IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 18, Issue 2 Ser. 1 (February 2025), PP 59-64
www.iosrjournals.org

"Genetic evolution of different genotypes of French bean (*Phaseolus vulgaris* L)"

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Abstract
In the current study, 23 germplasms of French bean were used during the rabi season of 2021-22 at Agriculture Research Farm Nidharia, S.M.M. TOWN PG College, Ballia (UP). The Analysis of variance showed a highly significant difference between the treatments for all the characters under the study. The genotypes such as Arka Sarath, Kashi Rajhans, Kashi Sampann, Arka Anmol and Contender produce the highest seed yield. Thus, these genotypes can be used as donor parents in breeding programmes and can be beneficial for transferring the desired gene. The highest amounts of GCV and PCV were observed for plant height, seed yield per plant, biological yield and number of pods per plant. Heritability in a broad sense for eleven characters studied, which ranged from 99.83 to 34.44 per cent. The maximum heritability was observed for plant height, test weight, pod length, biological yield, Days to 50 per cent flowering, harvest index, days to maturity and number of pods per plant. Maximum Genetic advance was reported for plant height. The seed yield per plant was positive and highly significant with the number of branches per plant, Number of pods per plant, pod length, biological yield, test weight and harvest index. The result revealed that these traits may serve as effective selection attributes during selection in breeding programmes for yield improvement.

Keywords. *French bean, analysis of variance, harvest index and heritability.*

I. Introduction

French bean (Phaseolus vulgaris L. 2n=2x=22) is a self-pollinated crop. It is an important legume crop to be used as a green pod vegetable known by various names as Snap bean, string bean, garden bean and fresh bean, while dry seeds are known as dry bean. The dry seed type varieties are called 'Rajmash' in India. In dry states like dry bean types, Pinto, kidney, pink, small red, etc. terms are also used.

French bean belongs to the family Fabaceae and it is a highly nutritious vegetable rich in Vitamins, particularly vitamin C and provitamin A and minerals such as calcium, phosphorus, potassium, magnesium and iron. French bean is valued as a green vegetable as well as a dry seed. Pods contain pectic substance as calcium pectate, 9-15 per cent on a dry state basis. With maturity of pods, the carotenes, thiamine and Riboflavin decrease while as ascorbic acid, copper, phosphorus and protein are found to increase. The dry seeds are rich in protein and are closely compared with meat but lack in nutritionally essential amino acids like tryptophan and methionine. The green pods are mildly diuretic and contain a substance that reduces blood sugar levels. It is used in the treatment of diabetes. The seed is diuretic, hypoglycaemic and hypotensive. It is used externally in the treatment of ulcers. French bean also reduces cardiovascular Collen, cancer and regulate the blood sugar and boost the immune system, bone health and it is a good source of fibre and folic acid. French bean is a nutritious legume and a short-duration vegetable crop.

French bean is quite popular among the farmers of India. It is being grown all over the country for its tender pods as well as for mature seeds and dry hay, silage and green manures, and plants can be fed to cattle after harvest (Kakon *et al., 2016).* Besides being used as a vegetable and pulse,it improves soil fertility by fixing atmospheric nitrogen through the presence of Rhizobium bacteria. Molybdenum is an essential element that acts as an essential cofactor in stimulating N- fixing activity of *Phaseolus vulgaris L.* (Vakhaiya *et al.,1990;* Reyes *et al.,*2016). Various mechanisms are involved to select the most suitable plant types for yield quality and apply the most suitable breeding method to develop modern varieties. It is therefore essential that germplasm should be chosen on the basis of their phenotypic and genotypic value of quantitative and qualitative traits for suitable breeding strategies in crop improvement. This investigation aims to determine the magnitudes of the correlation coefficient and path analysis for eleven characters.

