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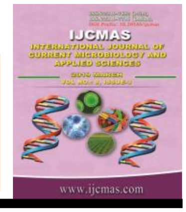

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Physiological Characterization of Cluster Bean (*Cyamopsis tetragonoloba* (L.) Taub) Genotypes for Growth Parameters

L. Ashwini*, S. Mohankumar, B. Fakrudin, M. Shivapriya, S. J. Prashath and Jayashree Ugalath

Department of Biotechnology and Crop Improvement, College of Horticulture, UHS Campus, GKVK Post, Bengaluru-65, Karnataka, India

**Corresponding author*

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A B S T R A C T

A field experiment was conducted during 2017-18 at College of Horticulture, Bengaluru. The experiment was laid out in augmented block design with 72 genotypes and 3 checks. The results revealed that there were significant differences between the genotypes for different morpho-physiological and biochemical traits studied. Among the genotypes the genotype COHBCBC 2 (100%), COHBCBC 16 (56.67cm), COHBCBC M5 (6.20), COHBCBC 6S1 (338.64 cm^2 $plant^{-1}$), COHBCBC 15S1(280.96 cm^2 g^{-1}), COHBCBC 28 (12.32g) performed better for the traits such as germination percent, plant height, number of branches per plant, leaf area, specific leaf area, total dry matter respectively. Genotypes COHBCBC 10 (82.67), COHBCBC M3 (88.20), COHBCBC25 (1.45), COHBCBC 27 (64.43) found superior for biochemical traits such as stomatal frequency, Relative water content, epicuticular wax content, SPAD values respectively. High PCV and GCV were observed for the traits number of branches per plant, leaf area, epicuticular wax content.

Introduction

Legumes play an important role in diet and they are often referred to as 'Poor Man's Meat'. Among the legumes cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) is a self-pollinated crop with erect and bushy annual growth habit having diploid chromosome number 2n=14 and belongs to family Fabaceae.

It is widely used as vegetable and commonly known as Gaur, Guwar, Gavar and Guvar bean.It is originated from African species *Cyamopsis senagalensis*.

It is a good source of nutrition and its tender green pods are also a economic source of nutrients. Tender pods are nutritionally rich in energy (16 Kcal), moisture (81 g), protein (3.2 g), fat (1.4 g), carbohydrate (10.8 g), Vitamin A (65.3 IU), Vitamin C (49 mg), phosphorus (57 mg), calcium (130 mg) and iron (4.5 mg) for every 100 g of edible portion (Kumar and Singh, 2002). A significant reduction was noted in serum cholesterol concentration of diabetic subjects after 15 and 30 days of consumption of roasted and cooked guar fibre (Soniand Rajnee, 2011). The seed of cluster bean contains about 30-33% gum in the endosperm called galactomannan.

(Reference). The crop is grown especially in the arid regions of India (Rajasthan, Haryana, Gujarat and Punjab) for gum purpose, whereas it is grown for vegetable purpose in other parts of India (Rai and Dharmatti, 2013).The major cluster bean cultivating countries are India, Pakistan, USA, Italy, Morocco, Germany and Spain. India produces about 80 percent of the world cluster bean production (Tripathy and Das, 2013).

The balanced partitioning of assimilates by the plant into the green leaves, stem, roots constitute a prime requirement in designing a plant architecture for high yield. In modern plant breeding, one of the major trends has been supporting the traditional methods by physio-biochemical investigation so as to obtain better estimates of the breeding value of the strain. So there is a need to develop genetically diverse varieties using morpho physiological and biochemical parameters as a selection tool for yield maximization in cluster bean. In this context present study has been attempted to identify variability in terms of morpho-physiological traits among cluster bean genotypes.

Materials and Methods

The study was carried out in experimental field of Department of Biotechnology and Crop improvement, College of Horticulture, Bengaluru, during the year 2017-18.The experiment site is located in the agro climatic zone-5 (Eastern dry zone) of Karnataka state. The material used in the study consisted of 75 genotypes (including check varieties PusaNavabahar, COHBCBC 8 and COHBCBC 45) collected from laboratory of Biotechnology and Crop Improvement was evaluated in an Augmented Block Design. After the layout preparation the genotypes and checks were assigned to different lines in each block by random table with a row-row and plant- plant spacing of 45×25 cm. Recommended basal dose of fertilisers (25:75:60 kg NPK /ha) was incorporated into the soil before final harrowing, remaining fertilisers applied after 35 DAS. Five randomly selected plants tagged for recording different morpho- physiological traits such as germination percent, plant height, number of branches per plant, leaf area, specific leaf area and total dry matter. Physio- biochemical traits include stomatal frequency, epicuticular wax content, relative water content and SPAD value.

