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Studies on Genetic Variability, Association of Characters and Path Analysis in French Bean (*Phaseolus vulgaris* L.)

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ABSTRACT

In the present investigation the genotypic correlation coefficients were slightly higher than phenotypic correlation coefficients. The analysis of variance revealed highly significant differences among the genotypes for all the twelve characters under studied, indicated the wide range of genetic variability in the existing material. The characters viz., harvest index, number of pods per plant, 100-seed weight, pod length, number of secondary branches per plant, number of primary branches per plant, number of seeds per pod, plant height, days to maturity and days to 50 per cent flowering showed significant positive correlation with seed yield per plant. In the association among component characters, days to 50 per cent flowering significantly and positively correlated with days to maturity, plant height, 100-seed weight whereas, protein content was negatively significant. Days to maturity correlated with plant height, 100-seed weight and harvest index. Path analysis revealed that harvest index, number of seeds per pod, pod length, days to maturity and number of secondary branches per plant recorded the maximum and positive direct effects on seed yield per plant and their association with seed yield per plant were also highly significant and positive.

Key words: *Correlation, Path Analysis, Variability, French Bean.*

INTRODUCTION

French bean is one of the most important leguminous crop used for grain as well as green pod vegetables, belonging to family *Leguminoceae,* sub family *papillionaceae.* . There is need to organized strong and efficient breeding programme to develop high yielding and good quality varieties of french bean, which comes under pulses crops. Rajmash bean is also known as French bean kidney bean, field bean, snap bean, string bean and dried pulses is called Rajmash seems to hold in Agriculture to meet out the challenges of under nutrition to much extent. The yield of french bean in India remain at low level and production is either stagnant or dropping might be due to lack of high yielding varieties. A critical assessment of nature and magnitude of variability and characters association is one of the important pre-requisites in formulating efficient breeding methods.

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The systematic breeding programme involves the steps like creating genetic variability, practicing selection and utilization of selected genotypes to evolve promising varieties. The large spectrum genetic variability in segregating populations depends on the level of genetic differences among genotypes offer better scope for selection. The knowledge of association among the yield and yield contributing characters would be of great help in constructing a suitable plant type and in planning breeding programme. However, the correlation coefficient does not give any indication about comparative magnitude of contribution made by various component characters Therefore, genotypic path coefficient analysis as outlined by Dewey and Lu[6] was carried out to find the direct and indirect effects of yield components and their correlation with seed yield per plant.

MATERIALS AND METHODS

The present investigation was conducted at Botany Farm, College of Agriculture, Pune-5, during *kharif*, 2014. The experiment was laid in Randomized Block Design with three replications. Each entry was represented by a single row of 4.5 m length with a spacing of 30 cm between rows and 10 cm between the plants. All the crop management and plant protection operations were carried out as per recommended package of practices. The observations were recorded on the five randomly selected plants for characters *viz.*, days to 50 per cent flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, pod length, number of pods per plant, number of seeds per pod, 100-seed weight, harvest index, protein content and seed yield per plant. The mean of five plants were subjected to statistical analysis. The data were analyzed by using ANOVA and genetic parameters such as PCV and GCV and heritability in broad sense (h^2) were calculated by the formula given by Burton[3] and genetic advance as per cent of mean (genetic grain) were workout by as suggested by Johnson *et al.*[7]. The phenotypic and genotypic correlation coefficients were calculated according to the method suggested by Singh and Chaudhary[14] and path coefficient analysis was carried out as per the Dewey and Lu[6].

RESULTS AND DISCUSSION

Analysis of variance revealed highly differences for yield and yield contributing components, indicating presence of good amount of genetic variability. It was revealed that the genotypic correlation coefficients were greater in magnitude, than the phenotypic correlation coefficients (Table 1). It was observed that the estimates for genotypic coefficient of variation (GCV) were lower than the phenotypic coefficient variation (PCV) for all the characters. The highest GCV and PCV was recorded for plant height, followed by days to 50 per cent flowering, number of secondary branches per plant, number of primary branches per plant, number of pod per plant, number of seed per pod and harvest index. The character protein content recorded magnitudinally lowest GCV and PCV, followed by pod length, 100-seed weight, days to maturity, and seed yield per plant. Dahiya *et al.*[4] reported highest GCV and PCV for days to 50 per cent flowering, plant height and number of primary branches per plant; Singh *et al.*[14] reported for number of branches per plant number of pods per plant and number of seeds per pod and Asati and Singh[1] for number of pods per plant and plant height;

