



# Plant Archives

Journal homepage: <http://www.plantarchives.org>

DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.2.285>

## VEGETABLE PURPOSE CLUSTER BEAN CULTIVAR ANAND BAHAR FOR LATE KHARIF AGRO CLIMATIC CONDITIONS OF GUJARAT INDIA

M.M. Pandya<sup>1\*</sup>, R.R. Acharya<sup>1</sup>, V.I. Joshi<sup>2</sup>, N.A. Patel<sup>1</sup>, K.B. Kathiria<sup>3</sup>, D.P. Gohil<sup>4</sup> and J.N. Patel<sup>2</sup>

<sup>1</sup>Main Vegetable Research Station, Anand Agricultural University, Anand-388 110, Gujarat, India.

<sup>2</sup>Bidi Tobacco Research Station, Anand Agricultural University, Anand-388 110, Gujarat, India.

<sup>3</sup>University Bhavan, Anand Agricultural University, Anand-388 110, Gujarat, India.

<sup>4</sup>Main Forage Research Station, Anand Agricultural University, Anand-388 110, Gujarat, India.

\*Corresponding author E-mail: [pandymihir1011@gmail.com](mailto:pandymihir1011@gmail.com)

(Date of Receiving- 25-04-2024; Date of Acceptance-11-07-2024)

### ABSTRACT

The Gujarat Vegetable Guar 11 variety underwent rigorous evaluation across 17 experimental trials conducted at the Anand, Junagadh, Jagudan, and Waghai research centers. Among the 13 trials deemed successful, this genotype demonstrated a statistically significant enhancement in green pod yield in 8 instances when compared to the national check variety, Pusa Navbahar. Based on the aggregate data for green pod yield, Gujarat Vegetable Guar 11 achieved an average yield of 148.15 quintals per hectare, reflecting a 27.10% increase over the national control variety, which recorded a yield of 116.56 quintals per hectare. Furthermore, the Anand Bahar genotype exhibited green pod yields of 149.40 quintals per hectare at Anand, 140.83 quintals per hectare at Junagadh, 168.84 quintals per hectare at Jagudan, and 137.16 quintals per hectare at Waghai. These results represent yield increases of 24.52%, 13.78%, 81.88%, and 23.72%, respectively, compared to the national check variety Pusa Navbahar.

**Key words:** Cluster bean, leguminous vegetables, Mean, Fiber and Protein.

### Introduction

*Cyamopsis tetragonoloba* (L.) Taub., commonly known as cluster bean, guar, or chavlikayi, is a significant yet underutilized leguminous vegetable belonging to the *Fabaceae* family, subfamily *Papilionoideae*. It is a self-pollinated species with a diploid chromosome number of  $2n=14$  (Hymowitz and Upadhyaya, 1963). This legume is recognized for its drought resistance, robust deep-root system, and multipurpose applications, primarily cultivated for its tender pods and endospermic gum in the arid and semi-arid regions of India (Kumar and Rodge, 2012; Kumar, 2005).

Cluster bean serves multiple functions: its immature green pods are consumed as a vegetable, its seeds are utilized as pulses, and the entire green plant is used for fodder and green manure. The plant enhances soil health by gradually shedding its leaves, which contribute organic carbon to the soil. Nutrient analysis of the immature pods reveals they are a rich source of energy (16 kcal),

carbohydrates (10.8 g), protein (3.2 g), fat (1.4 g), moisture (81 g), vitamin A (65.3 IU), vitamin C (49 mg), iron (4.5 mg), and calcium (57 mg) per 100 grams of the edible portion (Kumar and Singh, 2002).