Statistical analysis

The data collected was subjected to software the web service for Analysis of Augmented designs (Rathore, Prasad and Gupta, 2004).Genotypic and phenotypic variations among the characters analysed by using the formulae given by Burton (1952) presented in table 3. Degree of correlation among the characters was studied in accordance with Aljibouri *et al.*, (1958) presented in table 4.

Results and Discussion

The maximum percent of germination was recorded in genotype COHBCBC 2 (100%) and minimum germination percent was recorded in the genotype 28S4 (40%) table 2. This might be due to the better utilisation of seed reserve substances for good establishment (Adat *et al.*, 2011). Plant height varied significantly among the varieties at 90 DAS (Table 2). The maximum plant height was observed in the genotype COHBCBC 16 (56.67cm) significantly superior compared to all other genotypes. The minimum plant height is observed in the genotype 28S3 (18.89 cm) variations for plant height is a genotypic character and increased synthesis of carbohydrates, amino acids and phytohormones like auxins synthesis leads to good plant growth. Variability for plant height has been previously reported by Reddy *et al.*,

(2017) and Satyavathi *et al.,* (2014) in cluster bean.

Among the genotypes, COHBCBC M5 (6.20) recorded significantly more number of branches followed by COHBCBC 24 (5.80) and COHBCBC 25 (5.80). There were no primary branches observed in PusaNavabahar (check), genotypes COHBCBC 2, COHBCBC 5, COHBCBC 7, COHBCBC 10, COHBCBC 16, COHBCBC 21, COHBCBC 27, COHBCBC 28, COHBCBC 36, COHBCBC 39, COHBCB 40, COHBCBC 6S2, COHBCBC 21 S2, COHBCBC 28 S4, COHBCBC 31S1, COHBCBC 2 S1, COHBCBC 5S1 and COHBCBC 28 S2. Whereas the genotype COHBCBC 3 S1 (3.2) produced minimum number of branches per plant (Table 2). This might be due to reduced level of synthesis of phytohormones like auxins and proliferation of lateral buds which provides better plant architecture. Similar findings were reported by Ansari *et al.,* (2017) and Reddy *et al.,* (2017) in cluster bean. Leaf area determines the light interception and co_2assimilation capacity of a plant. Highest leaf area was recorded in the genotype COHBCBC6S1 (338.64) followed by COHBCBC M5 (329.59), lowest was found in COHBCBC M8 (121.59) followed by COHBCBC M12 (138.06) (Table 2). Variations for leaf area is might be a varietal character often leads to better canopy management.

Correspondingly variability for leaf area was noticed previously by Shilpa *et al.,* (2017) in cluster bean and Ahmed *et al.,* (2011) in mung bean. Highest Specific leaf area (SLA) was recorded in COHBCBC15-S1 (280.96) the least SLA was recorded in the genotype COHBCBC 29 (141.72) followed by COHBCBC 42 (150.16) (Table 2). This might be due to genetic nature of plant or environmental conditions. Similar findings have been reported earlier by Satyavathi *et al.,* (2014) and Sinha *et al.,* (2018). Genotypes varied significantly for total dry matter. The genotypes COHBCBC 28 (12.32) and COHBCBC 19 (12.31) were on par with each other and accumulated maximum dry matter content whereas the genotype COHBCBC 15-S1(5.40) recorded minimum total dry matter content followed by COHBCBC-14(5.51), COHBCBC43 (5.64) were at on par with each other (Table 2). Dry matter content is a chemical potential of the crop and reflects its true biological yield. These results are in conformity with results of Ansari *et al.,* (2017) and Ashok and Bajpai (1979).

The results on biochemical and physiological parameters *viz.,* stomatal frequency, relative water content, epicuticular wax content, SPAD values differed significantly among the genotypes (Table 2).

The genotype COHBCBC-10 (82.67) revealed maximum number of stomata on abaxial surface. Whereas the genotype COHBCBC 43(36.00) showed minimum stomatal number (Table 2).As stomata are associated with transpiration and photosynthesis and its regulation is controlled by stomatal frequency, reduced stomatal density leads to reduced photosynthetic rate and lower yields of plants on the contrary high stomatal frequency were able to take advantage of increased water and co_2supplyby increasing transpiration, photosynthetic rate and yield Buttery *et al.,* (1993).The maximum relative water content was noticed in COHBCBC M3 (88.20). Whereas the genotype COHBCBC 13 (60.13) recorded minimum relative water content (Table 2). RWC is a robust indicator of water status of a plant (Lawlor and Cornic, 2002) hence the genotype performed better may have better water holding capacity. Corresponding results were noticed earlier by Manzer *et al.,* (2015) in fababean. The genotype COHBCBC 25(1.45) recorded maximum epicuticular wax content.