II. Materials and Methods

In the present experiment, twenty-three genotypes of French bean were collected from the ICAR- Indian Institute of Vegetable Research, Varanasi. These varieties were evaluated at the Department of Genetics and Plant

Breeding, S.M.M.TOWN P.G. College, Ballia (UP) from December to April in the open field conditions during the year 2021-22. The experiment was laid out in a randomised block design with three replications. Genetically pure seeds of each genotype were sown in a 3 m long row at 30 cm spacing between rows. The plant-to-plant distance was kept at 20 cm and recommended cultural practices were followed to raise a uniform, healthy crop. The observations were recorded for eleven characters, *viz*. Days to 50 per cent flowering, plant height, days to maturity, number of pods per plant, biological yield, number of branches per plant, pod length, number of seeds per pod, test weight, harvest index and seed yield per plant. The pooled mean value of the parameters in each replication was statistically analysed. The table formulated by Fisher and Yates (1963) was consulted for the purpose of comparison of the 'F' value. The obtained information includes genotypic and phenotypic variance, which was evaluated by using the formula given by Singh and Chaudhary (1985). Whereas genetic advance as per cent of the mean estimated by using the method proposed by Johanson *et al.* (1955). The method suggested by Singh and Chaudhary 1985 was used for the estimation of the coefficient of correlation, and Path analysis was done by using the procedure given by Dewey and Lu 1959.

III. Result and Discussion

The Analysis of variance for the randomised block design was carried out on eleven characters. The mean square due to replication, treatment and error for all the characters are given in **Table 1.**

The variation due to replication was significant for days to 50 per cent flowering, number of pods per plant and pod length at the 5% level of significance, while days to maturity was highly significant at the 1 % level of significance. The variation due to treatment was significant for all eleven characters at the 1% level of significance. These results imply that this population of French bean genotypes would respond positively to selection for French bean improvement. Plant height ranged from 8.63 cm to 175.50 cm, and the mean was calculated to be 27.94 cm. Number of pods per plant ranged from 4.10 to 21.57, and the mean value was recorded as 10.76. Biological yield varied from 9.79 g to 42.93 g and the mean value was 20.32g. Test weight ranged from 13.36g to 51.49 g with a mean value of 26.39g. Seed yield per plant ranged from 4.89g to 21.17 g, with an overall mean performance of 11.03 g. Thus, these results indicate the existence of a wide range of genetic variability in the material. The variability parameters of all characters are given in **Table 2.**

The phenotypic coefficient of variation was higher than the corresponding genotypic coefficient of variation for all characters. It means that the expression of traits was influenced by the environment. Genotypic coefficient of variation (GCV) ranged from 4.90% to 157.46%, and phenotypic coefficient of variation (PCV) ranged from 5.06 % to 157.60%. Plant height and seed yield per plant exhibited the highest genotypic coefficient of variation of 157.46% and 44.57%, respectively. The highest phenotypic coefficient of variation was recorded in plant height, 157.60% and seed yield per plant 46.05%. The high PCV and GCV noticed are evident from their high variability, which helps in a favourable range of selection. The estimation of GCV and PCV is given in Table 3.

Heritability assessment along with genetic advance is usually beneficial in anticipating the gain under selection than selecting the best individual based on heritability alone (Johanson *et al.,* 1955). High heritability, along with high genetic advance was reported in plant height. A similar finding was reported by Panchbhaiya *et al.* 2015. The value of heritability estimates were very high for plant height (99.83%) fallowed by test weight (99.19%), pod length 97.04%), biological yield (95.35%) , day to 50 per cent flowering (94.96%), Harvest index (94%) and days to maturity (93.81%) . The highest estimate of genetic advance was recorded in plant height (90.55%) followed by test weight (22.15%) and biological yield (17.56%) presented in Table 3.

Genotypic and phenotypic correlation selection index is determined with the help of phenotypic correlation coefficient and genotypic correlation coefficient, and it gives a measure of close association between the characters and indicate the use of characters in overall improvement of crop. Seed yield per plant had a highly significant positive correlation with biological yield at both genotypic and phenotypic levels.

The identical result was recorded by Rana *et al.*, 2015 and Duzdemir and O. (2009). The seed yield per plant also showed positive and highly significant association with number of branches per plant, number of pods per plant, test weight and harvest index, respectively, at both genotypic and phenotypic levels and are given in Table 4.

