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EVALUATION FOR GROWTH AND YIELD TRAITS PERFORMANCE OF BUSH TYPE FRENCH BEAN (*PHASEOLUS VULGARIS* L.)

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ABSTRACT

The present investigation was undertaken in randomized block design with three replications during late *kharif*-2023 at Herbal Garden, College of Agriculture, Raichur. A set of 18 genotypes of bush type French bean viz. Arka Arjun, Arka Komal, Arka Suvidha, EC559573, Malgudi beans, EC13097, FB-117, Anup beans, Willvine contender, Arka Sharath, FBGC-1, FBGC-2, FBGC-3, FBGC-4, Palguni, FBGC-5, FBGC-6, and EC-13099 was evaluated. The data indicated the significant differences with respect to growth and yield among the various germplasm of French bean. The tallest plants and highest number of branches per plant were observed in genotype EC13099 (39.07 cm & 10.37, 48.87 cm & 20.87 and 52.33 cm & 22.37, respectively) at 30, 45, and 60 DAS. Maximum Plant spread was recorded in genotype Arka Komal (917.03, 1527.97 and 1761.87 cm², respectively) at 30, 45 and 60 DAS. Chlorophyll content was recorded significantly higher in genotypes Arka Suvidha (1.01 & 1.93 mg/g, respectively) at 30 and 45 DAS and genotype FB-117 (2.37 mg/g) at 60 DAS. Minimum days taken for first flowering was observed in genotype Arka Suvidha (27.33 days) it was on par with the genotype Arka Komal (27.67 days) whereas, minimum days taken for 50 per cent was observed in genotype Arka Komal (31.33 days) it was on par with the genotype Arka Suvidha (31.67 days). Superior pod length was observed in the genotype Arka Sharath (13.75 cm) and the genotype FB-117 (6.07) has maximum seeds per pod. The greater number of pods per plant was recorded in genotype EC13099 (41.33). However, the genotype Arka Suvidha recorded the highest single pod weight (5.76 g), pod yield per plant (184.13 g) and pod yield per hectare (22.49 t).

Key words: Bush type, French bean, Growth, Yield.

Introduction

French bean (*Phaseolus vulgaris* L.) is a leguminous crop, belongs to family Fabaceae with chromosome number of $2n=2x=22$. According to Vavilov (1950) the primary centre origin of French bean is Southern Mexico and Central America, while Peruvian-Ecuadorian-Bolivian area is considered to be secondary centre. It is originated from wild species *Phaseolus aborigineus* L. It is also known as Snap bean, Kidney bean, Haricot bean and also as called Rajmah in Hindi. Beans are essentially used for their tender green pods. The pods are slender, 10-25cm long, straight or slightly curved with prominent beak. Seeds are kidney-shaped, elongated but somewhat

compressed and white, red, purple or blackish in color. Being a short duration crop, French bean can be grown under different cropping patterns of hills and plains of India. It is a cool season vegetable widely cultivated in temperate and sub tropical region and in many parts of the tropics with a temperature around 21°C. The optimum temperature for better growth is 15-25°C and it can be grown in all types of soils ranging from light sandy loam to clayey soils but it cannot withstand water logging. The nutritive value of the French bean per 100 g of green pod is 1.7 g protein, 0.1 g fat, 4.5 g carbohydrate, 1.8 g fiber and is also rich in minerals and vitamins. Beans are also called as “meat of the poor”.

Materials and Methods

The study was conducted during the late *kharif* season of 2023 and 2024 at the Herbal Garden, College of Agriculture, Raichur. Eighteen bush-type French bean genotypes, including Arka Arjun, Arka Komal, Arka Suvidha, EC559573, Malgudi beans, EC13097, FB-117, Anup beans, Willvine contender, Arka Sharath, FBGC-1, FBGC-2, FBGC-3, FBGC-4, Palguni, FBGC-5, FBGC-6, and EC-13099, were evaluated in a randomized block design with three replications. Each plot measured 5×1 m², with rows spaced 45 cm apart and plants spaced 15 cm apart within rows, accommodating 66 plants per plot. Observations were recorded on ten randomly selected plants from each replication for yield and its associated traits viz., plant height (cm), plant spread (cm²), number of branches per plant, chlorophyll content (mg/g), days taken for first flower initiation, days taken for 50 per cent flowering, number of pods per plant, pod length (cm), single pod weight (g), number of seeds per pod, pod yield per plant (g), pod yield per plot (kg) and pod yield per hectare (t). Analysis of variance was carried out as per the procedure given by Panse and Sukhatme (1967).

