.67)	233.01	501.74	467.98	6.50
IC-522511	3.00 (1.87)	8.00 (2.91)	10.80 (3.36)	231.20	493.21	459.26	4.40
IC-522421	2.70 (1.79)	6.60 (2.66)	10.10 (3.25)	238.38	507.88	473.84	4.35
IC-522487	3.90 (2.10)	7.20 (2.77)	10.40 (3.30)	235.52	512.06	477.21	5.00
IC-522506	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	234.92	520.97	487.18	5.55
IC-52249	4.50 (2.23)	8.90 (3.06)	11.40 (3.45)	227.51	518.27	483.71	6.05
RGC-986	3.00 (1.87)	6.10 (2.56)	9.10 (3.10)	234.34	508.66	473.86	4.50
PLG-85	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	245.86	516.61	482.02	6.30
RGC-1038	2.40 (1.70)	5.60 (2.46)	8.90 (3.06)	227.72	508.62	475.35	5.25
IC-421850	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	242.54	519.43	485.46	4.80
IC-421855	2.90 (1.84)	4.50 (2.23)	9.70 (3.19)	245.95	514.47	479.37	6.10
IC-51063	3.30 (1.95)	5.80 (2.50)	9.70 (3.19)	250.84	533.90	499.03	4.85
Thar Bhadavi	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	258.91	543.27	509.06	5.50
MDU-1	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	258.46	582.99	548.38	5.65
Chitra Gold	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	299.36	583.28	550.15	5.00
Pusa Navbahar (Check)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	273.58	555.13	522.96	4.90
Mean	1.99 (1.45)	4.24 (1.95)	6.76 (2.37)	237.58	503.36	469.18	5.26
SEm ±	0.08	0.12	0.11	3.58	3.04	3.21	0.37
CD (P=0.05)	0.24	0.35	0.30	10.15	8.63	9.10	1.05

The values in brackets are square root transformation values.

DAS: Days After Sowing

Table 4. Mean performance of cluster bean genotypes for yield attributing characters

Accession no.	Days to flower initiation	Day to 50 % flowering	Days to first harvest
IC-113272	22.50	27.50	50.00
IC-113277	21.50	27.00	46.00
IC-113278	23.00	27.00	51.00
IC-113281	22.50	26.00	46.00
IC-113308	23.00	28.50	46.00
IC-113374	23.00	27.00	46.00
IC-113376	22.00	27.50	49.00
IC-113377	21.50	26.50	46.00
IC-113378	23.00	26.50	46.00
IC-113379	23.50	28.00	46.00
IC-113380	23.00	27.50	46.00
IC-113382	23.50	30.00	49.00
IC-113383	23.00	30.00	46.50
IC-113390	21.50	27.50	46.50
IC-113393	22.50	27.00	46.00
IC-113394	22.00	27.00	46.50
IC-113395	23.00	27.00	46.00
IC-113396	21.50	27.00	47.50
IC-113399	22.50	26.50	46.00
IC-113503	23.50	26.50	47.50
IC-113506	23.00	26.00	46.00
IC-113523	23.00	28.00	49.00
IC-113568	23.50	27.50	49.00
IC-113513	23.00	28.50	49.00
IC-116569	23.50	27.00	51.00
IC-116607	23.50	28.00	51.00
IC-116608	22.50	28.00	51.00
IC-116619	22.50	27.00	51.00
IC-116626	22.50	27.50	51.00
IC-116652	23.50	27.50	46.00
IC-116660	22.50	27.00	48.50
IC-116779	22.50	25.00	51.00
IC-116705	22.50	25.00	51.00
IC-116825	23.00	26.50	51.00
IC-116925	23.00	26.50	49.00
IC-116930	22.50	26.50	46.00
IC-116932	22.50	29.00	46.00
IC-384974	21.00	27.50	49.00
IC-384986	21.50	26.00	49.00
IC-522399	22.00	25.00	49.00
IC-522389	21.50	27.50	51.00
IC-522511	22.00	26.50	51.00
IC-522421	21.00	25.50	51.00
IC-522487	22.00	26.50	51.00
IC-522506	22.00	25.00	51.00
IC-52249	20.50	27.50	51.00
RGC-986	22.50	27.50	51.00
PLG-85	22.50	26.00	51.00
RGC-1038	22.50	27.00	51.00
IC-421850	22.50	26.50	47.50
IC-421855	22.50	26.50	46.00
IC-51063	23.50	26.50	46.00
Thar Bhadavi	20.50	26.50	46.00
MDU-1	22.50	27.00	46.00
Chitra Gold	23.00	26.50	46.00
Pusa Navbahar (Check)	20.50	26.00	46.00
Mean	22.44	26.98	48.31
SEm ±	0.63	0.74	0.52
CD (P=0.05)	1.78	2.08	1.47

