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Study on genetic diversity in French bean (*Phaseolus vulgaris* L.)

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Abstract
The present investigation was carried out with 24 French bean genotype during rabi 2009-10 in RBD having three replication at field experiment Centre of Department of Genetics and Plant Breeding, Allahabad School of Agriculture, SHIATS, Allahabad. The data were recorded on 13 quantitative characters to study the variability, heritability, genetic advance and correlation. Analysis of variance revealed considerable variability among the genotypes for all characters. All the 24 genotypes of French bean showed significant genetic divergence. Based on per se performance for seed yield per plant and other characters taken in consideration genotypes ET 8490 was found promising followed by IPR 96-4 and ET 8430.The characters like plant height, number of seeds per plant, harvest index and seed yield per plant exhibited high GCV, PCV, heritability and genetic advance should be given top priority during selection. The genetically more divergent genotypes present in cluster III and V may be utilized as parents in future hybridization programme to produce high yielding transgressive segregants. The grain yield exhibited positive and significant correlation with biological yield per plant, harvest index and test weight both at genotypic and phenotypic level. The large spectrum genetic variability in segregating populations depends on the level of genetic diversity among genotypes offer better scope for selection.

Keywords: french bean, genetic variability, correlation, heritability and genetic advance

Introduction
French bean (*Phaseolus vulgaris* L.) is also known as kidney bean, common bean, hairy bean and snap bean is an important grain legume. India grows nearly 23 million ha area pulse crops and produces nearly 14.4 million tonnes pulse grains (Trivedi, 2009) [8]. In India fresh pods used as vegetable are called faras and dried pods for pulse is called rajmash. Dried seed of raj mash contain 60.6% carbohydrate, 22.9% protein and 1.3% fat (Tripathi, 2003) [7]. In addition to it 100 g of seeds contains minerals *viz.* calcium (260 mg), phosphorus (410 mg) and iron (5.8 mg) (Prasad, 2006) [5]. Amongst the French bean producing countries Brazil ranks first in area and production. Other important French bean producing countries are Angola, Cameroon, Rwanda, Tanzania, and Uganda. Vavilov (1951) reported the primary centre of origin of *Phaseolus* is South Mexico and Central America, Secondary centre of origin in Peruvian Ecuadorian. Globally French bean is cultivated on about 28 m ha with an annual production of 18.95 million tonnes (Prasad, 2006) [5]. In India, common bean production is 4.340 million tonnes. It is grown mainly in the states of Maharashtra, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh Hills, Nilgiri (Tamil Nadu), Palni (Kerala) hills, Chickmagalur (Karnataka) and Darjeeling hills (West Bengal). Beans are said to be used for acne, bladder, burns, cardiac, carminative, depurative, diabsetes, diarrhea, diuretic, dropsy, dysentery, eczema, emollient, hiccups, itch, kidney, resolving, rheumatism, sciatica, and tenesmus.

The large spectrum genetic variability in segregating populations depends on the level of genetic diversity among genotypes offer better scope for selection. Estimates of GCV, PCV, heritability and genetic advance will play an important role in exploiting future research projections of French bean improvement. Heritability and genetic advance are other important selection parameters. The estimates of heritability help the plant breeder in determining the character for which selection would be rewarding. A successful breeding programme in French bean would need information on the nature and degree of genetic divergence in the available stock for choosing the right parents for further improvement. Subsequently, heterosis is directly proportional to genetic divergence and to dominance square and is also associated. with adaption (Falconer, 1981) [1]. The selection of agronomically suitable diverse parents for hybridization is important for getting desired recombinants segregating generations. Hybrids showing strong heterosis are usually developed from the parental lines that are diverse in relatedness, ecotype, geographic origin etc (Lin and Yaun, 1980). Genetic diversity can be evaluated with morphological traits, seed protein, isozymes and DNA markers Conventionally,

it is estimated by the D^2 analysis, metro glyph and principal component analysis using morphological traits. The D^2 technique is based on multivariate analysis developed by Mahalanobis (1936) [4] had been found to be a potent tool in quantifying the degree of divergence in germplasm. This analysis provides a measurement of relative contribution of different components on diversity both at intra and inter-cluster level and genotypes drawn from widely divergent clusters are likely to produce heterotic combinations and wide variability in segregating generation. Moreover, the relative contribution of different yield components to total divergence using Mahalanobis D^2-technique helps in the identification of selection parameter to be used as criteria for the improvement in the yield.