Results and Discussion

Growth and flowering parameters

Plant height at 30, 45 and 60 DAS

Significant differences were noticed in plant height among the genotypes of french bean under study at 30, 45 and 60 DAS (Table 1). The maximum plant height was recorded in genotype EC13099 (39.07, 48.87 and 52.33 cm, respectively) at 30, 45 and 60 DAS. It was on par with the genotypes Arka Suvidha (51.90 cm), Palguni (49.85 cm), Arka Sharath (49.70 cm) and Arka Arjun (48.63 cm) at 30 DAS. Arka Suvidha (46.73 cm), Palguni (46.32 cm), Arka Sharath (45.93 cm), Arka komal (45.13 cm), FB-117 (43.97cm), Malgudi beans (43.95 cm) and FBGC-1 (43.87 cm) at 45 DAS and Arka Suvidha (51.90 cm), Palguni (49.85 cm), Arka Sharath (49.70 cm) and Arka Arjun (48.63 cm) at 60 DAS. The lowest plant height was observed in genotype FBGC-6 (21.77, 32.37 and 36.95 cm, respectively) at 30, 45 and 60 DAS. The significant variation in plant height of genotypes may be due to the genetic makeup and inheritance of the character as well as differences in apical dominance, due to rapid cell division and cell elongation, also it might be due to genetic variations among the germplasm since they were grown under same environmental conditions. The present findings are in agreement with the results reported by Whankate *et al.*, (2021), Zelaing *et al.*, (2018) and Das *et al.*, (2014) in French bean.

Plant spread at 30, 45 and 60 DAS

Significant differences were noticed in plant spread among the genotypes of French bean under study at 30, 45 and 60 DAS (Table 1). The maximum plant spread was recorded in genotype Arka Komal (917.03, 1527.97 and 1761.87 cm², respectively) at 30, 45 and 60 DAS. It was on par with the genotypes Arka Sharath (878.90 cm²), Arka Suvidha (865.67 cm²), EC13099 (872.70 cm²) at 30 DAS. However, the minimum plant spread was noticed in genotype FBGC-4 (397.70, 728.83 and 865.23 cm², respectively) at 30, 45 and 60 DAS. The significant difference in plant spread was due to variation in genes and adaptability, which have been influenced by genotypes inherent characteristics. The different genotypes might have different genetic makeup that influence their plant spread potential and environment also had an impact on the plant spread. The results of present findings are in agreement with the results reported by Das *et al.*, (2014) in French bean and Hinge *et al.*, (2015) in Yard long bean.

Number of branches per plant at 30, 45 and 60 DAS

Significant differences were noticed in number of branches among the genotypes of French bean under study at 30, 45 and 60 DAS (Table 1). The maximum number of branches was recorded in genotype EC13099 (10.37 and 20.87). Lowest number of branches was observed in genotype Willvine contender (5.20) and Arka Arjun (11.10) at 30 and 45 DAS, respectively. At 60 DAS genotype EC13099 exhibited highest number of branches per plant (22.37) and it was on par with genotypes Arka Suvidha (20.93) and FB-117 (19.73). And lowest number of branches were recorded in genotype FBGC-5 (16.33). It could be because of the cell division process and vegetative bud bursting, which varies in rate depending on the variety, similar results were reported by Thapa *et al.*, (2024) in Winged bean.

Days taken for first flower initiation

The mean number of days taken for first flowering significantly differed among the genotypes of French bean (Table 1). The data revealed that early flowering was noticed in genotype Arka Suvidha (27.33 days) it was on par with genotype Arka Komal (27.67 days). Whereas, late flowering (38.33 days) was observed in genotype EC13099.

Days for 50 per cent flowering

The mean number of days taken for 50 per cent flowering significantly differed among the genotypes of French bean (Table 1). The data revealed that the minimum days for 50 per cent flowering (31.33 days)

Table 1: Growth and flowering parameters of bush type French bean genotypes.