Table.1 Genotypic variations among the cluster bean genotypes for Morpho-physiological parameters

Sl. No.	Genotypes	Germination percent (%)	Plant height (cm)	Number of branches / plant	Leaf area (cm^2/ plant)	Specific leaf area (cm^2/ plant)	Total dry matter (g)
1	COHBCBC 1	60.00	43.64	4.40	155.36	176.54	9.57
2	COHBCBC 2	100.00	43.97	0.00	165.89	211.32	9.77
3	COHBCBC 4	73.33	37.31	5.40	179.24	229.76	10.59
4	COHBCBC 5	60.00	35.78	0.00	196.34	194.93	9.48
5	COHBCBC 6	46.67	44.17	4.60	223.21	199.64	7.16
6	COHBCBC 7	66.67	47.22	0.00	187.86	243.19	6.14
7	COHBCBC10	66.67	43.61	0.00	143.25	197.69	6.34
8	COHBCBC 11	46.67	45.83	5.00	179.43	228.30	8.40
9	COHBCBC 13	46.67	47.22	5.20	195.05	221.54	8.30
10	COHBCBC 14	60.60	50.00	4.60	184.14	215.37	5.51
11	COHBCBC 16	60.60	56.67	0.00	172.24	230.87	8.26
12	COHBCBC 17	80.60	53.33	4.20	166.87	160.25	9.89
13	COHBCBC 18	73.33	45.31	4.40	147.49	180.80	8.26
14	COHBCBC 19	66.67	40.58	4.80	309.69	152.14	12.31
15	COHBCBC 21	73.33	39.75	0.00	193.22	207.83	8.99
16	COHBCBC 22	66.67	40.14	5.00	283.33	206.19	11.05
17	COHBCBC 23	60.00	40.97	4.80	183.38	223.82	6.90
18	COHBCBC 24	80.00	42.78	5.80	277.39	210.41	12.05
19	COHBCBC 25	80.00	44.44	5.80	258.40	184.89	12.17
20	COHBCBC 26	53.33	46.39	4.80	183.08	197.70	10.75
21	COHBCBC 27	66.67	52.50	0.00	185.73	222.76	10.40
22	COHBCBC 28	80.00	53.33	0.00	318.05	181.81	12.32
23	COHBCBC 29	86.67	51.39	4.20	182.94	141.72	8.08
24	COHBCBC 30	93.33	45.83	4.80	198.02	210.41	9.31
25	COHBCBC 31	80.00	38.33	5.60	170.76	247.29	9.79
26	COHBCBC 32	53.33	36.94	4.40	158.13	177.47	8.08
27	COHBCBC 33	93.33	36.11	3.40	171.08	236.54	8.28
28	COHBCBC 34	66.67	39.72	4.20	270.54	175.27	11.48
29	COHBCBC 35	73.33	37.28	4.80	196.88	211.32	11.32
30	COHBCBC 36	93.33	33.14	0.00	212.76	243.59	7.64
31	COHBCBC 37	86.67	35.64	4.20	163.74	190.71	7.93
32	COHBCBC 38	53.33	37.81	4.40	186.88	211.81	8.22
33	COHBCBC 39	80.00	40.00	0.00	274.64	172.39	8.71
34	COHBCBC 40	60.00	42.78	0.00	279.07	203.83	10.72
35	COHBCBC 41	53.33	30.00	4.20	308.32	188.67	9.55
36	COHBCBC 42	60.00	21.94	4.40	199.64	150.16	10.14
37	COHBCBC 43	66.67	28.61	3.40	181.07	213.29	5.64
38	COHBCBC 44	60.00	33.33	4.40	184.26	225.58	9.79

