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Studies on Variability in French Beans (*Phaseolus Vulgaris* L.)

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Studies on the variability of frenchbeans revealed wider variations for weight and number of pods per plant and length and diameter of the pod. The genetic analysis showed high genotypic coefficient of variation, genetic variance and genetic coefficient of variation, heritability, as well as genetic advance for weight of pods and number of pods per plant. Thus, the number and weight of pods per plant with additive gene effects would serve as useful indices for selection in french beans. The non-genetic factors are more in other charecters.

The improvement of crops largely depends on the magnitude of genetic variability and the extent to which desirable characters are heritable. The information on range of variability present in respect of different quantitative characters especially, when grouped on the basis of heritable and non-heritable traits, is of great importance to the plant breeder as the success of phenotypic selection depends on the range of genetic diversity present in the population.

Frenchbean is an important legume crop cultivated extensively in hills as well as in plains. It is grown almost throughout the year in the hills and in plains during cooler parts of the year. Little attempt has been previously made to study quantitative variation in the economic characters in french beans. An attempt was, therefore, made in the present investigation to explore genotypic variability of some quantitative characters in twenty varieties of frenchbeans and the results are presented here under.

MATERIAL AND METHODS

Twenty varieties of french beans were grown at the Horticultural Research Station, Kodaikanal during May to August 1978. A spacing of 30 × 10 cm. was adopted. The varietal trial was laid out in a randomised replicated block design with four replications. The cultural practices and plant protection measures were uniform for all the varieties included in the study. Fifteen plants were selected at random and observations were made on length of the pod, diameter of the pod, number of seeds per pod, weight of seeds per pod, number of pods per plant, weight of pods per plant and shelling percentage. The data were subjected to statistical analysis.

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The genotypic variance was calculated using the formula, $\sigma^2 g = \frac{\sigma ph - \sigma^2 e}{r}$ were $\sigma^2 g$, $\sigma^2 ph$ and $\sigma^2 e$ were genotypic and error variances respectively and was the number of replications. Genotypic coefficient of variation defined as the genotypic standard deviation and expressed as percentage of general mean was calculated by using the formula as suggested by Burton (1952).

$$GCV = \frac{\sigma g \times 100}{\bar{X}}$$ where, σg, = genotypic standard deviation $\bar{x}$ = population mean. Heritability in the broad sense is the ratio of genotypic variance (Burton and Devane 1953).

The expected genetic advance and the genetic advance as percent of mean were calculated by using the formulae as suggested by Johnson *et al* (1955).

$$GA = \frac{\sigma^2 g}{\sigma 2ph} \times K\sigma Ph$$ where, σPh is the phenotypic standard deviation and K is the selection differential which is 2.06 for broad sense.

GA as per cent of mean $\frac{GA \times 100}{mean}$

RESULTS AND DISCUSSION

The analysis of variance presented in Table I showed that all the seven parameters recorded in the study were highly significant exhibiting wide variations among the varieties. The range was wide for most of the characters, the weight of pods per plant exhibiting the maximum variation. This is further evidenced by the coefficient of variation which was 35.06 per cent for weight of pods per plant followed by number of pods per plant (25.39 per cent). The wide variation in the weight of pods per plant which is the marketable produce offer greater scope for selection.

The variance presented in Table II showed that the weight of pods per plant exhibited the highest phenotypic as well as genotypic variances (2011.58 and 1860.57 respectively) followed by shelling percentage, number of pods per plant and length of the pod. The variance for the other three characters viz. diameter of the pod, number of seeds per pod and weight of seeds per pod was very low. Considering the phenotypic and genotypic coefficient of variation of the different characters, the weight of pods per plant again exhibited the highest values of 32 09 and 30.86 per cent respectively followed by number of pods per plant (20.85 and 18.92 per cent respectively). Seth *et al*. (1972) and Sharma *et al*. (1977) reported high genotypic coefficient of variation for weight of pods per plant in french beans.