Geno- types	PH			PS			NBP			CC			DF	DFF
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS		
Arka Arjun	23.98	38.85	48.63	521.07	1112.60	1207.03	6.20	11.10	17.97	1.30	0.82	2.12	31.67	36.33
Arka Komal	35.98	45.13	47.73	917.03	1527.97	1761.87	8.83	14.83	18.77	1.29	0.70	1.99	27.67	31.33
Arka Suvidha	38.32	46.73	51.90	865.67	1273.97	1370.57	9.33	15.33	20.93	1.49	0.87	2.36	27.33	31.67
EC 559573	27.35	40.50	42.93	637.37	1108.47	1196.27	6.83	13.57	16.97	1.25	0.80	2.05	31.67	36.00
Malgudi beans	31.58	43.95	46.02	591.97	1043.14	1132.05	7.47	12.93	16.90	1.23	0.68	1.91	37.33	40.33
EC 13097	23.30	35.90	40.87	534.50	1008.15	1100.00	7.73	14.50	19.17	1.29	0.83	2.12	34.67	39.33
FB-117	35.96	43.97	47.83	794.83	1191.13	1249.82	8.43	15.03	19.73	1.50	0.87	2.37	37.67	42.67
Anup beans	30.65	40.07	42.13	741.60	937.33	1001.00	8.27	14.03	17.17	1.24	0.71	1.95	36.33	39.67
Willivine contender	32.03	34.68	39.57	515.78	840.90	1004.93	5.20	11.56	16.34	0.97	0.46	1.43	33.33	37.33
Arka Sharath	34.73	45.93	49.70	878.90	1205.53	1381.33	6.83	14.57	19.23	1.34	0.83	2.17	36.67	41.33
FBGC -1	33.22	43.87	45.63	702.97	1026.77	1160.23	7.73	11.43	18.67	1.30	0.82	2.12	34.67	40.33
FBGC -2	26.00	39.50	41.23	588.66	863.07	945.90	6.63	11.23	18.07	0.98	0.48	1.46	36.33	40.33
FBGC -3	32.62	37.88	39.28	581.00	858.93	906.90	7.03	13.70	17.91	1.20	0.74	1.94	35.67	39.33
FBGC -4	24.88	35.15	43.97	397.70	728.83	865.23	6.23	14.17	17.00	1.32	0.78	2.10	35.33	39.67
Palguni	36.88	46.32	49.85	765.07	1145.70	1219.68	8.27	17.43	19.50	1.23	0.58	1.81	36.33	40.33
FBGC -5	29.83	41.20	44.23	486.03	1016.13	1138.47	6.63	14.30	16.33	1.26	0.61	1.87	32.67	37.00
FBGC -6	21.77	32.37	36.95	629.82	850.73	1002.83	7.30	14.80	17.21	1.10	0.49	1.59	34.33	38.33
EC 13099	39.07	48.87	52.33	872.70	1132.50	1187.60	10.37	20.87	22.37	1.33	0.76	2.09	38.33	44.33
Mean	31.01	41.16	45.04	667.93	1048.44	1157.32	7.52	14.19	18.35	1.26	0.71	1.97	34.33	38.65
S.Em. ±	1.36	1.78	1.59	23.11	36.51	58.33	0.24	0.77	0.95	0.05	0.03	0.08	1.06	1.23
C.D. @ 5%	3.93	5.13	4.56	66.70	105.39	168.35	0.70	2.22	2.73	0.13	0.09	0.23	3.05	3.54
PH- Plant height; PS- Plant spread; NBP- Number of branches per plant; CC- Chlorophyll content; DF- Days taken for First flowering; DFF- Days taken for 50 per cent flowering														

was observed in genotype Arka Komal it was on par with the genotype Arka Suvidha (31.67 days). Whereas, the maximum days for 50 per cent flowering of (44.33 days) was observed in genotype EC13099. Environmental and genetic factors could be responsible for the variation in days for flowering. It is in accordance with the findings of Whankate *et al.*, (2021).

Yield parameters

Pod length

Significant variation was observed with respect to pod length among the genotypes (Table 2). Maximum pod length was observed in the genotype Arka Sharath (13.75 cm) it was on par with genotypes Arka Arjun

Table 2: Yield and yield attributing parameters of bush type French bean genotypes.

Genotypes	Pod length (cm)	Single Pod weight (g)	No of seeds per pod	Number of pods plant ⁻¹	Pod yield plant ⁻¹ (g)	Pod yield plot ⁻¹ (kg)	Pod yield ha ⁻¹ (t)
Arka Arjun	13.30	5.43	4.93	28.67	128.91	7.17	14.34
Arka Komal	13.09	5.19	5.40	31.89	155.41	7.52	15.04
Arka Suvidha	12.61	5.76	5.73	37.17	184.13	11.24	22.49
EC559573	12.78	4.63	5.07	21.67	92.96	5.44	10.88
Malgudi beans	12.17	4.43	5.13	30.34	140.86	8.76	17.52
EC13097	11.22	4.84	5.07	22.00	101.82	4.75	9.51
FB-117	11.51	4.95	6.07	33.39	162.95	10.01	20.03
Anup beans	12.13	4.85	5.80	22.33	98.86	6.66	13.32
Willivine contender	12.57	4.61	5.33	20.00	85.34	4.17	8.34
Arka Sharath	13.75	5.69	5.73	31.51	170.68	8.86	17.71
FBGC-1	11.70	4.40	5.87	25.00	101.60	6.02	12.04
FBGC-2	12.07	3.83	5.40	21.67	92.67	4.98	9.95
FBGC-3	12.02	3.88	4.80	22.67	98.94	6.55	13.11
FBGC-4	12.21	4.94	4.93	25.67	102.66	7.18	14.37
Palguni	8.97	3.77	5.33	32.67	126.68	7.45	14.90
FBGC-5	12.24	4.74	5.37	19.33	114.46	5.98	11.96
FBGC-6	10.98	4.77	5.33	24.33	119.72	6.32	12.64
EC13099	9.13	3.29	5.67	41.33	124.66	7.22	14.44
Mean	11.91	4.67	5.39	27.31	122.41	7.02	14.03
S.Em. ±	0.39	0.17	0.19	1.19	4.62	0.37	0.74
C.D. @ 5%	1.11	0.50	0.55	3.43	13.34	1.07	2.14