39	COHBCBC 6-S2	66.67	49.17	0.00	180.66	210.91	7.79
40	COHBCBC 3	53.33	48.06	4.20	186.24	213.52	8.95
41	COHBCBC 9	80.00	32.22	4.00	144.88	242.02	7.40
42	COHBCBC 20	53.33	34.17	4.00	188.87	204.61	6.31
43	COHBCBC M3	86.67	30.83	4.60	287.93	181.46	10.50
44	COHBCBC M5	93.33	25.83	6.20	329.59	174.73	10.76
45	COHBCBC M6	93.33	36.94	4.60	195.96	215.48	6.61
46	COHBCBC M8	93.33	42.22	4.80	121.59	271.42	7.27
47	COHBCBC M11	66.67	48.61	4.20	200.73	194.40	8.18
48	COHBCBC M12	93.33	41.25	4.20	138.06	208.81	7.18
49	COHBCBC M13	73.33	33.75	3.40	178.31	213.47	6.23
50	COHBCBC M15	73.33	34.86	4.80	195.25	200.07	9.08
51	COHBCBC 21-S2	66.67	22.64	0.00	206.51	195.79	9.13
52	COHBCBC 28-S3	66.67	18.89	4.20	197.91	182.36	9.08
53	COHBCBC 3-S1	86.67	33.19	3.20	193.54	208.00	6.87
54	COHBCBC 18-1	73.33	33.33	4.80	154.37	223.48	6.85
55	COHBCBC 15-S2	66.67	33.06	3.60	242.38	260.71	7.42
56	COHBCBC 28-S4	40.00	29.31	0.00	199.83	197.33	8.19
57	COHBCBC 22-S1	60.00	25.28	3.80	189.93	199.32	7.01
58	COHBCBC 33-S1	60.00	30.14	3.80	162.86	214.93	8.03
59	COHBCBC 15-S1	53.33	28.75	4.20	156.22	280.96	5.40
60	COHBCBC 4-S1	53.33	31.97	4.40	171.86	215.08	6.46
61	COHBCBC 4-S2	73.33	25.72	4.80	210.08	204.51	8.11
62	COHBCBC 12-S1	66.67	23.92	3.60	160.88	193.14	8.72
63	COHBCBC 31-S1	80.00	28.10	0.00	181.90	256.56	7.29
64	COHBCBC 2-S1	53.33	27.30	0.00	192.46	197.97	8.59
65	COHBCBC 5-S1	66.67	29.83	0.00	156.19	202.99	5.99
66	COHBCBC 28-S2	53.33	30.53	0.00	185.19	234.01	7.60
67	COHBCBC 14-S2	53.33	28.39	4.20	194.15	210.68	5.91
68	COHBCBC 20-S1	60.00	23.83	3.60	159.56	190.97	9.07
69	COHBCBC 24-S3	80.00	32.53	3.40	242.56	168.31	10.86
70	COHBCBC 16-S2	80.00	40.08	4.80	291.98	162.87	9.30
71	COHBCBC 6-S1	53.33	37.31	4.80	338.64	169.93	10.86
72	COHBCBC 45-S1	60.00	23.67	4.20	143.25	182.82	9.95
73	COHBCBC-8	89.52	40.42	4.83	183.98	197.20	8.75
74	COHBCBC-45	93.31	42.63	4.69	188.80	203.08	10.04
75	PusaNavabahar	92.19	47.88	0.00	170.70	153.34	11.34
	Mean	73.33	38.93	3.30	197.29	201.5	3.30
	SE d± Test treatment not in the same block	2.5	6.2	0.38	12.3	5.4	3.5
	CD @5% Test treatment not in the same block	5.6	13.8	0.86	27.3	12.0	1.14

Table.2 Genotypic variations among the cluster bean genotypes for biochemical and physiological parameters

Sl. No.	Genotypes	Stomatal frequency (number/ mm^2)	Relative water content (%)	SPAD values	Epicuticular wax content (mg /cm^2)
1	COHBCBC 1	48.33	72.94	59.53	0.50
2	COHBCBC 2	52.33	76.49	63.37	0.67
3	COHBCBC 4	50.67	86.57	54.17	0.52
4	COHBCBC 5	78.00	83.24	59.73	0.80
5	COHBCBC 6	55.67	62.35	57.70	0.55
6	COHBCBC 7	74.33	75.10	59.30	0.64
7	COHBCBC10	82.67	78.16	59.47	0.54
8	COHBCBC 11	54.33	67.90	59.90	0.65
9	COHBCBC 13	60.00	60.13	60.40	1.09
10	COHBCBC 14	55.33	62.15	60.77	0.93
11	COHBCBC 16	52.33	61.68	44.33	0.63
12	COHBCBC 17	55.67	69.46	63.23	0.49
13	COHBCBC 18	56.00	84.10	53.03	0.48
14	COHBCBC 19	50.33	78.89	62.43	0.41
15	COHBCBC 21	71.67	85.69	60.10	1.01
16	COHBCBC 22	46.67	87.15	61.90	0.72
17	COHBCBC 23	64.00	85.61	62.50	0.65
18	COHBCBC 24	45.67	85.13	54.77	0.92
19	COHBCBC 25	41.67	84.70	60.60	1.45
20	COHBCBC 26	46.00	80.09	61.50	0.47
21	COHBCBC 27	45.33	87.44	64.43	0.55
22	COHBCBC 28	37.00	79.35	57.57	0.66
23	COHBCBC 29	56.67	71.05	60.53	0.70
24	COHBCBC 30	56.33	83.04	58.30	0.71
25	COHBCBC 31	49.33	84.41	59.20	0.78
26	COHBCBC 32	53.33	79.80	57.40	1.05
27	COHBCBC 33	46.67	73.81	60.50	0.35
28	COHBCBC 34	41.33	86.45	56.83	0.70
29	COHBCBC 35	45.33	85.73	60.13	1.14
30	COHBCBC 36	37.00	75.11	57.70	0.75
31	COHBCBC 37	41.33	77.85	51.97	1.19
32	COHBCBC 38	53.67	82.39	58.83	1.24
33	COHBCBC 39	54.00	74.22	64.17	0.51
34	COHBCBC 40	54.00	75.19	52.90	0.71
35	COHBCBC 41	55.00	72.06	59.17	0.98
36	COHBCBC 42	48.00	80.13	57.97	0.68
37	COHBCBC 43	36.00	76.92	54.73	0.41
38	COHBCBC 44	40.33	80.51	61.07	0.42

