Multivariate Characterization of Indian Bean [*Lablab purpureus* (L.) Sweet] Genotypes

N Rai, Pramod Kumar Singh, Ajay Verma, Hira Lal, DS Yadav and Mathura Rai
Indian Institute of Vegetable Research, Varanasi-221305, Uttar Pradesh, India

In Indian bean, PCV values were slightly greater than GCV, revealing very little influence of environment for their expression. High heritability was expressed by days to first flower, number of pods per plant, pod length and pod yield per plant. High value of heritability along with high genetic advance was observed for number of pods per plant followed by days to first picking and days to first picking. Genetic advance as per cent of mean was observed maximum for number of pods per plant and pod yield per plant. Pod yield per plant showed positive and significant association with number of pods per plant and significant negative correlation with days to first flower and days to first picking at both genotypic and phenotypic levels. Path analysis revealed that number of pods per plant, number of days taken to first picking; pod length, pod width, seed width and seed length had direct positive effect on pod yield per plant. Multivariate hierarchical clustering depicted the classification of 46 Indian bean genotypes in 2 groups with 17 and 29 genotypes. First group further divided into 2 groups with 7 (VRSEM-765 is genetically different from 6 other genotypes) and 10 genotypes, while 29 genotypes divided into 2 clusters with 13 and 16 genotypes, respectively.

Key Words: Indian bean, Variability, Correlation, Path Coefficient analysis, Hierarchical clustering

Introduction

Indian bean {*Lablab purpureus* (L.) Sweet} is an important vegetable crop of Indian origin (Deka and Sarkar 1990). It occupies unique position for vegetable purpose among the legume vegetable (Biju *et al.*, 2001). It is a good source of protein, minerals and vitamins (Basu *et al.*, 2002). The progress in breeding for the yield and its contributing characters of any crop is polygenetically controlled, environmentally influenced and determined by the magnitude and nature of their genetic variability (Wright, 1935 and Fisher, 1981). Genetic variability, character association and path coefficient are pre-requisites for improvement of any crop including Indian bean for selection of superior genotypes and improvement of any trait (Rai *et al*., 2003). It is very difficult to judge whether observed variability is heritable or due to environment alone. Moreover, knowledge of heritability is essential for selection based improvement as it indicates the extent of transmissibility of a character in future generations. Knowledge of correlation between yield and its contributing characters are basic and for most endeavor to find out guide lines for plant selection. Partitioning of total correlation into direct and indirect effect by path coefficient analysis helps in making the selection more effective. Keeping in view the above facts, the present investigation was undertaken to know genetic divergence, correlation and path coefficient among yield and its contributing characters in 46 germplasms of Indian bean collected from Bihar.

Materials and Methods

The field experiment was comprised of 46 germplasm accessions of Indian bean growing during r*abi*, 2006-2007 at Indian Institute of Vegetable Reserch, Varanasi in a randomized block design with three replications. All the recommended package of practices were followed to raise a good crop. For this study, the genetic divergence, correlation and path coefficient of yield contributing characters, viz., days to first flower, days to first picking, number of pods per plant, per cent of fruit set per cluster, pod length (cm), pod width (cm), number of seeds per pod, seed length (cm), seed width (cm), 100 seeds weight (g) and pod yield per plant (kg) were recorded on randomly selected five plants in each replication. The variability for different quantitative characters was estimated as per procedure for analysis of variance suggested by Panse and Sukhatme (1985), GCV and PCV by Burton and De Vane (1953) and heritability and genetic advance by Johnson *et al.*, (1955). Correlation coefficient was worked out as per Al-Jibouri *et al.*, (1958) and path coefficient of various characters was calculated by the formula given by Dewey and Lu, (1959). Multivariate clustering analysis was used to explain variability in genotypes which will help in choosing the parents for hybridization. This approach helps in reducing the large amount of data about the parental lines to manageable proportions (Peter and Martinalli, 1989).

Results and Discussion

Variability, heritability and genetic advance

Data presented in Table 1 showed that there was considerable variability in all the traits. Close relationship between GCV and PCV was found in all the characters and PCV values were slightly greater than GCV, revealing

very little influence of environment for their expression. More than 80% heritability values was observed for all the characters except number of seeds per pod and seed length which indicated very good scope of selection in this crop. High heritability expressed in days to first flowering, number of pods per plant and pod length. High heritability along with high values of genetic advance was observed for number of pods per plant followed by days to first flower and days to first picking. Genetic advance as per cent of mean was observed maximum for number of pods per plant, pod yield per plant, pod width, 100-seed weight and days to first flower. In present investigation, characters, namely, number of pods per plant, pod yield per plant and pod width had high values of GCV accompanied with high heritability indicated additive gene action and good scope for selection. Johnson *et al.*, (1955) also suggested that high GCV along with high heritability and genetic advance gave better picture for the selection of the genotypes. Similar results were also reported by Rai *et al.*, (2003), Lal *et al.,* (2005) in Indian bean and Lal *et al.*, (2007) in cowpea.