Path analysis is a standard regression coefficient which split the correlation coefficient value into direct and indirect effects and shows the relative importance of causal components involved in the expression of the traits under consideration. The concept of path analysis was originally developed by **Wright in 1921**, but the technique was first used for plant selection by **Dewey and Lu (1951).** Path analysis of different characters contributing towards seed yield per plant exhibited that test weight had high positive direct effect, followed by harvest index, biological yield, plant height and days to maturity where as number of seed per pod and days to 50 per cent flowering showed a negative direct effect on seed yield per plant. The highest positive indirect effect is shown by the number of pods per plant through biological yield. The highest negative indirect effect is shown by

days to maturity through harvest index and is given in Table 5. Hence, for developing high-yielding varieties of French bean, these traits should be given more importance in breeding or selection programmes.

References

[1]. Duzdemir, O., 2009. Using Path Coefficient Analysis to Determine the Relationship between Yield and Yield Components of Dry Bean (Phaseolus vulgaris L.). *Journal of Applied Biological Sciences,* 3(2), pp.5-9.

[2]. Dewey, D.R. and Lu, 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production*, J.* Agron. 51: 515-518.

[3]. Fisher, R.A. 1963The correlation between relatives on the supposition of Mendelian inheritance. *Trans. Royal Soc. Edinberg*, 52: 399-433.

[4]. Johnson HW, Robinson HF and Comstock RE. 1955. Genotypic and phenotypic correlation in soybeans and their implications in selections. *Agron. J.,*47: 477-483.

[5]. Kakon SS, Bhuiya MSU, Hossain, SMA, Naher Q and Bhuiyan, MD. 2016. Effect of nitrogen and phosphorus on growth and seed yield of French bean. *Bangladesh Journal of Agricultural Research,*41(4): 759-772.

[6]. Panchbhaiya, A. and Singh, D.K.,2015. Genetic diversity and path coefficient analysis for yield and yield related traits in French bean (*Phaseolus vulgaris* L.) *Vegetable Science,*42(2),pp.56-64.

[7]. Rana, J.C., Sharma, Tyagi, R.K., Chahota , R.k., Gautam, N.K., Singh, M., Sharma, P.N. and Ojha , S.N., 2015. Characteristics of 4274 accessions of common bean (*Phaseolus vulgaris* L.) germplasm conserved in the Indian gene bank for phenological, morphological and agricultural traits. *Euphytica,* 205(2), pp.441-457.

[8]. Singh, R.K. and Chaudhary. 1985 B.D. Biometrical Methods in Quantitative Genetic Analysis. *Kalyani Publ*., New Delhi, India.

[9]. Vakhaiya, NA, Abashidze, ND, Chokheli MD and Nutsubidze NM . 1990. Influence of nitrate and molybdate on nitrogen fixation and productivity of kidney beans. *Fiziologiya Rastenii,37(4): 636-641*

[10]. Wright, S.1921. correlation and causation. *J. Agri. Res.*, 557-558.

Table No. 1 Analysis of variance for 11 characters in French bean *(Phaseolus vulgaris* L.*).*

Characters Sources of variation	d. f.	Days to 50% flowering	Plant height (cm)	No. of branches per plant	No. of pods per plant	Pod length (cm)	Days to maturity	Biological yield (g)	No. of seeds per plant	Test weight (g)	Harvest index (%)	Seed yield per plant(g)
Replication	2	11..652 *	1.7	0.235	9.39*	0.611*	12.058 **	0.567	0.416 6	0.17	0.267	0.05
Treatment	22	142.17**	5809.1 **	3.48**	50.909 **	14.390 **	83.163 **	232.319 **	3.359 **	350.62 **	229.715 **	74.14 **
Error	44	2.247	3.3	1.351	2.611	0.1449	1.8	3.71	0.293 9	0.95	4.787	1.627