The heritability estimate (Table II) which helps in determining the heritable portion of variation ranged from 76.51 to 100.00 percent, the diameter of the pod registering the highest heritability of 100.00 per cent followed by length of pods (94.12 per cent) and weight of

pods (92.49 per cent). Seth *et al.* (1972) recorded the highest heritability of 78.09 per cent for weight of pods while Sharma *et al.* (1977) reported the highest heritability of 83.19 per cent for number of pods and length of pod (80.0 per cent).

The genotypic coefficient of variation together with heritability estimate would give a clear picture of the extent of advance to be expected from selection (Burton, 1952). In the present study, the weight of pods per plant and number of pods per plant registered high genotypic coefficient of variation and heritability, thus, offering greater scope for selection. Though the heritability was very high in diameter of the pod and length of pod, the genetic coefficient of variation was low, indicating limited scope for selection because of low variability.

Johnson *et al.* (1955) and Lerner (1958) were of the view that the heritability estimates when used in conjunction with genetic advance, would provide a better information than the heritability estimate alone. In the present investigation, the genetic advance as per cent of mean was the highest (61.14) in weight of pods per plant with a heritability estimate of 92.49 per cent, while the number of pods per plant, diameter of the pod and length of the pod accounted for 35.42, 29.90 and 29.44 per cent of genetic advance with 82.73, 100.00 and 94.12 per cent heritability. Thus, the weight of pod with high additive gene effect was the single character forming the most reliable index for selection. The other character which may help in the selection is the number of pods per plant which accounted for maximum genetic variation, heritability and genetic advance as per cent of mean. Sharma *et al.* (1977) suggested that number of pods and weight of pods formed good indices for selection in french beans while Aggarwal and Singh (1973) found that the pods per plant was not reliable index for selection in kidney bean.

Though the heritability estimates are fairly high in number of seeds per pod, weight of seeds per pod and shelling percentage, the genetic advance as per cent of mean were relatively low indicating that they are influenced by other factors and may not form reliable indices for selection.

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TABLE I Analysis of variance for seven parameters in french beans.

Characters	Mean	Range	C.V.	"F" value	SED	CD
Length of the pod (cm)	14.88	10.93-19.00	16.42	16.85**	0.78	1.56
Diameter of the pod (cm)	0.97	0.75-1.27	14.23	36.84**	0.03	0.06
No. of seeds/pod	5.12	3.4 - 6.0	12.34	9.69**	0.26	0.52
Weight of seeds/pod (g)	2.55	1.99-3.07	12.08	6.5 **	0.14	0.28
Shelling percentage	53.14	36.93-66.25	19.70	4.26**	5.54	11.08
No. of pods/plant	18.55	10.9 -23.0	25.39	5.78**	2.27	4.54
Weight of pods/plant (g)	139.77	51.1 -196.3	35.06	13.32**	17.38	34.76

TABLE II Variance, Coefficient of variation, heritability and genetic advance for seven characters in french beans.

Characters	Variance		Coefficient of Variation		Heritability (per cent)	Genetic advance	Genetic advance as per cent of mean
	Phenotypic	Genotypic	Phenotypic	Genotypic			
Length of the pod (cm)	5.10	4.80	15.17	14.72	94.12	4.38	29.44
Diameter of the pod (cm)	0.01	0.02	14.54	14.54	100.00	0.29	29.90
No. of seeds/pod	0.32	0.28	11.05	10.33	87.50	1.02	19.92
Weight of seeds/pod (g)	0.07	0.06	10.39	9.61	85.71	0.47	18.43
Shelling percentage	65.39	50.03	15.22	13.31	76.51	12.74	23.97
No. of pods/plant	14.88	12.31	20.85	18.92	82.73	6.57	35.42
Weight of pods/plant (g)	2011.58	1860.57	32.09	30.86	92.49	85.46	61.14