(13.30 cm), Arka Komal (13.09 cm) and EC559573 (12.78 cm). Whereas, minimum pod length was observed in genotype Palguni (8.97). The variation in pod length might be due to genetic makeup of the genotypes and environment condition. Also, might be the inherent characteristic of genotype. Das *et al.*, (2014) and Whankate *et al.*, (2021) reported that pod length in French bean germplasm differed significantly due to variation in genetic makeup of the plant.

Single pod weight

Highest single pod weight was recorded in genotype Arka Suvidha (5.76 g). It was found to be significantly superior over all genotypes, it was on par with genotypes Arka Sharath (5.69 g) and Arka Arjun (5.43 g). Whereas, the lowest pod weight was observed in genotype EC13099 (3.29 g). The significant variation in single pod weight might be due to genetic makeup of the genotypes and environment condition. It is in accordance with the findings of Whankate *et al.*, (2021) and Kalauni *et al.*, (2019) in French bean.

Number of seeds per pod

The genotype FB-117 had maximum seeds per pod (6.07). It was on par with the genotypes FBGC-1 (5.87), Anup beans (5.80), Arka Sharath (5.73), Arka Suvidha (5.73) and EC13099 (5.67). Whereas, the minimum seeds per pod was recorded in genotype FBGC-3 (4.80). The

significant variation in number of seeds per pod might be due to the environmental and genetic factors of different cultivars. Variation in number of seeds per pod is proportional to the pod length. And it also depends on seed size and length. Das *et al.*, (2014) and Whankate *et al.*, (2021) in French bean.

Number of pods per plant

French bean genotypes varied significantly for number of pods per plant (Table 2). The greater number of pods per plant was recorded in genotype EC13099 (41.33), it was on par with the genotype Arka Suvidha (37.17), followed by FB-117 (33.39). Whereas, the smaller number of pods per plant was observed in FBGC-5 (19.33). The vigour and growth of the plant effected the variation in the number of pods per plant. The number of pods on the plant is directly correlated with the number of branches Arora *et al.*, (2011) in cluster bean, Aysun pekson (2004) in Cowpea.

Pod yield per plant

Pod yield per plant analysis of variance shows significant variation among the genotypes (Table 2) here the genotype Arka Suvidha recorded the highest pod yield per plant of (184.13 g), it was on par with genotype Arka Sharath (170.68 g). Whereas, the lowest pod yield per plant was observed in Willivine contender (85.34 g). The highest pod yield per plant might be yield attributing traits

such as the number of flowers and number of pods additionally, single pod weight and pod length may have contributed. These current investigational data are in accordance with the previous findings. Arora *et al.*, (2011) and Kalauni *et al.*, (2019) in French bean.

Pod yield per hectare

The pod yield per hectare significantly varied among the genotypes (Table 2). The highest pod yield per hectare was observed in Arka Suvidha (22.49 t). Whereas, the lowest pod yield per hectare was observed in genotype Willivine contender (8.34 t). The highest pod yield per plot might be influenced by the yield attributing traits such as the number of flowers number of pods; additionally, average pod weight and pod length may have contributed. These research findings are in line with the findings of Aryal *et al.* (2020), Dhakal *et al.*, (2020), Whankate *et al.*, (2021) in French bean.

Conclusion

Sufficient variation with respect to growth, yield, yield attributes and morphological characters were observed among the genotypes of bush type French bean. The genotype Arka Suvidha had significantly highest single pod weight, test weight, pod yield per plant and pod yield per hectare. It was found to be superior over all other genotypes. And the genotypes FB-117 and Arka Sharath were also considered as superior genotypes for yield characteristics.

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