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Evaluation of bush type French bean (*Phaseolus vulgaris*) genotypes for growth, yield and quality traits

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Abstract

The present experiment was conducted at Horticulture Research Station, Pandirimamidi, East Godavari district, Andhra Pradesh during *rabi*, 2021-22. The experiment was laid out in Randomized Block Design and replicated twice. Total eighteen genotypes showing bush type growth habit were evaluated for growth, yield and quality traits. Out of eighteen genotypes under the present study, the genotypes EC-398534, EC-398527, IC-556463 and EC-530823 were found to be superior in terms of growth, yield and yield attributing traits. The genotypes EC-398567 and IC-545791 are superior for quality traits.

Keywords: French bean, *Phaseolus vulgaris*, mean performance, genotypes, growth, yield, yield attributing traits, quality traits

Introduction

French bean (*Phaseolus vulgaris* L.) having the chromosome number $2n=22$ is an important legume crop, used as green pod vegetable. It is also known as kidney bean, haricot bean, snap bean, navy bean and string bean or for dry seeds (also known as dry beans). French beans are known to have originated from Central and South America where they are grown as an indigenous crop for the past 5,000 years. Among the 150 species of *Phaseolus*, French bean (*Phaseolus vulgaris*) is the most widely cultivated form. More than 400 cultivars of this crop are now cultivated in the world and it occupies a premier place among grain legumes in the world including India. It belongs to family leguminosae (Fabaceae).

It is a multipurpose crop grown for vegetable, dry seed, fodder and as a canned vegetable (Biswas *et al.*, 2010 and Singh, 2000) ^[1, 3]. It is rich in protein (19-31%) and is closely compared with meat (Joshi and Rana, 1995) ^[2]. They are the rich sources of vitamin A, C and K, folic acid and are having heart protective calcium and fiber. There are three types of French bean based on growth habit. They are bush type with short internodes, semi-pole-type with longer internodes than those in bush type and the pole-type having longer internodes than those of the semi-pole type.

Today, French beans are a common alternative to green beans and other legumes, and are grown around the world. French beans are recognized as valued vegetables in many dietary items. They fight against protein malnutrition, especially in vegetarians. In India, French bean is extensively grown as green pod vegetable for fresh consumption, they can also be used in dry state like the dry bean types. In India, it is primarily grown in Jammu and Kashmir, Himachal Pradesh and in the hills of Uttarakhand.

French bean genotypes having the bush growth habit are desirable because of their early bearing nature and dwarf nature, which requires less spacing and better facilitation of intercultural operations when compared to pole types and semi pole types. Hence, bush type genotypes were considered for this present study.

French bean fetches premium price in market as compared to other vegetables and it is a popular vegetable grown under irrigated conditions almost throughout the year. It is gaining lot of importance due to its short duration and high production potential as well as its high nutritive value. It is one of the most important leguminous vegetables, which is grown for fresh pod consumption and for processing as a frozen vegetable in many countries. The large dry seed type varieties are called as 'Rajmah' in India.

Material and Methods

The experiment was conducted at Horticulture Research Station, Pandirimamidi, Rampachodavaram mandal, East Godavari district. Since, the temperatures and climatic conditions of higher altitude zones were preferable for the cultivation of this crop, the experiment was conducted at Pandirimamidi during *rabi*, 2021-22. The experiment was laid out in Randomized Block Design and replicated twice. Total eighteen genotypes showing bush type growth habit were evaluated for growth, yield and quality traits. All these genotypes were sourced from NBPGR, Shimla. The experimental site was well prepared and all the necessary cultural practices like ploughing, weeding, irrigation, fertilizer application and plant protection measures were followed for the healthy growth of the experimental material. Data on growth, yield and yield attributing characters were collected at appropriate stages and for the quality traits lab analysis was done.