Materials and Methods

This experiment was conducted during 2009-10 at the field experimentation centre of the Department of Genetics and Plant Breeding, Allahabad School of Agriculture, Sam Higgin Bottom Institute of Agriculture Technology and Science, Allahabad India. The experimental materials consisted of 24 genotypes of French bean. These genotypes were received from Indian Institute of Pulses Research; Kanpur. The cultivars and advance generation materials *viz*. EC 400-404,ET 8430,VSLR 2,EC I4920,IC 84607,ET8447, IC 311 670, EC 400-419, IPR 96-4, E 400-398, IC 14351, ET 8412, 118 EC 400 -414, EC 564 795, EC 541702, IPR 9839, ET 8490, NO 3160,EC 400 -414, PDR 14, GPR 418A, HURG 13-B, HUR -15,ID 2-1 were sown in randomized block design with three replications**.** The experimental field was divided into 3 blocks of equal size and each block possesses 24 plots. Each line was accommodated in three rows of 2 m length spaced at 30 cm with an approximate plant to plant distance of 15 cm. The data were recorded for thirteen charters including days to 50% flowering, days to maturity, Number of primary branches per plant, Number of secondary branches per plant, Plant height (cm), Number of pods per plant, Days to maturity, Pod length (cm), Number of seeds per pods, Number of seeds per plant, Biological yield (g), 100 seed weight (g), Seed yield per plant (g) and Harvest Index (%). The present investigation three types of coefficient of variations were estimated *viz.*, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) and error/environmental coefficient of variation (ECV). Johnson *et al.* (1955) [2] suggested that heritability and genetic advance when calculated together would prove more useful in predicting the resultant effect of selection on phenotypic expression, without genetic advance the estimates of heritability will not be of practical value and emphasized the concurrent use of genetic advance along with heritability. Selection of diverse parents in breeding programme helps in isolation of superior genotypes. Genetic diversity determines the inherent potential of a cross for heterosis and frequency of desirable recombinants in advanced generations. Based on relative magnitude of D^2statistics the 24 genotypes of french bean were grouped into 5 clusters. Among the different clusters, cluster I consisted maximum number of genotypes (10 genotypes) followed by cluster IV (8 genotypes) and cluster V (4 genotypes), whereas cluster II and cluster III includes single genotype. The pattern of group constellation proved the existence of significant amount of variability. Similar findings also reported by Singh *et al.* (2007) [6].

Results and Discussion

Analyses of variance revealed that mean sum of squares due to treatments were significant for all the traits. So, this indicates the presence of substantial genetic variability among the genotypes of French bean that provides the basis for effective selection. On the basis of mean performance, the highest seed yield per plant was observed for ET 8490 (41.68g) followed by IPR 96-4 (39.00g), ET 8430 (37.43g) and ET 8412 (34.129g). An estimate of GCV and PCV revealed that phenotypic coefficient of variation was higher than genotypic coefficient of variation, which indicates less effect of environment on the expression of characters studied. Higher estimates of GCV and PCV were depicted by number of secondary branches per plant (6935, 69.4) followed by plant height (61.95, 61.97), number of seeds per plant (45.67, 45.83) and number of pods per plant (45.01, 45.07) respectively. Heritability estimates revealed that characters like 100 seed weight (100 percent) exhibited highest heritability followed by plant height (99.9 percent), number of secondary branches (99.8 percent), pod length (99.4 percent), and number of seeds per plant (99.3 percent) respectively.