39	COHBCBC 6-S2	45.00	87.09	56.47	0.45
40	COHBCBC 3	44.00	68.54	56.43	0.53
41	COHBCBC 9	51.00	80.92	59.07	0.35
42	COHBCBC 20	54.33	68.50	40.47	0.66
43	COHBCBC M3	52.67	88.20	59.60	0.38
44	COHBCBC M5	74.33	80.98	62.73	0.32
45	COHBCBC M6	61.00	81.05	57.13	0.47
46	COHBCBC M8	57.67	80.98	63.13	0.65
47	COHBCBC M11	58.00	87.16	56.97	0.57
48	COHBCBC M12	41.67	81.54	44.47	0.42
49	COHBCBC M13	64.33	86.41	40.70	0.67
50	COHBCBC M15	66.00	73.64	55.57	1.18
51	COHBCBC 21-S2	61.67	74.79	50.40	0.91
52	COHBCBC 28-S3	55.00	75.20	53.17	1.11
53	COHBCBC 3-S1	45.00	75.43	51.63	1.11
54	COHBCBC 18-1	49.67	79.12	61.33	1.11
55	COHBCBC 15-S2	45.67	78.44	53.70	0.95
56	COHBCBC 28-S4	40.67	76.95	60.63	1.05
57	COHBCBC 22-S1	49.67	72.10	60.40	0.60
58	COHBCBC 33-S1	36.33	78.42	59.83	1.08
59	COHBCBC 15-S1	48.33	77.50	60.30	0.87
60	COHBCBC 4-S1	57.33	73.30	51.07	1.07
61	COHBCBC 4-S2	50.33	82.47	53.07	1.02
62	COHBCBC 12-S1	37.67	87.56	61.13	1.12
63	COHBCBC 31-S1	39.00	84.83	52.07	1.17
64	COHBCBC 2-S1	56.00	83.20	52.80	0.82
65	COHBCBC 5-S1	67.33	85.41	55.13	0.96
66	COHBCBC 28-S2	44.67	81.70	56.63	0.76
67	COHBCBC 14-S2	59.33	83.88	59.37	1.18
68	COHBCBC 20-S1	47.33	70.80	52.40	0.66
69	COHBCBC 24-S3	44.33	65.79	58.17	1.11
70	COHBCBC 16-S2	50.00	69.43	60.50	0.64
71	COHBCBC 6-S1	54.00	83.76	51.37	0.45
72	COHBCBC 45-S1	55.00	77.70	59.50	0.90
73	COHBCBC-8	48.43	76.04	60.93	1.20
74	COHBCBC-45	50.31	80.53	56.66	0.99
75	PusaNavabahar	62.58	86.21	60.34	1.10
Mean		52.45	78.82	57.65	0.83
SE d±	Test treatment not in the same block	2.60	4.4	2.40	5.3
CD @5%	Test treatment not in the same block	5.80	9.9	0.16	0.36

