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Genetic variability studies of advanced mutants of French bean (*Phaseolus vulgaris* L.) for horticulture traits

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Abstract
Thirty-five advanced mutant lines of French bean **(***Phaseolus vulgaris* L.) along with one commercial check were evaluated in Randomized Complete Block Design (RCBD) with two replications during *Kharif* 2017-18 at College of Horticulture Bengaluru. Genetic variability, heritability and genetic advance as percent of mean for 20 characters were assessed by field evaluation for all the characters were considered for the study. The analysis of variance indicated presence of significant variability among the genotypes for all the characters. Phenotypic and genotypic coefficients of variation for most of the traits were found moderate to high except for protein content per cent. High heritability along with high genetic advance over mean (GAM) was observed for pod width (cm), followed by pod yield plot (kg) and number of pods per cluster indicating that these traits could be exploited for further improvement through selection procedures. Most of the vegetable traits recorded higher variability among the mutants.

Keywords: French bean, variability, heritability, mutants

1. Introduction
French bean (*Phaseolus vulgaris* L.) having the diploid chromosome number of 22 belongs to the family Fabaceae is also known as snap bean, kidney bean, garden bean. It is an important protein sources in many developing countries including India (Markhart, 1985) [7]. Beans are the "meat of the poor", contribute essential protein to the under nourished people. French bean is an important source of carbohydrate (61.4 %), proteins (17.5-28.5%) and mineral matter (3.2-5.0%). It has significant amount of fiber and supplies minerals like iron, potassium, phosphorus, magnesium, copper etc. It constitutes 84% of the pulses and 65% of total plant and animal sources of protein diets (FAO, 2008)[1]. It is grown for edible pods, consumed as green pod vegetable and as dry seeds. Pods and seeds are rich in proteins and are excellent source of vitamins and minerals. Shelled beans are widely used as pulse and are a good source of vitamin A, B and C. French bean besides being a legume help in fixing atmospheric nitrogen in the soil, thereby improving soil fertility (Singh, 1985)[9]. French bean originated from Central America and Peruvian Andes in South America (Vavilov, 1950) [11]. It was introduced to India in 17th century. It is self-pollinated crop. Plants are dwarf bush or pole type, depending upon growth habit (Vanderplank, 1963) [10]. French bean possesses medicinal properties, which useful against diabetes, certain cardiac problems and a good natural cure for bladder burn. It has both carminative and reparative properties against constipation and diarrhea respectively (Duke, 1981) [4].
In India, French bean is being grown over an area of 2.97 lakh ha with annual production of 27.44 lakh tons. It is extensively grown in Himachal Pradesh, Punjab, Haryana, Uttaranchal, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. (Indiastat, 2022) [12]. Changing cultivated landscapes and cropping pattern coupled with evolving pest and pathogen there is need to improve the crop mutants is a speed and significant breeding method.

2. Material and methods
Thirty five advanced mutants of French bean **(***Phaseolus vulgaris* L.) along with one commercial check "Arka Anoop" released by IIHR, were evaluated in Randomized Complete Block Design (RCBD) with 2 replications were evaluated during *Kharif* 2017-18 at RHREC (Regional Horticulture Research and Extension center), UHS Campus, GKVK, Bengaluru. The experimental block was well prepared and crop was raised at plant spacing of 30 x 15 cm

and recommended dose of fertilizers were applied for the crop at different growth staged. Standard cultural, manurial and plant protection practices were followed to ensure a healthy crop growth. Five random sample plants were tagged in each plot and used for recording the observations of characters. Mean values for all characters were worked out.