High estimates of heritability coupled with high values of genetic advance was observed for plant height (99.9 and 66.74) followed by number of seeds per plant (99.3 and 49.59), biological yield (99.3 and 26.50), harvest index (99.3 and 25.67) and seed yield per plant (98.6 and 20.01). High estimates of heritability coupled with moderate to low value of genetic advance was observed in days to 50 % flowering (97.00 and 11.20), number of pods per plant (99.7 and 10.46), days to maturity (98.6 and 8.10) and 100 seed weight (100 and 7.99) and pod length (99.4 and 3.41) respectively suggesting that there was preponderance of additive gene action and non-additive gene action for the expression of these characters. Highest inter cluster distance was observed between cluster III and V (174280.90) followed by cluster III and IV (111121.70) and cluster II and V (73057.410). Minimum inter cluster distance was observed between clusters IV and V (16223.470). Clusters means were found highest for different characters. Cluster I showed highest mean performance for harvest index (61.74%). Cluster II showed highest mean performance for plant height (176.400 cm), pod length (14.80 cm), number of seeds per pod (5.70), number of seeds per plant (70.490), biological yield (67.133g) and seed yield per plant. Cluster mean performance of cluster III is maximum for 100 seed weight (52.023g). Cluster IV recorded high mean value for days to 50% flowering (103.708), number of primary branches, (3.564), number of secondary branches per plant (2.142) and number of pods per plant (12.477). However, cluster V recorded high cluster means for days to maturity (132.667).

Conclusion

All the 24 genotypes of French bean showed significant genetic divergence. Based on *per se* performance for seed yield per plant and other characters taken in consideration genotypes ET 8490 was found promising followed by IPR 96-4 and ET 8430.The characters like plant height, number of seeds per plant, harvest index and seed yield per plant exhibited high GCV, PCV, heritability and genetic advance should be given top priority during selection. The genetically more divergent genotypes present in cluster III and V may be utilized as parents in future hybridization programme to produce high yielding transgressive segregants.

Table 1: Mean performance for different quantitative characters in french bean

Genotypes	Days to 50 % flowering	Number of primary branches	Number of secondary branches	Plant height (cm)	Number of pods/ plant	Days to maturity	Pod length (cm)	Number of seeds/ pod	Number of seeds/ plant	Biological yield (g)	100 seed weight (g)	Seed yield/ plant (g)	Harvest index (%)
EC 400-404	88.000	4.033	2.233	44.533	9.233	126.333	12.100	4.433	40.937	27.000	41.843	17.129	63.467
ET 8430	91.333	3.933	3.200	44.267	21.667	132.667	12.200	4.233	91.727	53.533	40.810	37.432	69.913
VSLR 2	97.333	2.433	2.000	44.467	8.633	135.333	11.773	4.567	39.427	28.513	46.567	18.360	64.373
EC I4920	94.000	2.967	1.767	45.433	7.233	130.000	12.100	4.700	33.997	44.577	52.023	17.686	39.663
IC 84607	101.333	3.807	0.000	58.267	7.300	129.000	12.200	4.467	32.273	53.800	42.667	31.145	57.883
ET8447	100.000	2.167	2.000	33.200	17.233	128.000	8.500	4.733	81.563	45.333	36.637	29.883	65.897
IC 311 670	106.333	3.443	2.233	46.000	7.700	128.000	11.767	4.400	33.890	25.500	38.777	13.141	51.523
EC 400-419	99.333	4.700	0.000	39.000	8.333	123.000	13.157	5.300	44.157	25.600	42.270	18.665	72.897
IPR 96-4	101.000	4.427	2.600	41.133	22.367	134.667	9.387	4.567	102.140	53.700	38.190	39.007	72.630
E 400-398	102.000	3.200	2.500	30.333	18.173	129.000	8.070	4.100	74.517	55.667	38.890	28.980	52.043
IC 14351	98.000	4.233	2.033	32.000	6.656	135.333	9.800	4.100	27.289	25.444	34.170	9.313	36.610
ET 8412	98.000	3.167	2.200	55.000	14.867	128.000	11.637	5.433	80.760	50.633	42.270	34.129	65.743
118 EC 400 -414	102.000	2.300	1.900	47.000	8.567	129.000	11.433	4.267	36.540	43.333	45.600	16.440	37.920
EC 564 795	100.000	4.200	2.200	36.700	12.167	134.333	11.770	4.167	50.697	50.000	42.500	21.547	43.113
EC 541702	106.333	4.290	1.700	36.111	9.278	128.000	10.467	5.233	48.551	34.533	39.717	19.283	55.837
IPR 9839	90.333	2.133	2.000	52.833	13.433	123.000	14.213	5.100	68.500	42.733	43.173	29.574	69.190