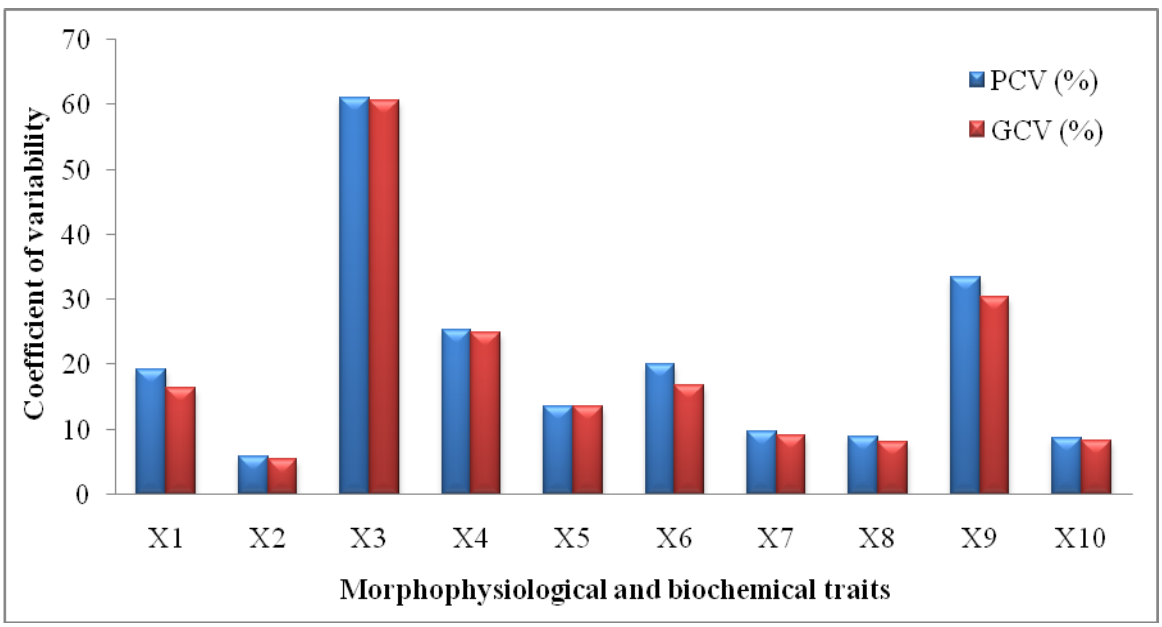
*40x microscope field having an area of 0.159 mm^2

Table.3 Estimates of variability for morpho-physiological traits among cluster bean genotypes

Traits	Mean	Range		PCV (%)	GCV (%)	h^2	GA as % of mean
		Min.	Max.				
Germination percent (%)	73.33	40.00	60.00	19.18	16.47	73.71	40.53
Plant height (cm)	38.93	18.89	60.00	5.89	5.33	84.21	14.55
No. of branches/ plant	3.30	0.00	6.20	60.98	60.53	98.51	42.50
Leaf area (cm^2 /plant)	197.29	121.5	338.6	25.22	24.93	97.73	52.45
Specific leaf area (cm^2/ plant)	201.05	141.7	280.95	13.59	13.49	98.53	28.49
Total dry matter (g /plant)	8.90	5.40	12.69	19.94	16.85	71.42	49.10
Stomatal frequency (number/ mm^2)	52.45	36.0	82.6	9.61	9.13	90.17	21.53
Relative water content (%)	78.82	60.13	89.28	8.84	8.14	84.77	19.29
Epicuticular wax content (mg/ cm^2)	0.83	0.32	1.45	33.39	30.42	80.09	166.0
SPAD values	57.65	40.46	64.43	8.74	8.36	91.54	19.60