The highest magnitudinal difference between GCV and PCV was recorded for harvest index (3.61), followed by pod length (2.66), 100-seed weight (2.63), seed yield per plant (2.45), days to maturity (1.9) and pod per plant (1.82), whereas lowest difference between GCV and PCV was found for protein content (0.16). (table.1). Highest heritability was observed for plant height, followed by days to 50 per cent flowering, protein content and number of secondary branches per plant, number of seeds per pod, number of primary branches per plant, number of pods per plant, seed yield per plant, days to maturity, harvest index and 100-seed weight. The lowest heritability was recorded for pod length.In the

present investigation, significant positive correlation were observed between seed yield per plant with harvest index followed by number of pods per plant, 100-seed weight, pod length, number of secondary branches per plant, number of primary branches per plant, number of seeds per pod, plant height, days to maturity and days to 50 per cent flowering. Mishra *et al.*[10] reported that seed yield was significantly and positively correlated with number of pods per plant, pod length, number of seeds per pod. Shinde and Dumbre[12] reported that seed yield per plant was positively and significantly correlated with days to maturity, plant height, number of seeds per pod; Bhushan *et al*.[2] reported seed yield per plant showed positive and significant correlation with number of pods per plant, pod length and 100-seed weight; Karasu and Oz[9] reported that seed yield per plant was positively and significantly correlated with number of pods per plant, number of seeds per pod, pod length and plant height. However, the character protein content showed negatively and non-significant correlation with seed yield per plant.In the association among component characters, days to 50 per cent flowering significantly and positively correlated with days to maturity, plant height, 100-seed weight whereas, protein content was negatively significant. Days to maturity correlated with plant height, 100-seed weight and harvest index. Bhushan *et al.*[2] reported days to 50 per cent flowering had significant positive correlation with days to maturity and plant height. Shahid and Kamaluddin[12] reported days to 50 per cent flowering was positively and significantly correlated with plant height. Number of pods per plant had significant and positive correlation with number of seeds per pod, harvest index and 100-seed weight. Number of seeds per pod showed positive significant correlation with harvest index and 100-seed weight. 100-seed weight exhibited positive significant correlation with harvest index. Shahid and Kamaluddin[12] reported number of pods per plant positively significantly correlated with number of seeds per pod. These results suggested the inter dependency of these characters on each other (Table.2).The path coefficient analysis indicated that harvest index, number of seeds per pod, pod length, days to maturity and number of secondary branches per plant were recorded the maximum and positive magnitude to direct effects on seed yield per plant and their association with seed yield per plant were also highly significant and positive, indicating the facts that t5here exists a true and perfect association between these characters (Table 2). Kamaluddin and Shahid[8] reported that days to 50 per cent flowering, number of pods per plant, pod length and 100-seed weight had direct effects on seed yield per plant; Rai *et al*.[11] reported that number of pods per plant had maximum direct effect toward seed yield per plant and Dahiya *et al*.[4] reported that number of seeds per pod had direct influence and highly significant on seed yield per plant. Number of pods per plant had negative significant direct effect and was positively and significantly correlated with seed yield per plant. It exhibited negative indirect effects *via* number of seeds per pod, pod length, number of secondary branches per plant, number of primary branches per plant, harvest index and 100-seed weight. Mishra *et al*.[10] reported indirect effects for pod length and harvest index.The yield component 100-seed weight recorded minimum negative direct effect but was significantly and positively correlated with seed yield per plant. These findings suggested, indirect selection of 100-seed weight for yield improvement. Whereas, the trait number of pods per plant exhibited the maximum negative and significant magnitude of direct effect on seed yield per plant.(Table.3) In the present investigation the analysis of variance revealed highly significant differences among the genotypes for all the twelve characters under studied, indicated the wide range of genetic variability in the existing material selected for present investigation. Thus, there is a ample scope for selection of genotypes regarding different characters for French bean improvement. Association of characters and path analysis revealed that harvest index, number of seeds

per pod, pod length, days to maturity and number of secondary branches per plant were good indicators of yield per plant in French bean and can be used for making direct selection for yield.