Results and Discussions

The mean values of all the genotypes for growth parameters are presented in the Table 1, for yield and yield attributing parameters in the Table 2 and for quality traits in the Table 3. The tallest plant height at 30 DAS was recorded with the genotype IC-556463 (45.56 cm), the tallest plant height at 60 DAS was recorded for the genotype IC-556451(68.65 cm), the highest number of leaves were recorded in the genotype

IC-556451(312.50), the highest mean leaf area was recorded in the genotype EC-512812 (47.90 cm²), the highest chlorophyll content was recorded in the genotype EC-398527 (46.80), the earliest days to first flowering was observed in the genotype EC-398527 (24.50), the highest percentage of fruit set was recorded in the genotype EC-398527 (86.50%), the highest number of branches were recorded in the genotype IC-545792 (5.73), the earliest days to fifty percent flowering was recorded in the genotype EC-398534(29.75), the highest number of inflorescence were recorded in the genotype EC-398534 (14.84), the highest length of inflorescence was recorded in the genotype EC-398534 (9.30 cm), the highest number of pod clusters per plant were recorded in the genotype EC-398534 (13.00), the highest number of pods per plant were recorded in the genotype EC-398534 (55.00), the highest pod length was recorded with the genotype EC-398534 (17.16 cm), the highest pod girth was recorded in the genotype EC-397824 (3.00 cm), the highest mean weight of fifty pods was recorded in the genotype EC-398534 (214.00 g), the highest number of seeds per pod were recorded in the genotype EC-398534 (6.85), the highest hundred seed weight was recorded in the genotype EC-398534 (59.61 g), the highest pod yield was recorded in the genotype EC-398534 (102.11 g), the highest seed yield was recorded in the genotype EC-398534 (47.61 g) and for the quality traits the genotype EC-398567 (5.00 °brix) and the genotype IC-545791 (24.89%) recorded the highest protein content.

Table 1: Mean performance of bush type French bean genotypes for growth characters

Accession number	Plant height		NOB	LA (cm ²)	CC	NOB
	30 DAS	60 DAS				
EC-397824	31.00	68.54	49.50	28.48	36.10	3.24
IC-547540	33.88	66.31	95.50	22.34	35.25	4.83
EC-530826	34.52	54.94	69.50	34.22	32.20	3.54
EC-398534	43.50	61.43	58.00	23.06	43.95	2.37
IC-545792	32.06	47.32	76.50	14.00	26.10	5.73
IC-556451	40.55	68.65	312.50	18.50	32.20	2.71
EC-398541	34.29	49.34	159.50	36.00	33.50	3.50
IC-556464	24.54	38.02	79.00	21.60	27.75	4.11
EC-398567	28.75	46.54	48.50	28.91	44.90	3.60
IC-398565	27.88	39.44	29.50	13.88	35.40	3.18
EC-398527	22.85	39.83	71.50	16.93	46.80	3.80
IC-556463	45.56	66.82	115.00	22.35	32.85	3.37
EC-530823	29.03	64.88	203.50	26.13	35.20	3.09
EC-512812	33.64	55.41	132.50	47.90	37.20	3.44
IC-545791	32.17	45.78	52.50	38.50	32.66	3.34
EC-398533	21.40	39.45	36.50	18.75	39.10	2.63
IC-545790	30.50	46.63	139.00	15.34	38.95	4.81
EC-502157	42.75	52.99	51.50	28.50	39.30	4.76
Mean	32.72	52.91	98.89	25.30	36.08	3.67
SE(m)±	0.46	0.82	1.68	0.49	0.56	0.05
CD (P=0.05)	1.36	2.44	4.97	1.44	1.64	0.15

Table 2: Mean performance of bush type French bean genotypes for yield attributing and yield attributing traits

Accession number	DFP	DFPF	NOIPP	LOI	PFS	NOPCP	NOPP	PL (cm)	PG (cm)	MWFP (g)	NSPP	HSW	PYPP	SYPP
EC-397824	33.25	39.35	13.30	7.35	73.00	9.85	27.50	12.86	3.00	100.50	6.25	42.00	59.20	26.27
IC-547540	30.87	37.25	12.47	8.97	86.50	8.75	22.50	12.83	1.95	98.25	6.00	41.00	53.45	24.90
EC-530826	33.55	40.00	12.40	5.40	72.00	9.30	26.00	12.00	2.55	98.25	6.00	41.00	55.00	18.70
EC-398534	25.42	29.75	14.84	9.30	86.50	13.00	55.00	17.16	2.30	214.00	6.85	59.61	102.11	47.61
IC-545792	34.75	41.35	7.83	2.83	19.68	2.50	9.50	7.35	2.90	39.00	3.93	20.00	23.98	6.75
IC-556451	27.92	32.67	11.87	5.00	68.50	9.35	26.00	12.50	2.90	89.00	6.66	41.00	56.90	17.78
EC-398541	28.50	32.67	11.01	3.25	64.00	7.65	20.00	13.58	2.05	90.82	6.00	37.40	49.30	12.72
IC-556464	27.00	31.64	8.17	3.25	20.43	2.25	13.50	7.85	2.95	33.50	4.50	24.15	25.03	7.20