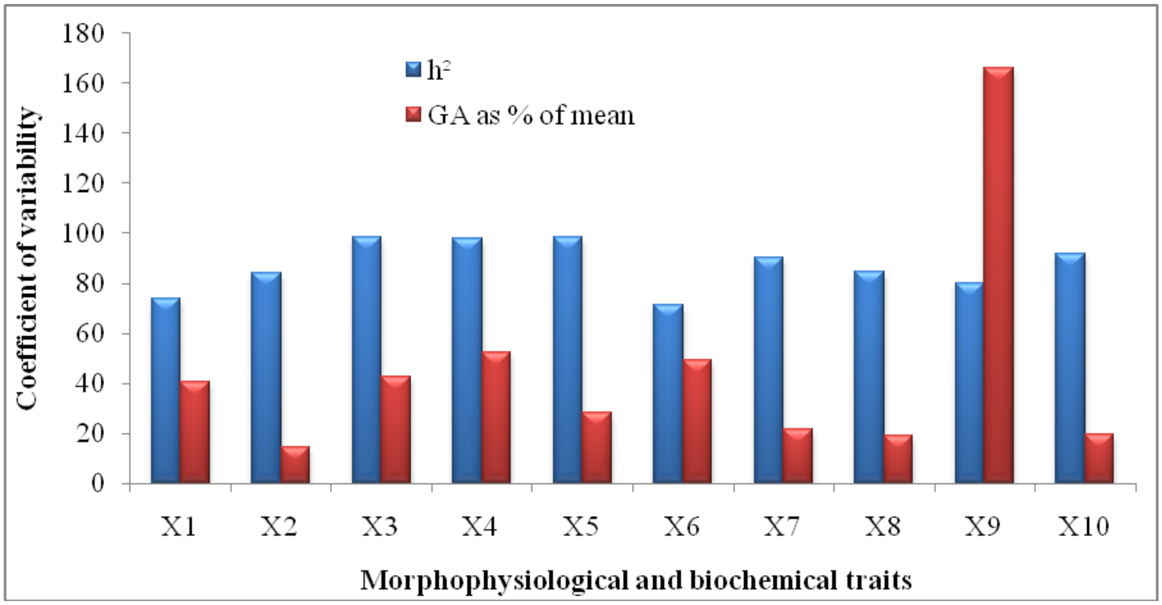
h^2 - Broad sense heritability, GAM - Genetic advance as per cent of mean, GCV - Genotypic co-efficient of variation, PCV - Phenotypic co-efficient of variation

Fig.1 Genotypic and phenotypic variability for morpho physiological and biochemical parameters in cluster bean genotypes



X1 : Germination %	**X5: Specific leaf area (cm^2/gram)**	**X9: Epicuticular wax content (mg /cm^2)**
X2 : Plant height (cm)	X6 : Total dry matter (g /plant)	X10 : SPAD value
X3 : Number of branches / plant	X7: Stomatal frequency (number /mm^2)	
X4 : Leaf area (cm^2/ plant)	X8: Relative water content (%)	

Fig.2 Heritability estimates and genetic advance over percent mean for morpho - physiological and biochemical parameters in cluster bean genotypes



X1 : Germination %	**X5: Specific leaf area (cm^2/gram)**	**X9: Epicuticular wax content (mg /cm^2)**
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X4 : Leaf area (cm^2 / plant)	X8: Relative water content (%)	

The minimum wax content was noticed in the genotypes COHBCBC M5 (0.32), COHBCBC-33(0.35) and COHBCBC-9(0.35) were at on par with each other (Table 2). This might be due to genotype have efficiency to synthesise wax content to control loss of water from epicuticular tissues. Similar results were reported earlier by Jayant *et al.*, 2015 in peanut genotypes. The highest SPAD value was recorded in the genotype COHBCBC-27 (64.43) followed by COHBCBC 39 (64.17), COHBCBC 2(63.37) and were on par with each other. The least SPAD value was observed in the genotype COHBCBC-20 (40.47) followed by COHBCBC M13 (40.70) (Table 2).This might be due to genetic ability of a genotype to synthesise increased amount chlorophyll pigment. Thakur *et al.*, (2016) and Kashiwagi *et al.*, (2010) noticed similar findings in cluster bean and chickpea genotypes.

Estimates of variance

The genetic parameters *viz.*, genotypic and phenotypic coefficient of variation, heritability in broad sense and genetic advance along with the mean were analysed and presented in table 3 and figure 1 and 2. High GCV and PCV values were recorded for traits like number of branches per plant (PCV = 60.98, GCV = 60.53), leaf area (PCV = 25.22, GCV = 24.93), epicuticular wax content (PCV = 33.39, GCV = 30.42) these results are in confirmation with earlier reports of Patil, 2014. Narrow differences between GCV and PCV indicate that these traits were less influenced by environment. A high value for GCV over PCV suggests that there is possibility of improvement through direct selection for these traits. Based on the above results the traits like number of branches per plant, leaf area, epicuticular wax content selection based on these traits have ample scope for direct selection.

Heritability estimates were high for all the characters studied. Similar results were obtained in previous study (Patil, 2014; Jithendar *et al.,*). It indicates characters are least influenced by the environment. Relatively high genetic advance as percent of mean was noticed for trait epicuticular wax content these results are similar to results of previous study Galeano *et al.*, 1985. High heritability combined with high genetic advance as percent mean is indicative of additive gene action and selection based on these traits would be beneficial.

From the findings of the present studies, we conclude that genotypic variations among the genotypes due to their differential responses for morpho-physiological and biochemical characteristics. The data obtained from this study identified several better performing cluster bean genotypes compared to check varieties and these could likely utilised in further breeding programme

References

Adat, S. S., Chavan, A. B., Sawashe, A. Y., Sonavane, P. N. and Chalke, P. R., 2011, Studies on growth parameters of cluster bean (*Cyamopsis tetragonoloba*) varieties under Marathwada condition. *Green farming.* 2(6): 684-685.