Table 5. Mean performance of cluster bean genotypes for yield attributing characters

Accession no.	NCPP	NPPC	AWP	PL	PG	NSPP	HSW
IC-113272	13.30	6.39	66.00	6.24	33.17	6.00	3.58
IC-113277	11.00	7.33	72.50	5.91	28.67	7.10	3.29
IC-113278	12.90	5.47	65.50	6.28	31.84	8.00	2.98
IC-113281	20.40	7.55	51.00	6.34	31.67	7.80	3.69
IC-113308	13.00	6.33	63.00	5.86	30.34	9.00	3.54
IC-113374	19.40	7.90	78.00	6.31	30.17	7.90	2.99
IC-113376	14.20	9.08	74.50	6.43	26.17	7.90	3.04
IC-113377	13.40	8.60	106.00	6.83	26.17	9.00	3.89
IC-113378	14.20	8.50	65.50	6.28	29.17	7.80	3.26
IC-113379	12.00	9.35	86.50	6.18	24.50	8.40	3.33
IC-113380	17.20	6.77	65.50	6.09	32.33	8.60	2.98
IC-113382	15.00	12.66	75.00	6.73	32.17	9.10	3.46
IC-113383	12.70	8.60	67.00	6.00	30.84	7.80	3.98
IC-113390	12.10	7.00	65.00	5.77	27.67	8.10	3.55
IC-113393	13.20	11.03	82.50	6.35	32.50	7.20	2.98
IC-113394	12.60	12.65	81.00	6.24	27.67	8.90	2.99
IC-113395	17.60	10.47	82.50	6.68	30.34	8.80	3.57
IC-113396	12.70	10.62	90.00	6.38	28.50	8.10	3.76
IC-113399	21.70	7.92	73.00	6.59	31.67	7.90	4.01
IC-113503	13.30	9.06	73.50	6.82	34.50	8.80	4.27
IC-113506	13.80	10.21	79.00	6.14	23.84	7.90	3.64
IC-113523	15.30	9.04	74.50	6.71	29.50	7.40	3.33
IC-113568	14.30	10.09	74.00	6.51	35.50	9.20	2.98
IC-113513	13.10	12.42	77.50	6.17	25.67	7.20	3.56
IC-116569	14.50	10.09	75.50	6.44	34.00	8.10	3.44
IC-116607	13.90	5.81	74.00	6.77	30.00	6.10	3.01
IC-116608	13.90	5.75	89.00	6.71	25.00	7.20	2.87
IC-116619	13.40	5.00	76.50	7.00	22.34	7.80	4.03
IC-116626	13.40	5.79	71.50	6.09	32.00	6.60	3.56
IC-116652	12.80	7.35	80.50	7.13	25.00	6.80	3.54
IC-116660	18.20	5.90	73.50	6.20	33.00	8.80	3.76
IC-116779	14.70	6.04	65.00	6.49	22.84	9.20	3.21
IC-116705	17.40	9.64	89.00	5.95	35.34	8.90	3.23
IC-116825	15.50	7.49	72.50	6.37	33.34	8.40	3.12
IC-116925	14.00	7.55	76.00	6.25	30.34	9.40	2.45
IC-116930	16.30	8.38	73.50	5.90	26.17	4.60	3.09
IC-116932	10.90	10.90	111.00	7.73	34.33	6.20	2.78
IC-384974	13.70	9.11	85.50	6.73	34.50	5.20	3.12
IC-384986	12.60	8.04	81.50	6.54	34.00	6.40	3.87
IC-522399	12.00	8.87	68.50	4.76	22.50	7.00	3.45
IC-522389	16.80	8.92	70.00	6.06	31.33	5.20	3.67
IC-522511	13.50	10.48	74.00	6.04	28.67	8.60	3.22
IC-522421	18.90	10.73	75.50	7.05	27.17	7.10	3.89
IC-522487	19.60	11.80	62.50	7.77	29.17	7.10	3.55
IC-522506	13.60	6.77	67.00	7.41	27.84	7.10	4.23
IC-52249	14.50	8.19	77.50	7.57	27.17	8.20	2.99
RGC-986	15.40	10.98	71.00	7.01	34.00	9.10	2.99
PLG-85	12.00	10.01	77.50	7.20	32.00	8.20	3.13
RGC-1038	16.00	6.83	63.50	7.03	29.17	8.80	3.19
IC-421850	14.30	10.56	78.50	5.88	28.50	7.80	3.21
IC-421855	20.00	9.74	118.50	7.56	31.84	8.20	3.48
IC-51063	21.30	7.03	142.00	9.45	35.67	8.40	3.23
Thar Bhadavi	14.40	11.50	104.00	7.01	32.67	9.40	4.78
MDU-1	15.80	6.30	243.00	13.69	35.00	8.20	4.66
Chitra Gold	15.10	7.00	224.50	6.21	30.67	9.00	4.49
Pusa Navbahar (Check)	21.80	6.30	239.00	13.58	39.50	10.0	4.73
Mean	14.98	8.57	86.42	6.81	30.17	7.88	3.48
SEm ±	1.89	0.36	8.72	0.31	2.92	0.11	0.01
CD (P=0.05)	5.36	1.01	24.72	0.89	8.28	0.31	0.02