India dominates global guar production, contributing approximately 80% of the total output. The cultivation is concentrated in the arid and semi-arid zones of Rajasthan, Gujarat, Haryana, Punjab, and parts of Uttar Pradesh, Madhya Pradesh, and Tamil Nadu, covering an area of about 3.34 million hectares and yielding 0.4 million tonnes of guar seed. Rajasthan is the leading state with 82.1% of the cultivation area, followed by Haryana (8.6%), Gujarat (8.3%), and Punjab (1%), producing 64%, 22%, 12%, and 2% of the guar seeds, respectively (Pathak et al., 2010). Specifically, Rajasthan alone accounts for 70% of the national production, followed by Gujarat, Haryana, and Punjab. The productivity varies significantly, from 474 kg/ha in Rajasthan to 1200 kg/ha in Haryana (Ahlawat et al., 2013). As of 2014, the total area under

cluster bean cultivation in India was 4.25 million hectares, with a production of 2.41 million tonnes and an average yield of 0.57 tonnes per hectare.

Beyond its use as a vegetable, cluster bean is a valuable livestock fodder. Its seeds are processed into guar gum (galactomannan), a crucial substance in various industries such as textiles, paper, cosmetics, and oil extraction. Additionally, guar gum serves as an absorbent in explosives manufacturing (Smith, 1976).

### Material and Methods

The genotype ACLB 14-05 was developed through rigorous pure line selection from germplasm accession No. 32 at the Main Vegetable Research Station (MVRS), Anand Agricultural University (AAU), Anand. This genotype underwent initial evaluation in Preliminary Evaluation Trials (PET) during the *kharif* season of 2014. Due to its superior performance, it was subjected to extensive testing in the Large-Scale Varietal Trials (LSVT) from the *kharif* season of 2015 through 2019 across multiple locations within the state. Cultivation of this genotype involved row spacing of 45 cm and plant spacing of 30 cm, with a seeding rate of 8-10 kg/ha. The recommended agronomic practices were meticulously followed to ensure optimal crop growth. This included the application of farmyard manure (FYM) at a rate of 15-20 t/ha, and a basal dose of fertilizers at 20:40:00 NPK kg/ha, along with maintaining a uniform water level throughout the field. The genotype was cultivated in well-leveled fields with adequate irrigation infrastructure. Over a six-year period, from 2014 to 2019, the promising genotype was evaluated through comparative trials at multiple locations including Anand, Junagadh, Jagudan, and Waghai. These evaluations took place during the *kharif* season and included on-farm trials with various experimental designs. Additionally, the genotype's resistance to major pests and diseases was assessed following standard protocols, and grain quality parameters were thoroughly analyzed.

The cluster bean genotype ACLB 14-05, having shown consistent and favorable results, was proposed for release under the name Gujarat Vegetable Guar 11 (GVG 11: Anand Bahar) in the year 2020.

### Results and Discussion

The morphological characteristics of Anand Bahar were visually assessed in comparison with the reference variety Pusa Navbahar, which serves as the national check. Anand Bahar exhibits an erect growth habit and falls within the medium maturity category, with the first harvest occurring between 48 to 57 days (Table 4). The

**Table 1:** Morpho-physiological observations of cluster bean variety Anand Bahar along with national check.

S.	Characteristics	Anand Bahar	Pusa Navbahar (NC)
1	Plant: Anthocyanin coloration of hypocotyl	Absent	Absent
2	Plant: Branching pattern	Non branching	Non branching
3	Plant: Growth habit	Erect	Erect
4	Time of flowering	Early	Early
5	Stem : Colour	<b>Dark green</b>	<b>Green</b>
6	Stem: Pubescence	<b>Strong</b>	<b>Weak</b>
7	Leaf: Colour	<b>Dark green</b>	<b>Green</b>
8	Leaf: Pubescence	<b>Strong</b>	<b>Medium</b>
9	Leaf: Size	<b>Large</b>	<b>Small</b>
10	Leaf: Shape	Ovate	Ovate
11	Leaf: Serration of margin	<b>Sparse</b>	<b>Dense</b>
12	Flower: Pattern	Short inflorescence	Short inflorescence
13	Flower: Days to 50% flower	Medium	Medium
14	Flower: colour	Whitish purple	Whitish purple
15	Pod: Bearing	Cluster	Cluster
16	Pod: Colour	<b>Dark green</b>	<b>Green</b>
17	Pod: Pubescence	Absent	Absent
18	Pod: Waxiness	Absent	Absent
19	Pod : Surface stickiness	Present	Present
20	Pod: Construction	<b>Prominent</b>	<b>Weak</b>
21	Pod: Length	Long	Long
22	Pod: Hairiness	Non hairy	Non hairy
23	Pod: Maturity	Early	Early
24	Seed: Colour	Grayish Black	Grayish Black
25	Seed: Colour pattern	Uniform	Uniform

distinguishing features of this proposed variety in field conditions include:

- (i) dark-colored foliage with minimal leaf serration
- (ii) an erect growth habit with a typically non-branching pattern, and

**Table 2:** Biochemical parameters recorded in cluster bean variety Anand Bahar along with check at Anand during 2019-20.

S.	Characteristics	Anand Bahar	Pusa Navbahar (NC)
1	Moisture (%)	84.42	83.83
2	Fibre (%)	<b>0.513</b>	0.502
3	TSS (%)	1.938	2.169
4	Crude protein (%)	<b>4.121</b>	3.127
5	Phenol (%)	<b>0.228</b>	0.210
6	Flavanoid (%)	<b>0.171</b>	0.131
7	Total chlorophyll (mg/100g)	<b>0.127</b>	0.121

**Table 3(a):** Comparative performance of cluster bean variety Anand Bahar in Gujarat.

Season/ Year/Trials	Locations	Green pod yield (q/ha)		S. Em <sub>±</sub>	CD at 5 %	CV %
		Anand Bahar	Pusa Navbahar (NC)			
<i>Kharif</i> -2014 PET	Anand	172.72*	125.81	4.94	14.68	5.64
	Mean (1)	172.72	125.81			
	% Inc. over		<b>37.29</b>			
<i>Kharif</i> -2015 LSVT	Anand	179.63	173.46	12.28	36.00	14.20
	Junagadh	110.62	105.56	6.73	19.75	12.24
	Mean (2)	145.13	139.51			
	% Inc. over		<b>4.03</b>			
<i>Kharif</i> -2016 LSVT	Anand#	88.59*	52.32	1.86	5.57	5.97
	Junagadh	107.41	106.48	19.0	56.49	13.52
	Jagudan	175.93*	105.43	9.74	28.95	11.64
	Mean (2)	141.67	105.96			
	% Inc. over		<b>33.70</b>			
<i>Kharif</i> -2017 LSVT	Anand	111.12*	77.78	3.61	10.96	6.70
	Junagadh	175.62	141.36	18.72	56.81	9.50
	Jagudan	161.74*	80.23	10.01	30.34	6.70
	Mean (3)	149.49	99.79			
	% Inc. over		<b>49.81</b>			
<i>Kharif</i> -2018 LSVT	Anand	136.05*	100.00	9.76	30.06	15.06
	Junagadh	165.43*	134.57	7.44	22.92	9.27
	Jagudan#	56.46	16.05	5.18	15.97	22.56
	Waghai#	65.11	82.45	3.37	10.39	9.37
	Mean (2)	150.74	117.29			
	% Inc. over		<b>28.52</b>			
<i>Kharif</i> -2019 LSVT	Anand	147.47*	122.84	6.60	19.60	9.12
	Junagadh	145.06	130.86	7.31	21.72	9.63
	Waghai	137.16*	110.86	5.78	17.19	9.43
	Jagudan#	85.62	93.15	6.29	18.87	25.89
	Mean (3)	143.23	121.52			
	% Inc. over		<b>17.87</b>			
Over all mean (13)		<b>148.15</b>	<b>116.56</b>			
Over all % increase over check			<b>27.10</b>			

Note:- \* indicates the significantly superior than check and # Data was not considered due to below state average yield and/ or high CV%.

(iii) dark green, elongated pods that are prominently clustered (Table 1).