Table 1: Estimates of genetic parameters for twelve characters in French bean

Characters	Phenotypic coefficient of variation (PCV)	Genotypic coefficient of variation (GCV)	Heritability (h^2) % (bs)	GA	GA as per cent of mean
Days to 50 % flowering (No.)	28.25	27.57	95	22.16	55.42
Days to maturity (No.)	14.66	12.76	76	17.58	22.88
Plant height (cm)	42.16	41.30	96	36.49	83.34
Primary branches per plant (No.)	25.01	23.42	88	1.32	45.17
Secondary branches per plant (No.)	26.55	25.77	94	2.27	51.54
Pod length (cm)	11.87	9.21	60	1.29	14.72
Pods per plant (No.)	24.62	22.80	86	3.78	43.48
Seeds per pods (No.)	21.65	20.70	91	1.74	40.77
100-seed weight (g)	13.54	10.91	65	5.83	18.12
Harvest Index (%)	23.76	20.15	72	17.27	35.18
Protein content (%)	5.28	5.12	94	2.30	10.24
Seed yield per plant (g)	19.75	17.30	77	2.88	31.23

Table 2: Genotypic correlation coefficient of 12 characters in 50 genotypes of French bean

Observations	Days to maturity (No.)	Plant height (cm)	Primary branches per plant (No.)	Secondary branches per plant (No.)	Pod length (cm)	Pods per plant (No.)	Seeds per pod (No.)	100 - seed weight (g)	Harvest index (%)	Protein content (%)	Seed yield per plant (g)
Days to 50% flowering (No.)	0.866**	0.289**	-0.058	0.037	0.092	0.005	-0.060	0.244**	0.155	-0.243**	0.191*
Days to maturity (No.)		0.365**	-0.037	0.029	0.145	0.041	-0.067	0.358**	0.174*	-0.220**	0.263**
Plant height (cm)			0.114	0.222**	0.192*	0.297**	0.232**	0.325**	0.278**	-0.095	0.288**
Primary branches per plant (No.)				0.924**	0.809**	0.845**	0.919**	0.647**	0.724**	0.047	0.724**
Secondary branches per plant (No.)					0.812**	0.849**	0.917**	0.698**	0.714**	0.006	0.748**
Pod length (cm)						0.874**	0.819**	0.760**	0.683**	-0.035	0.758**
Pods per plant (No.)							0.920**	0.779**	0.818**	0.075	0.819**
Seeds per pod (No.)								0.685**	0.695**	0.048	0.698**
100- seed weight (g)									0.765**	-0.141	0.798**
Harvest index (%)										0.044	0.923**
Protein content (%)											-0.005

Table 3: Direct (diagonal) and indirect (above and below diagonal) path effects of different characters towards seed yield at genotypic level in French bean

Sr. No.	Days to 50 % flowering (No.)	Days to maturity (No.)	Plant height (cm)	Primary branches per plant (No.)	Secondary branches per plant (No.)	Pods length (cm)	Pods per plant (No.)	Seeds per pod (No.)	100-seed weight (g)	Harvest index (%)	Protein content (%)	Correlation with seed yield per plant (g)
Days to 50% flowering (No.)	**-0.356**	-0.308	-0.103	0.021	-0.013	-0.033	-0.002	0.021	-0.087	-0.055	0.087	0.191*
Days to maturity (No.)	0.344	**0.397**	0.145	-0.015	0.011	0.058	0.016	-0.027	0.142	0.069	-0.088	0.263**
Plant height (cm)	-0.015	-0.019	**-0.052**	-0.006	-0.011	-0.010	-0.015	-0.021	-0.017	-0.014	0.005	0.288**
Primary branches per plant (No.)	0.036	0.023	-0.072	**-0.632**	-0.584	-0.511	-0.534	-0.581	-0.409	-0.458	-0.030	0.724**
Secondary branches per plant (No.)	0.010	0.007	0.057	0.239	**0.258**	0.210	0.219	0.237	0.180	0.184	0.002	0.748**
Pod length (cm)	0.043	0.067	0.089	0.376	0.378	**0.465**	0.407	0.381	0.354	0.319	-0.016	0.758**
Pods per plant (No.)	-0.004	-0.030	-0.216	-0.615	-0.618	-0.636	**-0.728**	-0.669	-0.567	-0.595	-0.055	0.819**
Seeds per pod (No.)	-0.032	-0.036	0.124	0.492	0.490	0.438	0.492	**0.535**	0.366	0.372	0.026	0.698**
100-seed weight (g)	-0.067	-0.098	-0.089	-0.177	-0.191	-0.208	-0.212	-0.187	**-0.273**	-0.209	0.038	0.798**
Harvest index (%)	0.223	0.250	0.400	0.043	0.918	0.984	0.849	0.890	0.910	**0.985**	0.064	0.923**
Protein content (%)	0.009	0.008	0.004	-0.002	-0.000	0.001	-0.003	-0.002	0.005	-0.002	**-0.038**	-0.005

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