Table 6. Mean performance of cluster bean genotypes for yield and quality characters

Accession no.	Pod yield per plant (g)	Pod yield per plot (kg)	Pod yield per hectare (q)	Protein content of pods (%)	TSS of pods (°Brix)
IC-113272	206.90	7.45	30.66	15.70	1.70
IC-113277	170.40	6.14	25.25	13.49	1.10
IC-113278	152.00	5.47	22.52	23.67	1.20
IC-113281	191.10	6.88	28.31	29.15	1.25
IC-113308	242.00	8.72	35.85	19.37	1.85
IC-113374	188.60	6.79	27.94	15.50	1.75
IC-113376	205.80	7.41	30.49	22.44	1.20
IC-113377	182.60	6.57	27.05	13.13	2.90
IC-113378	255.40	9.20	37.84	14.14	2.00
IC-113379	168.80	6.08	25.01	15.81	2.15
IC-113380	246.30	8.87	36.49	19.80	1.75
IC-113382	189.40	6.82	28.06	18.89	2.55
IC-113383	222.50	8.01	32.97	13.35	2.00
IC-113390	205.10	7.39	30.39	23.50	1.60
IC-113393	198.70	7.15	29.44	28.15	2.95
IC-113394	190.20	6.85	28.18	14.17	2.60
IC-113395	234.80	8.46	34.79	14.28	1.65
IC-113396	223.90	8.06	33.18	15.64	2.65
IC-113399	279.00	10.05	41.34	19.74	2.45
IC-113503	203.30	7.32	30.12	21.48	1.10
IC-113506	257.70	9.28	38.18	13.87	1.45
IC-113523	196.50	7.08	29.11	13.45	1.30
IC-113568	207.30	7.46	30.71	16.53	2.20
IC-113513	205.50	7.40	30.45	23.04	1.65
IC-116569	190.00	6.84	28.15	15.70	1.50
IC-116607	193.80	6.98	28.72	15.16	1.60
IC-116608	167.90	6.04	24.88	13.16	1.20
IC-116619	148.50	5.35	22.00	13.50	3.05
IC-116626	144.30	5.19	21.38	12.90	2.10
IC-116652	168.00	6.05	24.89	15.06	2.65
IC-116660	223.90	8.06	33.17	13.45	3.85
IC-116779	166.20	5.99	24.63	12.62	1.30
IC-116705	256.90	9.25	38.06	16.03	1.55
IC-116825	175.40	6.32	25.99	13.54	1.10
IC-116925	152.10	5.48	22.54	20.53	1.15
IC-116930	214.30	7.72	31.75	23.75	1.20
IC-116932	182.70	6.58	27.07	15.49	1.65
IC-384974	185.20	6.67	27.44	12.70	1.85
IC-384986	256.10	9.22	37.94	20.66	1.70
IC-522399	200.60	7.22	29.72	14.16	1.10
IC-522389	231.40	8.33	34.29	13.65	3.20
IC-522511	182.60	6.58	27.05	13.58	1.55
IC-522421	290.50	10.46	43.04	22.34	1.55
IC-522487	244.60	8.81	36.24	19.06	1.30
IC-522506	230.70	8.31	34.18	23.57	1.30
IC-52249	211.60	7.62	31.35	12.43	1.50
RGC-986	153.00	5.51	22.67	15.91	2.40