EC-398567	31.50	37.25	9.22	4.30	62.97	7.25	19.00	9.77	2.10	58.50	4.90	28.00	31.15	11.01
IC-398565	27.00	36.14	9.11	3.63	28.50	5.00	16.00	9.30	1.00	56.00	4.67	25.50	30.50	10.00
EC-398527	24.50	34.50	14.40	9.27	86.50	11.50	41.00	15.50	2.95	156.00	6.66	57.00	67.50	30.23
IC-556463	31.57	37.25	14.00	6.77	85.00	11.50	39.50	12.75	2.10	133.40	6.00	50.65	65.83	28.94
EC-530823	27.92	32.75	13.64	7.37	85.00	10.83	29.50	13.03	2.00	114.00	6.25	33.50	65.60	13.35
EC-512812	35.25	42.79	10.64	4.73	63.08	7.52	22.25	11.58	2.70	89.00	5.66	36.50	41.25	26.91
IC-545791	34.25	37.00	10.02	4.71	48.50	6.25	27.00	11.00	2.20	85.00	5.50	34.45	37.80	15.20
EC-398533	27.17	31.90	8.99	4.80	21.50	3.50	15.50	8.75	2.00	32.00	5.25	24.50	29.80	7.68
IC-545790	27.67	34.40	9.53	4.60	55.50	6.50	17.50	10.91	2.00	83.50	4.65	30.00	32.67	11.90
EC-502157	34.25	41.60	9.77	4.67	64.00	7.07	19.50	10.75	1.55	70.95	5.50	33.91	35.40	12.70
Mean	30.13	36.12	11.18	5.57	60.62	7.75	24.82	11.64	2.29	91.20	5.62	36.68	47.91	18.33
SE(m)±	0.44	0.59	0.16	0.10	0.93	0.11	0.47	0.17	0.03	1.61	0.08	0.54	0.66	0.32
CD (P = 0.05)	1.31	1.75	0.47	0.29	2.76	0.33	1.39	0.50	0.10	4.77	0.22	1.60	1.95	0.95

DFF – Days to first flowering

NOPCP – Number of pod clusters per plant

NSPP – Number of seeds per pod

DFPF – Days to fifty percent flowering

NOPP – Number of pods per plant

HSW – Hundred seed weight (g)

NOIPP – Number of inflorescence per plant

PL – Pod length (cm)

PYPP – Pod yield per plant (g)

LOI – Length of inflorescence (cm)

PG – Pod girth (cm)

SYPP – Seed yield per plant (g)

PFS – Percentage fruit set (%)

MFWP – Mean weight of fifty pods (g)

Table 3: Mean performance of bush type French bean genotypes for quality traits

Accession number	Total soluble solids (° brix)	Protein content (%)
EC-397824	2.50	23.19
IC-547540	3.50	24.35
EC-530826	4.00	19.00
EC-398534	2.50	17.98
IC-545792	4.50	22.91
IC-556451	3.00	20.43
EC-398541	2.00	19.55
IC-556464	1.00	18.26
EC-398567	5.00	23.30
IC-398565	4.50	21.23
EC-398527	1.00	23.40
IC-556463	2.00	18.85
EC-530823	1.50	21.79
EC-512812	1.50	22.44
IC-545791	1.50	24.89
EC-398533	2.00	22.03
IC-545790	2.00	21.52
EC-502157	1.50	23.08
Mean	2.53	21.57
SE(m)±	0.04	0.33
CD (P=0.05)	0.12	0.97

Conclusion

Based on the experimental results, it was evident that the genotypes EC-398534, EC-398527, IC-556463 and EC-530823 were superior when compared all the other genotypes under the present investigation. The genotypes EC-398534, EC-398527 and IC-556463 can be grown as dual purpose types for both vegetable pods and Rajmah seeds whereas the genotype EC-530823 is preferred for vegetable pods due to its high pod weight and less seed weight. As the genotypes were evaluated for only one season, repetition of the trail is required to know the performance consistency of the genotypes. The superior genotypes can be used for the further crop improvement programme. The genotype IC-545791 can be utilized to combat malnutrition which is prevalent in the tribal zones of Andhra Pradesh due to its highest protein content.

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