Ahamad, M. A., Kalsoom, A., Sarwao, G. and Ashraf, M., 2011, Evaluation of varieties of greengram at varied plant densities. *Bangladesh J. Agri.*, pp: 473-482.

Ansari, Z. G., Rao, R., Vasht, D., Sreelatha, P. and Aparna, K., 2017, Evaluation of morpho-physiological traits at various growth stages and its correlation with seed yield in guar gum genotypes. *Int. J. Chemi. Studies.* 5(6): 909-912

Ashok, C., and Bajpai, M. R., 1979, A note on the response of rainfed guar to phosphorus and nitrogen. *Ann. Arid Zone*. 18(4): 272-73.

Buttery, B.R., Tan C. S., Buzzel, R. I., Gaynor, J. D. and Mactavish. D. C., 1993, Stomatal numbers of soyabean and response to water stress. *J. Plant. Soil.*, 149(2):283-288.

Galeano, R., Rambaugh, M.D., Johnson, D. A., and Bushnell, J. L, 1985, Variation in epicuticular wax content of alfalfa cultivars and clones. *Crop Sci.*, 26(4): 703-706.

Jayant, K. S. and Sarangi, S. K., 2015, Effect of drought stress on epicuticular wax load in peanut genotypes. *J. Appl. Bio. Biotech*., 3 (4): 046-048.

Jithendar, S. K., Pahuja, Varma, N., and Bhusal, N., 2014, Genetic variability and heritability for seed yield and water use efficiency related characters in cluster bean (*Cyamopsis tetragonoloba* (L.) Taub). *Forage Res.*, 39 (4): 170-174.

Kashiwagi, J., Hari D., Upadhyayaand Krishnamurthy, L.,2010, Significance and genetic diversity of SPAD chlorophyll meter reading (SCMR) in the chickpea (*Cicer arietinum* L.) germplasm in the semiarid environments. *J. Food Leg.* 23(2): 99-105.

Lawlor, D. W. and Cornic, G., 2002. Photosynthetic carbon assimilation and associated metabolisnm in relation to water deficits in higher plants.*Pl. Cell Envt*., 25:275-294.

Manzer, H. S., Muthahar Y., Al- Khaishany., Mohammed, A., Mohammed. H., Grover, A., Hayssam, M., Mona, S. and Najat, A., 2015, Response of different genotypes of French bean plant to drought stress. *Int. J. Mol. Sci.*, 16:10214-10227.

Patil, D.V., Genetic variability and sowing dates effect of cluster bean (*Cyamopsis tetragonoloba* (L.) Taub) genotypes in semi-arid region of Maharashtra. *Plant archives* 14(1): 1-6.

Rai, P. S., Dharmatti, P. R., Shashidhar, T. R., Patil, R. V. and Patil, B. R., 2012, Genetic variability studies in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub]. *Karnataka J. Agric. Sci.*, 25(1): 108-111.

Reddy, D. R., Saidaiah, P., Ravinder, R. K. and Pandravada, S. R., 2017, Mean performance of cluster bean genotypes for yield, yield parameters and quality traits. *Int. J. Current Mic. and Appl. Sci.,* 6(9): 3685-3693.

Satyavathi, P. M., Vanaja, A. G. K., Reddy, P., Vagheera, A. N., Reddy, G. V., Kumar, A., Razak, S., Vaidya, P. S. and Khan, I., 2014, Identification of suitable guar genotypes for summer season of semi-arid region. *Int. J. Appl. Biol. Pharm. Technol.*, 5(4): 71-73.

Shi1pa, V. C. and Chandranath, H. T., 2017, Dry matter production and partitioning of clusterbean (*Cyamopsis tetragonoloba* (L.) taub) genotypes (gum) as influenced by plant density and bio inoculants. *Int. J. Curr. Microbio. App. Sci.,* 6(12): 1797-1803.

Sinha, T., Mondal, S. and Hembramm. S. K., 2018, Evaluation of Chickpea Genotypes on the Basis of their Physiological Growth Parameters. *Int. J. Curr. Microbiol. App. Sci* 7: 3888-3895.

Thakur, K., Katiyar, P. and Ramteke, V., 2016, Physiological and growth response of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] varieties to different growing seasons. *J. Envir. Sci.*, 9:651-657.

Tripathy, S. and Das, M. K., 2013, Guar gum: present status and applications. *J. Pharm. Scientific Innov.*, 2:24 -28.

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