3. Results and Discussion

Analysis of variance revealed highly significant differences among genotypes used in the present study for all the characters studied. Maximum range of mean values was observed for yield per plant (235.72 to 408.85) followed by plant height (55.12 to 76.04). The minimum range values was recorded in number of seeds per pod (3.89 to 6.79) followed by pod width (0.43 to 1.13) (Table 1). In general, the phenotypic coefficients of variation were higher than the corresponding genotypic coefficients of variation for all traits indicating the predominant role of environment in the expression of traits under study. The highest estimates of phenotypic and genotypic coefficients of variability were recorded for pod width (2034 to 20.68), whereas moderate coefficients of phenotypic and genotypic variability were recorded for pod yield per hectare, number of branches, plant spread (North-South), plant spread (East-West), number of pods per cluster, number of pods per plant, number of seeds per pod, pod yield per plant, pod yield per plot, protein content and number of flowers per plant. Similar observations were made by Lenkala *et al.* (2015) [5], Lyngdoh *et al.* (2018) [6] and Shah *et al.* (2021) [8]. However, rest of the traits exhibited low estimates of phenotypic and genotypic coefficients of variation.

The range of heritability varied from 53.65 per cent for pod yield per hectare to 99.67 percent for protein content. Heritability along with genetic advance is more helpful in predicting the gain under selection than heritability alone. High heritability associated with high genetic advance over mean was recorded for the traits namely number of branches, plant spread (North-South), plant spread (East-West), number of pods per cluster, number of pods per plant, number of seeds per pod, pod yield per plant, pod yield per plot, average pod weight, protein content (%), pod width (cm), number of flowers per plant. The value of genetic advance over mean varied from 11.36 per cent for plant height 41.19 per cent for pod width. The above results are in conformation with the findings of Devi *et al.* (2018) [3], Lyngdoh *et al.* (2018) [6] and Aklade *et al.* (2018) [2].

4. Conclusion

On basis of results obtained from the present experiment, it can be concluded that the French bean genotypes used has vast genetic variability with narrow differences between genotypic coefficients of variation and phenotypic coefficients of variation, high to moderate heritability and genetic advance over mean for most of the characters, so the selection would be more feasible for these traits.

Table 1: Genetic variability parameters of yield component traits in advanced mutant lines of French bean

Traits	Mean	Range		GCV (%)	PCV (%)	Heritability (%)	GA (%)	GAM (%)
		Minimum	Maximum					
Plant height (cm)	65.32	55.13	76.04	7.53	10.28	70.13	7.42	11.36
Number of branches	8.07	5.08	10.77	15.22	16.69	83.16	2.31	28.59
Number of leaves per plant	63.16	50.39	75.10	9.68	11.26	73.91	10.83	17.15
Plant spread (N-S) (cm)	62.89	44.21	75.48	11.12	11.41	94.92	14.07	22.31
Plant spread (E-W) (cm)	47.77	30.03	56.90	12.24	12.70	92.90	11.61	24.30
Number of pods per cluster	5.06	3.16	6.46	18.25	18.62	96.02	1.86	36.84
Number of pods per plant	29.37	21.08	39.92	18.38	19.26	91.07	10.61	36.13
Number of seeds per pod	5.92	3.89	6.79	11.95	12.22	98.14	1.43	24.08
Pod yield per plant (g)	318.12	235.72	408.85	14.29	14.58	96.17	57.12	28.87
Pod yield per plot (kg)	8.57	4.88	12.70	18.21	18.68	91.23	3.46	38.35
Pod yield per hectare (t/ha)	17.31	9.86	25.66	19.77	19.96	53.65	6.98	40.35
Average pod weight (g)	9.51	7.42	11.86	10.70	11.07	93.46	2.03	21.32
Days to first flowering	31.92	27.00	37.50	9.18	11.02	69.50	5.03	15.77
Days to 50 % flowering	40.05	36.50	44.50	7.14	8.54	69.79	5.04	12.28
Days to first harvest	5-.75	46.00	55.50	6.06	6.90	76.99	6.28	10.95
Protein content (%)	17.81	9.18	23.05	14.90	15.16	96.67	5.38	30.18
Pod length (cm)	15.33	11.20	17.96	10.27	10.98	87.43	3.03	19.78
Pod width (cm)	0.69	0.43	1.13	20.34	20.68	96.66	0.29	41.19
Number of flowers per plant	37.86	28.00	47.50	12.31	15.58	62.47	7.59	20.05
Pod set percentage	78.49	48.93	93.93	10.81	13.83	61.05	13.52	17.40

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