Continued…

Genotypes		Days to 50 % flowering	Number of primary branches	Number of secondary branches	Plant height (cm)	Number of pods/ plant	Days to maturity	Pod length (cm)	Number of seeds/ pod	Number of seeds/ plant	Biological yield (g)	100 seed weight (g)	Seed yield/ plant (g)	Harvest index (%)
ET 8490		104.000	4.167	0.000	83.111	20.067	129.000	12.170	5.100	102.347	57.167	40.727	41.683	72.913
NO 3160		88.000	3.513	0.200	176.400	12.367	128.000	14.800	5.700	70.490	67.133	44.583	31.427	46.810
EC 400 - 414		98.000	3.600	0.000	115.889	6.656	135.333	12.630	5.100	33.944	28.150	38.600	13.103	46.560
PDR 14		102.000	4.197	1.267	36.583	8.333	134.333	8.827	4.067	33.900	27.563	39.033	13.232	47.997
GPR 418A		107.667	3.603	3.033	21.167	9.500	135.333	10.633	4.100	38.967	35.500	40.813	15.900	44.763
HURG 13-B		104.333	3.183	1.800	46.533	7.233	134.333	12.733	4.733	33.540	41.000	40.500	13.580	33.110
HUR -15		95.667	3.133	0.000	43.533	6.667	134.000	11.744	5.278	35.178	25.000	37.067	13.040	52.150
ID 2-1		103.000	1.317	0.000	46.222	7.333	126.000	11.247	4.633	33.967	25.111	35.033	11.899	47.350
Mean		99.083	3.423	1.536	52.322	11.291	130.417	11.473	4.688	52.887	40.272	40.936	22.316	54.598
Range	Max	107.667	4.700	3.200	176.400	22.367	135.333	14.800	5.700	102.347	67.133	52.023	41.683	72.913
	Min	88.000	1.317	0.000	21.167	6.656	123.000	8.070	4.067	27.289	25.000	34.170	9.313	33.110
C.V.		0.986	3.401	2.710	1.702	2.302	0.356	1.109	2.506	3.778	2.627	0.119	3.685	2.743
C.D. 5%		1.606	0.191	0.068	1.464	0.427	0.763	0.209	0.193	3.284	1.739	0.080	1.352	2.461
S.E.		0.564	0.067	0.024	0.514	0.150	0.268	0.073	0.068	1.153	0.611	0.028	0.475	0.865

Table 2: Analysis of variance for 13 quantitative characters of 24 genotypes of French bean

S. NO	Characters	Mean sum squares		
		Replication (df=02)	Treatment (df=23)	Error (df=46)
1	Days to 50% Flowering	5.38 *	92.38 **	0.95
2	Number of primary branches	0.05	2.22 **	0.01
3	Number of secondary branches	0.00	3.41 **	0.00
4	Plant height	1.21	3152.3 2 **	0.79
5	Number of pods per plant	0.05	77.55 **	0.07
6	Days to Maturity	0.38	47.25 **	0.22
7	Pod length	0.01	8.27 **	0.02
8	Number of seeds per pod	0.00	0.71 *	0.01
9	Number of seeds per plant	0.24	1754.26 **	3.99
10	Biological yield	3.63 *	500.90 **	1.12
11	100 Seed weight	0.01	45.11 **	0.00
12	Harvest index	0.05	285.83 **	0.68
13	Seed yield per plant	3.20	474.76 **	2.24

* Indicate significance at 5% level of significant.
** Indicate significance at 1% level of significant.