PLG-85	235.60	8.48	34.91	14.38	1.50
RGC-1038	165.50	5.96	24.52	23.28	1.90
IC-421850	166.60	6.00	24.68	18.65	1.80
IC-421855	225.80	8.13	33.46	17.15	2.35
IC-51063	220.50	7.94	32.67	13.17	3.30
Thar Bhadavi	210.50	7.58	31.19	15.68	3.60
MDU-1	238.70	8.59	35.36	13.45	1.75
Chitra Gold	251.10	9.04	37.20	20.43	1.40
Pusa Navbahar (Check)	342.00	12.31	50.67	19.96	1.25
Mean	208.04	7.49	30.82	17.20	1.88
SEm ±	17.19	0.62	2.55	0.06	0.15
CD (P=0.05)	48.73	1.75	7.22	0.17	0.43

Chitra Gold (299.36 cm²) recorded the highest leaf area at 30 DAS which was on par with check Pusa Navbahar (273.58 cm²), Thar Bhadavi (258.91 cm²) and MDU-1 (258.46 cm²). The genotype IC-52249 (227.51 cm²) recorded the lowest leaf area. Highest leaf area at 60 DAS was obtained in Chitra Gold (583.28 cm²) which was on par with MDU-1 (582.99 cm²) and check Pusa Navbahar (555.13 cm²). Lowest leaf area was recorded in IC-113278 (487.54 cm²). Leaf area at final harvest was highest in Chitra Gold (550.15 cm²) which was on par with MDU-1 (548.38 cm²) and check Pusa Navbahar (522.96 cm²). Genotype IC-113278 (452.37 cm²) recorded the lowest. The genotype IC-113383 (9.25 cm) had the longest internodal length followed by IC-113503 (7.30 cm) and IC-113390 (7.15 cm) whereas IC-113272 (3.65 cm) had the shortest internodal length

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 (Muthuselvi *et al.*, 2018). The genotypes; IC-52249, Thar Bhadavi and check Pusa Navbahar (20.50 days) were the earliest to flower whereas IC-113379, IC-113382, IC-113503, IC-113568, IC-116569, IC-116607, IC-116652 and IC-51063 (23.50 days) were late. Days to 50% flowering was early for IC-116779, IC-116705, IC-522399 and IC-522506 (25.00 days). The genotypes IC-113382 and IC-113383 (30.00 days) were late. Among the fifty six genotypes studied, twenty one genotypes were harvested earlier at 46.00 DAS whereas eighteen genotypes were late at 51.00 DAS. The data pertaining to this trait are in accordance with the studies conducted by Reddy *et al.* (2017) and Muthuselvi *et al.* (2018).