From a nutritional perspective, quality is a critical parameter in evaluating any vegetable crop. This genotype exhibits higher contents of fiber (0.513%), crude protein (4.121%), phenols (0.228%), and flavonoids (0.171%) compared to the national check, Pusa Navbahar (Table 2). These findings are consistent with previous studies conducted by Solanki and Chaudhary (1996), Dwivedi (2009), and Reddy *et al.*, (2017).

The proposed variety, Anand Bahar, demonstrated a yield of 148.15 quintals per hectare, which is 27.10% higher than the national check variety Pusa Navbahar, which yielded 116.56 quintals per hectare across 13 locations (Table 3a). Specific yields recorded were 149.40

**Table 3(b):** Performance of cluster bean variety Anand Bahar for green pod yield (q/ha) for different zone of Gujarat.

S. No.	Different Zone of Gujarat	Anand Bahar	Pusa Navbahar (NC)	% Inc. over Check
1	Middle Gujarat (Anand) Over all mean (5)	149.40	119.98	24.52
2	Saurashtra (Junagadh) Over all mean (5)	140.83	123.77	13.78
3	North Gujarat (Jagunan) Over all mean (2)	168.84	92.83	81.88
4	South Gujarat (Waghai) Over all mean (1)	137.16	110.86	23.72
Over all mean (13)		148.15	116.56	27.10

**Table 4:** Ancillary observations of proposed cluster bean variety Anand Bahar along with check.

S. No.	Characters	Anand Bahar	Pusa Navbahar (NC)
1	Days to 50% flowering	33.40 (32.00-36.00)	32.60 (31.00-36.00)
2	Days to first picking	50.20 (48.00-54.00)	51.40 (50.00-55.00)
3	Plant height (cm)	130.00 (125.00-143.50)	120.40 (115.00-126.50)
4	Pod length (cm)	10.40 (9.10-12.00)	11.10 (9.50-15.00)
5	Pods per plant	<b>128.80</b> <b>(125.50-135.00)</b>	90.40 (85.00-105.00)
6	Clusters per plant	<b>12.50</b> <b>(11.50-13.00)</b>	10.80 (8.50-11.50)
7	Pods per cluster	<b>11.20</b> <b>(11.00-12.50)</b>	9.30 (9.00-10.50)
8	Seeds per pod	<b>9.40</b> <b>(8.00-10.00)</b>	8.60 (7.50-9.00)
9	10 green pod weight (g)	<b>24.00</b> <b>(22.50-31.50)</b>	22.50 (21.00-30.00)
10	1000 seed weight (g)	39.20 (38.8-39.9)	39.80 (38.9-40.0)

**Table 5 (A):** Major disease and pest reaction under field condition at Anand.

(a) <i>Alternaria</i> blight(0-5) disease					
Variety /Check	<i>Alternaria</i> blight(0-5)				Reaction
	<i>Kharif</i> -2017	<i>Kharif</i> -2018	<i>Kharif</i> -2019	Range	
Anand Bahar	1.5	2.0	2.0	1.5-2.0	<b>MR</b>
Pusa Navbahar (NC)	2.3	2.7	2.6	2.3-2.7	<b>MS</b>

  

Rating Scale	Disease Reaction	Description
0	Near immune/ Resistant reaction (I)	No symptoms
1	Resistant (R)	1-10 % leaf area infected
2	Moderately Resistant (MR)	11-25 % leaf area infected
3	Moderately Susceptible (MS)	26-50 % leaf area infected
4	Susceptible (S)	51-75 % leaf area infected
5	Highly Susceptible (HS)	76 % above leaf area infected

(b) Population of Aphids, Jassid and Whitefly												
Variety /Check	No. of Aphids/Jassid / Whitefly per 3 leaves											
	<i>Kharif</i> 2017			<i>Kharif</i> -2018			<i>Kharif</i> -2019			Range		
	Aphid	Jassid	Whitefly	Aphid	Jassid	Whitefly	Aphid	Jassid	Whitefly	Aphid	Jassid	Whitefly
Anand Bahar	4.7	1.2	2.1	4.3	2.3	2.0	4.7	2.9	2.5	43-47	12-29	20-25
Pusa Navbahar (NC)	8.3	2.3	2.6	6.0	3.1	3.1	5.6	2.8	3.7	56-83	23-31	26-37

quintals per hectare in Anand, 140.83 quintals per hectare in Junagadh, 168.84 quintals per hectare in Jagudan, and 137.16 quintals per hectare in Waghai, representing increases of 24.52%, 13.78%, 81.88%, and 23.72%, respectively, over Pusa Navbahar. These yield improvements were corroborated by key contributing traits (Table 3b).

