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Genetic Variability for Structural and Economic Traits in French Bean (*Phaseolus vulgaris* L.)

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A B S T R A C T

The genetic variability and heritability were carried out 66 genotypes of French bean (*Phaseolus vulgaris* L.). A degree of variation was observed for structural and economic traits such as plant height, number of pods per plant, number of seeds per pod and green pod yield per plant. High PCV was observed for pod weight, number of pods per plant, number of seeds per plant and green pod yield per plant. High GCV was observed for pod weight, number of seeds per plant and green pod yield per plant. High heritability coupled with high genetic advance as per cent mean was observed for plant height at 60 DAS, number of branches per plant at 60 DAS, pod length, pod weight, number of pods per plant, hundred seed weight and green pod yield per plant. The estimates of genetic parameters revealed scope for further improvement of green pod yield by selection.

Introduction

French bean (*Phaseolus vulgaris* L., 2n=22) of family Leguminosae is a nutritious vegetable consumed as tender pods, shelled beans and dry beans. It has evolved from wild growing vine distributed in the high lands of Middle-America and Andes. Number of varieties has been recommended for cultivation in different parts of the country. Genetic variability is an important criteria for yield and contributing traits while making selection. The presence and magnitude of genetic variability in a gene pool is the prerequisite of breeding programmes (Tiwari *et al.*, 2011). Heritability of a trait is important in determining its response to selection. It was found out earlier that genetic improvement of plants for quantitative traits requires reliable estimate of heritability in order to plan an efficient breeding programme. Selection of superior parents with high heritability and genetic advance for various characters is an essential prerequisite for any yield improvement programme (Khan *et al.*, 2008). Therefore, for further improvement evaluation of available genetic variability is prerequisite for planning the crop improvement programme. Knowledge of the nature and magnitude of variation provide rationale choice of character(s) on which selection can be

practiced. The observed variability is a combined estimate of genetic and environmental factors, of which the former is heritable and responds to selection. However the estimate of heritability alone does not provide an idea about the expected gain in the next generation, therefore it has to be considered in conjugation with genetic advance. Hence, the present investigation was carried out to analyze variability for growth and yield characters of French bean.

Materials and Methods

The present study was carried out to assess the variability and character association in 66 diverse genotypes of French bean. The 66 genotypes were grown in a simple RCBD with two replications at Kitture Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot. Arabhavi is situated in Northern dry Zone of Karnataka state at 16°15' North Latitude, 74°45' East Longitude and at an Altitude of 612.03 meters above the mean sea level and comes under zone-3 of region-2 among the agro-climatic zones of Karnataka. Ridges and furrows were opened at a distance of 30 cm. Seeds of each genotype were dibbled at a distance of 10 cm in a row. Observations were recorded on the five plants chosen at random in each cross and in each replication. The mean of five plants were taken for analysis in each genotype and observations were recorded. The variance components and coefficients of variation were computed as per Burten (1952). The heritability in broad sense and expected genetic advance were determined by using the formula given by Johnson *et al.*, (1955).

Results and Discussion

The analysis of variance for different quantitative characters for 66 genotypes of French bean results indicated that there was highly significant (P=0.01) difference among all the genotypes for all the characters (Table 1). This indicated the presence of high degree of variation within the genotypes. Similarly, highly significant variations for all characters are reported by Makhdoomi and Dar (2011) and Kamaluddin and Shahid (2011) in French bean. One of the ways by which variability in these characters is assessed through a simple approach of examining the range of variations. Range of variation observed for all the traits in the present study (Table 2) indicated the presence of sufficient amount of variation among the genotypes for all the characters.

High PCV was observed for pod weight (22.96), number of pods per plant (26.87), number of seeds per plant (33.17) and green pod yield per plant (25.72). High GCV was observed for pod weight (21.46), number of pods per plant (21.00), number of seeds per plant (20.53) and green pod yield per plant (21.63) where as low PCV was recorded for days to fifty per cent (3.77) and low GCV were observed for number of branches per plant at 30 DAS (4.92), and days to fifty per cent flowering (2.83) indicating the existence of limited variability in the germplasm evaluated for the trait indicating low genetic variability in the germplasm stock studied.

This necessitates need for generation of new variability for these characters and high PCV and GCV were recorded for pod weight, number of seeds per plant and green pod yield per plant, indicating maximum amount of variability present in the germplasm in these characters. Moderate PCV and GCV were recorded for the characters like plant height both at 30 and 60 DAS, pod length and hundred seed weight, indicating the existence of limited variability in the germplasm evaluated for these traits. The higher estimates of PCV than the GCV indicated towards the environmental influence in the expression of all the characteristics.