Table 3: Estimation of component and variance and genetic parameter for13 quantitative characters of 24 genotypes in French bean

S. No	Characters	VG	VP	VE	GCV	PCV	h^2 (broad Sense)%	GA	GA as %of mean
1	Days to 50% Flowering	30.48	31.43	0.95	5.57	5.66	97	11.20	11.30
2	Number of primary branches	0.74	0.75	0.01	25.07	25.3	98.2	1.75	51.17
3	Number of secondary branches	1.13	1.14	0	69.35	69.4	99.8	2.19	142.75
4	Plant height	1050.51	1051.30	0.79	61.95	61.97	99.92	66.74	127.56
5	Number of pods per plant	25.83	25.9	0.07	45.01	45.07	99.7	10.46	92.60
6	Days to Maturity	15.68	15.89	0.22	3.04	3.06	98.6	8.10	6.21
7	Pod length	2.75	2.77	0.02	14.45	14.50	99.4	3.41	29.69
8	Number of seeds per pod	0.23	0.24	0.01	10.25	10.56	94.4	0.96	20.52
9	Number of seeds per plant	583.42	587.41	3.99	45.67	45.83	99.3	49.59	93.76
10	Biological yield	166.59	167.71	1.12	32.05	32.16	99.3	26.50	65.80
11	100 Seed weight	15.03	15.04	0.00	6.47	9.47	99.93	7.99	19.51
12	Harvest index	157.51	159.75	2.24	22.99	23.15	99.3	25.67	47.02
13	Seed yield per plant	95.05	95.73	0.68	43.69	43.84	98.6	20.01	89.68

VG= genotypic variance
VP =Phenotypic variance.
GCV =genotypic coefficient of variation.
GA = Genetic advance.
PCV =Phenotypic coefficient of variation.
h^2 (bs) =Heritability in broad sense

Table 4: Distribution of 24 genotypes of French bean into different clusters

Cluster No.	Number of genotypes	Name of genotypes included
I	10	VSLR 2, 118 EC 400 -414, EC 400-419, ET 8412, ET 8490, EC 564 795, IPR 9839, EC 400-404, ET 8430, IC 84607
II	1	NO 3160
III	1	EC I4920
IV	8	IPR 96-4, E 400-398, ET8447, EC 541702, PDR 14, IC 311 670, GPR 418A, HURG 13-B
V	4	HUR -15, ID 2-1, IC 14351, EC 400 -414

Table 5: Intra (diagonal) and inter cluster average distance for different quantitative characters in French bean

	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V
Cluster I	9948.025	33445.040	60819.390	16326.480	41201.100
Cluster II		0.000	69467.930	53206.630	73057.410
Cluster III			0.000	111121.7000	174280.900
Cluster IV				4977.070	16223.470
Cluster V					10691.290

References

1. Falconer DS. Introduction to quantitative genetics.2ndedn. Longman, London. 1981, 340.
2. Johnson HW, Robinson HF, Comstock RE. Estimate of genetic and environmental variability in Soybean and their implication in selection Agron. J. 1955; 47:477-483.
3. Lin SC, Yuan LP. Genetic divergence in plant breeding. Ind. J Genet. 1980; 14:226-236.
4. Mahalanobis PC. On the generalized distance in statistics. Proc. Natl. Inst. Sci. India. 1936; 2:49-55.
5. Prasad R. Textbook of crop prod., ICAR, New Delhi. 2006, 323-326.
6. Singh AK, Singh KP, Singh BK. Genetic variability, heritability and genetic advance in French bean (*Phaseolus vulgaris*). Haryana J of Hortic. Sci. Hortic. Society of Haryana, Hisar, India. 2007; 36(3/4):352-353.
7. Tripathi AK.Agricultural Crop Production. Kalyani Publishers, Ludhiana, India. 2003; 1:173-176.
8. Trivedi TP. Hand book of Agriculture. Indian council of Agric Res. New Delhi. 2009; 32(7):87.