The mean plant height values (Table 4) ranged from 125.00 cm to 143.50 cm, with an overall mean of 130.00 cm. This is in contrast to the national check, Pusa Navbahar, which exhibited a range from 115.00 cm to 126.50 cm, with a mean height of 120.40 cm across various locations. These findings are consistent with those reported by Rai *et al.*, (2012) and Girish *et al.*, (2013). The average number of days to 50% flowering varied between 32.00 and 36.00 days, with a mean of 33.40 days. Comparatively, Pusa Navbahar showed an average of 32.60 days, ranging from 31.00 to 36.00 days. The days to first picking spanned from 48.00 to 54.00 days, averaging 50.20 days, whereas Pusa Navbahar had a mean of 51.40 days within a range of 50.00 to 55.00 days. These observations align with the studies conducted by Rai *et al.*, (2012).

The number of pods per cluster ranged from 11.00 to 12.50, with a mean of 11.20, while Pusa Navbahar exhibited a lower range of 9.00 to 10.50 and a mean of 9.30. The number of clusters per plant ranged from 11.50 to 13.00, with an average of 12.50, compared to Pusa

**Table 5 (B):** Major diseases reaction under field condition at Junagadh.

Variety/ check	Name of disease (PDI)	Leaf spot (PDI)			Range
		<i>Kharif</i> -2017	<i>Kharif</i> -2018	<i>Kharif</i> -2019	
Anand Bahar	Leaf spot	8.40	8.00	8.71	8.00-8.71*
	BCMV	0.00	3.40	3.49	0.00-3.49*
Pusa Navbahar (NC)	Leaf spot	14.66	14.67	15.22	14.66-15.22*
	BCMV	0.00	26.25	26.66	0.00-26.66*

\* Values indicate original values

Navbahar's lower mean of 10.80, within a range of 8.50 to 11.50. These results corroborate the findings of Vir and Singh (2015) and Vikas and Ram (2015). The number of pods per plant ranged from 125.50 to 135.00, with a grand mean of 128.80, while Pusa Navbahar showed a lower mean of 90.40, within a range of 85.00 to 105.00. These findings are consistent with the studies by Anandhi and Oommen (2007) and Jitender *et al.*, (2014). Pod length ranged from 9.10 cm to 12.00 cm, with an average of 10.40 cm, which is higher than the mean length observed in Pusa Navbahar (11.10 cm), ranging from 9.50 to 15.00 cm. These observations are in line with the findings of Rai *et al.*, (2012).

In terms of disease resistance, bacterial blight, Alternaria leaf spot, and powdery mildew pose significant threats to guar production in many regions. Developing resistant varieties is crucial to mitigate economic losses (Kumar, 2005; Sharma *et al.*, 1999). The proposed genotype showed lower incidence of Alternaria blight and Bean Common Mosaic Virus (BCMV) compared to Pusa Navbahar (Tables 5A and 5B). Furthermore, it exhibited reduced infestation by jassids, aphids, and whiteflies relative to Pusa Navbahar (Table 5A). DNA fingerprinting analysis confirmed that the Anand Bahar genotype is genetically distinct from Pusa Navbahar.