Table.1 Analysis of variance (mean squares) for different growth and yield parameters in French bean

Character	Plant height at 30 DAS (cm)	Plant height at 60 DAS (cm)	Number of branches at 30 DAS	Number branches at 60 DAS	Pod weight (g)	Pod length (cm)	Number of pods per plant	Number of seeds per plant (g)	100seed weight (g)	Days to 50 % flowering	Green pod yield per plant(g)
Replication	133.20	154.21	0.98	0.68	0.10	0.33	471.06	390.74	0.05	8.86	163.12
Treatment	96.40**	137.75**	0.31**	2.48**	2.72**	4.16**	17.78**	56537.3**	63.32**	3.93**	458.36**
Error	29.13	23.71	0.25	0.55	0.18	0.55	14.80	6719.54	1.57	1.10	78.64
S.Em±	3.82	3.44	0.29	0.52	0.30	0.52	2.06	7.19	0.89	0.74	6.27
C.D. at 5%	10.78	9.73	0.82	1.48	0.86	1.48	5.81	20.31	2.51	2.10	17.71
CV (%)	12.17	8.11	11.43	12.38	8.18	6.98	17.81	17.20	2.91	2.49	13.92

**=Highly significant (1%)
DAS= days after sowing

Table.2 Range, mean, estimates of components of variance, heritability and genetic advance for growth and yield parameters in French bean

Sl. No.	Character	Range		Mean	GV	PV	PCV (%)	GCV (%)	h^2 (%)	GA	GAM (%)
		Minimum	Maximum								
1	Plant height at 30 DAS (cm)	29.67	59.58	44.34	33.63	62.76	17.87	13.08	53.6	8.75	19.73
2	Plant height at 60 DAS(cm)	37.50	72.92	60.06	57.01	80.73	14.96	12.57	70.6	13.07	21.76
3	No. of branches per plant at 30 DAS	2.99	4.67	3.59	0.031	0.27	14.56	4.92	11.4	0.12	3.34
4	No. of branches per plant at 60 DAS	3.58	8.25	5.99	0.964	1.51	20.54	16.40	63.7	1.61	26.88
5	Pod weight (g)	3.00	7.70	5.25	1.268	1.45	22.96	21.46	87.3	2.17	41.33
6	Pod length (cm)	6.67	13.41	10.63	1.802	2.35	14.43	12.60	76.6	2.42	22.77
7	No. of pods per plant	10.17	22.50	16.32	5.75	14.34	26.87	21.00	70.1	0.76	4.66
8	No. of seeds per plant	27.00	111.00	59.05	145.59	430.22	33.17	20.53	38.3	12.45	21.08
9	100 seed weight (g)	23.00	63.05	43.20	30.87	32.44	13.19	12.86	95.1	11.16	25.83
10	Days to 50% flowering	38.68	44.56	42.08	1.41	2.51	3.77	2.83	56.2	1.84	4.37
11	Green pod yield plant (g)	33.88	97.08	63.70	189.85	268.49	25.72	21.63	70.7	23.87	37.47

GV- Genotypic variance
PV- Phenotypic variance
GCV- Genotypic co-efficient of variation
PCV- Phenotypic co-efficient of variation
h^2- Broad sense heritability
GA- Genetic advance
GAM- Genetic advance as per cent of mean
DAS- Days after sowing

However, effectiveness of selection for any character depends not only on the amount of phenotypic and genotypic variability but also on estimates of broad sense heritability. High heritability in broad sense is useful in identifying appropriate character for selection and enables the breeder to select superior genotypes on the basis of phenotypic expression of quantitative traits.

In this study, heritability ranged from 9.1 per cent (number of pods per plant) to 95.1 per cent (hundred seed weight). High heritability was noticed for plant height at 60 DAS (70.60%), number of branches per plant at 60 DAS (63.70%), pod weight (87.30%), pod length (76.60%), number of pods per plant (70.10%), hundred seed weight (95.10%) and green pod yield per plant (70.70%), indicating that these characters are less influenced by environmental factors and are under the control of additive gene effect and selection for improvement of such characters would be rewarding.

Burten (1952) suggested that GCV along with heritability estimates would provide a better picture of the amount of advance expected by phenotypic selection. Heritability estimates in conjunction with genetic gains are more effective and dependable in predicting the improvement through selection (Johnson *et al.,* 1955). Since the units of measurements influence the magnitude of genetic advance (GA), the GA as per cent of mean is considered as an essential selection parameter. High genetic advance as per cent mean was observed for plant height at 60 DAS (21.76%), number of branches per plant at 60DAS (26.88%), pod weight (41.33%), number of pods per plant (21.00%), number of seeds per plant (21.08%), hundred seed weight (25.83) and green pod yield (37.47%), indicating that these characters are controlled by additive gene action. Thus, selection for these characters will improve the yield.

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