*Significance at 5% level
**Significant at 1% level

Table No. 2 Mean performance, range and grand mean of 23 genotypes

S.N.	Days to 50% flowering	Plant height (cm)	No. of Branches/plant	No. pods/plant	pod length (cm)	Days to Maturity	Biological Yield (g)	No. of seeds/pod	Test weigh t	Harvest index (96)	Seed yield/plant (g)
Arka subidha	52.67	11.13	4.40	10.00	10.33	101.00	24.13	3.85	37.89	49.37	12.03
poulista	55.00	14.08	5.27	10.80	11.99	111.67	24.47	5.22	16.00	49.42	12.10
bonga	53.33	13.62	4.37	11.80	8.42	111.33	14.57	4.40	13.36	33.30	4.89
Kashi rajhans	55.33	19.17	5.60	21.57	11.84	111.67	42.93	5.62	21.53	43.96	18.88
Kashi sampann	54.33	16.38	6.13	19.03	9.09	112.33	28.29	4.41	26.86	64.92	18.40
Suvannah	54.67	11.80	3.20	9.93	8.27	110.00	13.29	3.55	24.77	47.20	6.27
Giolli	65.67	9.78	4.63	6.60	9.85	109.67	10.89	3.83	15.16	49.25	5.35
Pencil	64.33	14.64	4.00	12.47	9.86	111.33	15.20	4.39	18.22	42.44	6.47
Ns-636	52.67	10.95	4.53	9.33	9.34	110.00	11.45	4.61	19.45	51.45	5.91
Valentino	54.33	8 63	5.03	11.10	9.53	102.33	11.66	3.60	21.86	62.08	7.28
Rivegaro	62.33	10.97	3.10	5.87	9.84	108.33	9.79	3.21	22.18	50.11	4.89

Banoa	62.33	9 50	4.33	7.00	9.71	108.33	11.83	3.29	18.59	49.40	5.85
Arka anoop	59.67	9.87	3.17	4.10	11.82	108.00	10.08	3.78	27.38	53.53	5.44
Arka anmol	59.00	15.12	7.33	10.47	9.59	102.67	37.57	4.48	26.19	43.66	16.41
Kashi vaigani	72.33	175.50	5.70	14.07	14.81	112.00	22.47	7.42	21.85	62.70	14.18
Kashi param	49.00	13.20	4.33	8.57	11.77	96.67	20.18	3.54	43.83	55.47	11.04
Kashi agrim	50.00	22.18	4.93	8.93	13.95	98.33	21.80	3.93	21.74	56.83	12.40
Contender	52.00	17.72	4.53	8.27	12.09	100.33	25.54	3.83	42.83	61.01	15.62
HVR-137	53.00	18.47	6.07	16.30	13.51	109.67	18.95	5.02	17.97	61.90	11.74
Arka sarath	57.00	20.40	5.87	13.73	11.49	100.00	31.33	2.96	51.49	67.76	21.17
Arka komal	51.33	23.60	4.73	11.60	15.13	102.33	19.10	4.13	28.74	56.59	10.82
Malviya rajmash	51.00	18.39	4.80	8.13	11.77	100.67	20.15	3.10	47.55	62.64	12.62
EC-972386	74.67	157.47	6.63	7.87	16.04	112.67	21.60	6.16	21.58	64.40	13.93
Minimum	49.00	9.78	3.10	4.10	8.27	96.67	9.79	2.96	13.36	33.30	4.89
Maximum	74.67	175.50	7.33	21.57	16.04	112.67	42.93	7.42	51.49	67.76	21.17
Grand mean	57.22	29.74	4.90	10.76	11.31	106.58	20.32	4.28	26.39	53.89	11.03

Table No. 3 Genetic variability, heritability, genetic advance and genetic advance as % of mean.

Variability parameters Character	Genotypic Coefficient of Variance	Phenotypic Coefficient of Variance	Heritability (Broad Sense)	Genetic advance	Genetic Advance in % of mean
Days to 50% flowering	11.93	12.24	94.96	13.70	23.94
Plant height (cm)	157.46	157.60	99.83	90.55	324.10
No. of branches per plant	17.19	29.30	34.44	1.02	20.79
No. of pods per plant	37.28	40.19	86.04	7.67	71.23
Days to maturity	4.90	5.06	93.81	10.42	9.78
Pod length (cm)	19.27	19.57	97.04	4.44	39.11
Biological yield (g)	42.97	44.00	95.36	17.56	86.43
No. of seeds per pod	23.64	26.82	77.66	1.84	42.91
Test weight (g)	40.91	41.07	99.19	22.15	83.92
Harvest Index (%)	16.07	16.57	94.00	17.29	32.09
Seed yield per plant (g)	44.57	46.05	93.69	9.80	88.88

Table No. 4 Genotypic and phenotypic correlation among 11 characters in French bean *(Phaseolus vulgaris* L.*)*