### Conclusion

The Anand Bahar variety exhibited a remarkable green pod yield of 148.15 quintals per hectare, surpassing the national check variety Pusa Navbahar by 27.10 percent, which recorded a yield of 116.56 quintals per hectare across various locations. Specifically, Anand Bahar achieved yields of 149.40 quintals per hectare at Anand and 140.83 quintals per hectare at Junagadh. This genotype is characterized by its dark green pod color, sparse leaf serration, elongated pods typically lacking branching, and prominent pod formation in clusters. Additionally, Anand Bahar demonstrated a lower incidence of Alternaria blight and Bean Common Mosaic Virus (BCMV) diseases, along with reduced infestations of jassid, aphid, and whitefly compared to the national check variety Pusa Navbahar.

### References

- Ahluwat, A., Pahuja S.K and Dhingra H.R. (2013). Studies on interspecific hybridization in *Cyamopsis* species. *African Journal of Agriculture*, **8(27)**, 3590-3597.
- Anandhi, K and Oommen S.K. (2007). Variability, heritability of yield and related characters in cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.). *Legume Research*, **30(4)**, 287-289.
- Dwivedi, N.K. (2009). Evaluation of vegetable guar [*Cyamopsis tetragonoloba* (L.) Taub.] germplasm. *Journal of Arid Legumes*, **6(1)**, 17-19.
- Gillett, J.B. (1958). Indigofera (*Microcharis*) in tropical Africa with the related genera *Cyamopsis* and *Rhyncotropis*. *Kew Bull Add Ser*, **1**, 1-66
- Girish, M.H, Gasti V.D., Shantappa T., Thammaiah N., Mastiholi A.B., Kerutagi M.G. and Mulge R. (2013). Genetic variability studies in cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.). *Karnataka Journal of Agricultural Science*, **26(3)**, 442-443.
- Hymowitz, T. and Upadhyaya M.D. (1963). The chromosome number of *Cyamopsis serratesching*. *Current Science*, **32**, 427-428.
- Jitender, S.K., Pahuja, Verma Naresh and Bhusal Nabin (2014). Genetic variability and heritability for seed yield and water use efficiency related characters in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.]. *Forage Research*, **39(4)**, 170-174.
- Kumar, D. (2005). Status and direction of arid legumes research in India. *Indian Journal of Agricultural Science*, **75**, 375-391
- Kumar, D. and Rodge A.B. (2012). Status, scope and strategies of arid legumes research in India: A Review *Journal of Food Legume*, **25**, 255-272.
- Kumar, D. and Singh N.B. (2002). Guar – an introduction. In: Guar in India. [Kumar D, Singh NB (Eds).], *Scientific Publishers*, Jodhpur, India, 1-10.
- Pathak, R., Singh S.K., Singh M. and Henry A. (2010). Molecular assessment of genetic diversity in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] genotypes. *Journal of Genetics*, **89**, 243-246.
- Rai, P.S., Dharmatti P.R., Shashidhar R.V., Patil R.V and Patil B.R. (2012). Genetic variability studies in cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.). *Karnataka Journal of Agricultural Science*, **25(1)**, 108-111
- Reddy, D.R.P., Saidaiah K., Reddy Ravinder and Pandravada S.R. (2017). Mean performance of cluster bean genotypes for yield, yield parameters and quality traits. *International Journal Current Microbiology Applied Science*, **6(9)**, 3685-3693.
- Sharma, B.S., Bhatnagar K. and Cheema H.A. (1999). Fungal management of stem blight disease of cowpea induced by *Macrophomina phaseolina*. *J. Mycol. Plant Pathol.* **29**, 276.
- Smith, P.M. (1976). *Evolution of Crop Plants* (ed. N. W. Simmonds), Longman, London and New York, 311-312.
- Solanki, Z.S. and Choudhary B.R. (1996). Stability analysis in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.]. *Indian Journal of Agricultural Science*, **66(8)**, 470-473.
- Kumar Vikas and Ram R.B. (2015). Genetic variability, correlation and path analysis for yield and yield attributing traits in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] Genotypes. *International Journal of Pure Applied Bioscience*, **3(1)**, 143-149.
- Vir, Om and Singh A.K. (2015). Variability and correlation analysis in the germplasm of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] In hyper hot arid climate of Western India. *Legume Research*, **38(1)**, 37-42.