Number of clusters per plant is an important character to be considered to select a cluster bean genotype exhibiting high yield indirectly (Muthuselvi *et al.*, 2018). More number of clusters per plant was recorded in check Pusa Navbahar (21.80) which was on par with twelve genotypes. The genotype IC-116932 (10.90) had less number of clusters per plant. The genotype IC-113382 (12.66) recorded the highest number of pods per cluster which was on par with IC-113394 (12.65), IC-113513 (12.42) and IC-522487 (11.80). Less number of pods per cluster was recorded in IC-116619 (5.00). The results of this study collaborate with the results of Vikas and Ram (2015) and Reddy *et al.* (2017).

An average weight of 50 pods was more for MDU-1 (243.00 g) which was on par with check Pusa Navbahar (239.00 g) and Chitra Gold (224.50 g). Less weight was recorded in IC-113281 (51.00 g). Longest pod length was measured in MDU-1 (13.69 cm) which was on par with check Pusa Navbahar (13.58 cm). The genotype IC-522399 (4.76 cm) had the shortest pod length. These results are similar to the findings of Reddy *et al.* (2017) who also studied average weight of 50 pods in different genotypes. The widest pod girth was recorded in check Pusa Navbahar (39.50 mm) which was on par with twenty

four genotypes. The genotype IC-116619 (22.34 mm) had lesser pod girth. More number of seeds per pod was obtained in check Pusa Navbahar (10.00) and none of the genotypes studied were significantly superior over check. Less number of seeds per pod was obtained in IC-116930 (4.60). Thar Bhadavi (4.78 g) had more 100 seed weight followed by check Pusa Navbahar (4.73 g) and MDU-1 (4.66 g). The Lowest seed weight was obtained in IC-116925 (2.45 g). The data pertaining to these characters are in accordance with the studies conducted by Reddy *et al.* (2017).

The check Pusa Navbahar (342.00 g) obtained the highest pod yield per plant and none of the genotypes were significantly superior over check. The lowest was in IC-116626 (144.30 g). Highest pod yield per plot was obtained in check Pusa Navbahar (12.31 kg) and none of the genotypes were significantly superior over check, whereas the lowest was in IC-116626 (5.19 kg). Pod yield per hectare was the highest for check Pusa Navbahar (50.67 q) and none of the genotypes were significantly superior over check, while the lowest was in IC-116626 (21.38 q). These results are similar to earlier findings of Reddy *et al.* (2017).

From the nutrient point of view, quality is considered as an important factor in any vegetable crop. Genotype IC-113281 (29.15%) had the highest protein content of pods, whereas IC-52249 (12.43%) had the lowest. The data pertaining of this character are in accordance with the studies conducted by Girish *et al.*, (2013), Malaghan *et al.*, (2013) and Kapoor (2014) from different cluster bean genotypes. Highest TSS of pods was obtained in IC-116660 (3.85 °Brix) which was on par with Thar Bhadavi (3.60 °Brix). The genotypes IC-113277, IC-113503, IC-116825 and IC-522399 (1.10 °Brix) had the lowest TSS of pods. These results are similar to earlier findings of Rishita (2018) who also studied the nutritional content of cluster bean genotypes.

In any selection programme, the mean performance of the genotypes for individual character serves as an important criterion for discarding the undesirable types. This indicated that germplasm studied might act as a potential source and offer scope for selection of high yielding genotypes with desirable quality traits.

In conclusion, superior genotypes; IC-52249, Thar Bhadavi, IC-116779, IC-116705, IC-522399 and IC-522506 might be used in breeding programmes for the improvement of earliness in cluster bean. MDU- 1 could be used for the improvement of characters like average weight of 50 pods and pod length as it showed significant superiority over check. Chitra Gold might be used for the improvement of traits like plant height and leaf area whereas, Thar Bhadavi might be used for 100 seed weight improvement as well as earliness characters. Genotype IC-113281 might be used for the improvement of protein content of pods.

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