Characters	Days to 50% flowering	Plant height (cm)	No. of Branches/plant	No. pods/plant	pod length (cm)	Days to Maturity	Biological Yield (g)	No.of seeds/pod	Test weight	Harvest index (96)	Seed yield/plant (g)
Days to 50% flowering	r_g	0.715**	0.227	-0.15	0.229	0.564**	-0.125	0.550**	-0.369**	0.046	-0.087
	r_p	0.696**	0.13	-0.136	0.221	0.538**	-0.121	0.433**	-0.359**	0.039	-0.085

Plant height (cm)		r_g	0.500**	0.072	0.642**	0.316**	0.1 16	0.802**	-0.105	0.378**	0.254*
		r_p	0.315**	0.078	0.633**	0.305*	0.12	0.716**	-0.105	0.369**	0.253*
No. of Branches/plant			r_g	0.584**	0.439**	0.052	0.818**	0.538**	0.013	0.419**	0.858**
			r_p	0.464**	0.279*	0.028	0.597**	0.483**	0.014	0.283*	0.634**
No. pods/plant				r_g	0.038	0.301*	0.638**	0.440**	-0.085	0.064	0.594**
				r_p	0.052	0.258*	0.631**	0.42Y*	-0.084	0.079	0.593**
pod length (cm)					r_g	-0.12	0.226	0.522**	0.125	0.539**	0.387**
					r_p	-0.121	0.222	0.464**	0.122	0.518**	0.375**
Days to Maturity						r_g	-0.148	0.618**	-0.742**	-0.297*	-0.233
						r_p	-0.138	0.513**	-0.716**	-0.277*	-0.218
Biological Yield (g)							r_g	0.309**	0.322**	0.091	0.907**
							r_p	0.320**	0.314**	0.105	0.909**
No. of seeds/pod								r_g	-0.466**	0.023	0.260*
								r_p	-0.407**	0.069	0.288*
Test weight (g)									r_g	0.495**	0.504**
									r_p	0.477**	0.487**
Harvest index (%)										r_g	0.479**
										r_p	0.486**

*Significance at 5% level

r_g = Genotypic correlation coefficient

**Significant at 1% level

r_p = Phenotypic correlation coefficient

Table No. 5 Direct and Indirect effects at phenotypic level of different quantitative characters on yield in French bean *(Phaseolus vulgaris* L.*)*

Characters	Days to 50% flowering	Plant height (cm)	No. of Branches/plant	No. pods/plant	pod length (cm)	Days to Maturity	Biological Yield (g)	No.of seeds/pod	Test weight	Harvest index (96)	Seed yield/plant (g)
Days to 50% flowering	**-0.01672**	0.04836	0.00576	-0.00671	-0.00151	0.03499	-0.09818	-0.03104	-0.03343	0.01319	-0.0853
Plant height (cm)	-0.01164	**0.06945**	0.0139	0.00385	-0.00433	0.01985	0.09705	-0.05132	-0.00973	0.12604	0.2531*
No. of Branches/plant	-0.00218	0.02185	**0.04416**	0.02293	-0.00191	0.00182	0.48338	-0.03462	0.00131	0.09685	0.6335**
No. pods/plant	0.00227	0.00542	0.02051	**0.04938**	-0.00036	0.01682	0.51041	-0.03074	-0.00787	0.02696	0.5928**
pod length (cm)	-0.00369	0.04398	0.01233	0.00258	**-0.00684**	-0.00784	0.17944	-0.03329	0.01134	0.1771	0.3752**
Days to Maturity	-0.009	0.02119	0.00124	0.01277	0.00082	**0.06505**	-0.1117	-0.03676	-0.0667	-0.0945	-0.2176
Biological Yield (g)	0.00203	0.00833	0.02637	0.03114	-0.00152	-0.00898	**0.8094**	-0.02297	0.02925	0.03585	0.9089**
No. of seeds/pod	-0.00724	0.0497	0.02132	0.02117	-0.00318	0.03334	0.25933	**-0.07172**	-0.03791	0.02358	0.2884*
Test weight	0.006	-0.00726	0.00062	-0.00417	-0.00083	-0.04659	0.25415	0.02918	**0.09315**	0.16305	0.4873**

Harvest index (96)	-0.00065	0.02561	0.01251	0.0039	-0.00354	-0.01799	0.08491	-0.00495	0.04444	**0.34175**	0.486**

Residual effects = 0.014