Correlation Coefficients

Genotypic correlations were observed to be higher than the corresponding phenotypic correlation coefficients for all the characters indicating the supervision of phenotypic expression under the influence of environmental factors (Table 2). Pod yield per plant showed maximum positive and significant association with number of pods per plant (0.80) at both genotypic and phenotypic levels. On contrary, pod yield per plant expressed significant negative correlation with days to first flower (-0.44) and days to first picking (-0.33).The number of days taken to first flower showed the positive correlation with days to first picking (0.79) and negative correlation with number of pods per plant. The number of days taken to first picking showed negative correlation with number of pods per plant (0.55), whereas per cent fruit set per cluster showed negative correlation with pod length (0.38) and number of seeds per pod (0.46). The pod length showed positive correlation with number of seeds per pod (0.52), while seed length had positive correlation with seed width (0.72) and 100-seed weight (0.54). The seed width had positive correlation with 100-seed weight (0.59).

Path Coefficient Analysis

Path analysis revealed that number of pods per plant (0.921), number of days taken to first picking (0.336), pod length (0.299), pod width (0.246), seed width (0.066) and seed length (0.093) had positive direct effect on pod yield per plant (Table 3). Thus, selection for these traits may lead to an overall increase in pod yield per plant. These results are in close conformity with the findings of Baswana *et al.*, (1980), Biju *et al.*, (2001) and Lal *et al.*, (2005) in Indian bean. The highest indirect effect on pod yield per plant (0.799) was shown by number of pods per plant (0.921) through days to first flower (0.149), per cent fruit set per cluster (0.015) and number of seeds per plant (0.001). However, the highest indirect positive effect of days to first picking (0.336) on pod yield per plant was recorded through pod width (0.072), seed width (0.010) and seed length (0.003). A indirect positive effect of pod length (0.299) on pod yield (0.161) was obtained high through per cent fruit set per cluster (0.034), seed width (0.018) and seed length (0.017). Similarly, the pod width showed indirect positive effect (0.246) on pod yield (0.123) through days to first picking (0.100), seed width (0.010) and seed length (0.002). On contrary the, the number of days taken to first flower (-0.275), 100-seed weight (-0.124), per cent fruit set per cluster (-0.088) and number of seeds per pod (-0.078) had direct negative effect on pod yield per plant. Thus, path coefficient analysis

Table 1. Variability, heritability and genetic advance for the 11 characters in Indian bean

Characters	Range	Grand mean	Variability PCV	Variability GCV	Heritability %	Genetic advance	Genetic advance as % of mean
Days to first flower	33.00 -136.60	110.268	18.30	18.29	99.9	41.52	37.65
Days to first picking	55.00 -165.00	141.82	12.03	12.00	99.4	34.95	24.64
Number of pods/ plant	45.33 -689.67	231.572	64.04	63.99	99.9	305.05	131.73
Per cent fruit set/ cluster	35.33 - 75.00	53.123	16.69	16.07	92.7	16.93	31.87
Pod length (cm)	7.25 - 12.82	9.78	14.05	14.02	99.5	2.82	28.83
Pod width (cm)	0.50 - 3.23	2.154	29.30	28.67	95.8	1.25	58.03
Number of seeds/ pod	3.67 - 5.67	4.522	13.78	10.33	56.2	0.72	15.92
Seed length (cm)	0.81 - 1.42	1.149	10.63	8.90	70.1	0.18	15.67
Seed width (cm)	0.50 - 0.93	0.781	11.07	10.07	82.8	0.15	19.21
100-seed weight (g)	14.67 - 42.33	27.789	24.72	23.65	91.6	12.96	46.64
Pod yield per plant (kg)	0.30 - 3.94	1.603	63.51	63.38	99.6	2.09	130.38

Table 2. Phenotypic and Genotypic correlation coefficients for 11 characters in Indian bean

Characters		Days to first flower	Days to first picking	Pods per plant	Fruit set per Cluster %	Pod length cm	Pod width cm	Seeds per pod	Seed length cm	Seed width cm	100 seed weight	Pod yield per plant
Days to first	P		0.792**	-0.543**	0.079	0.019	0.242	0.081	-0.009	0.067	-0.227	-0.435**
flower	G		0.793**	-0.543**	0.081	-0.020	0.247	0.107	-0.006	0.075	-0.237	-0.436**
Days to first	P			-0.554**	0.081	0.002	0.289	0.038	0.024	0.138	0.105	-0.332*
picking	G			-0.556**	0.083	0.002	0.296	0.052	0.035	0.157	0.112	-0.333*
Pods per plant	P				-0.156	-0.143	-0.140	-0.007	-0.104	-0.094	0.026	0.799**
	G				-0.165	-0.143	-0.142	-0.015	-0.127	-0.102	0.027	0.800**
Fruit set per	P					-0.366*	0.158	-0.310	0..010	-0.024	-0.139	-0.243
cluster (%)	G					-0.382*	0.165	-0.456**	-0.005	-0.026	-0.157	-0.255
Pod length (cm)	P						-0.043	0.384**	0.157	0.251	0.218	0.161
	G						-0.045	0.518**	0.180	0.273	0.230	0.162
Pod width (cm)	P							-0.024	0.012	0.124	0.038	0.123
	G							-0.007	0.017	0.150	0.041	0.126
Seeds per pod	P								0.023	-0.006	0.060	0.072
	G								0.019	0.019	0.049	0.087
Seed length (cm)	P									0.592**	0.421*	0.023
	G									0.721**	0.544**	0.026
Seed width (cm)	P										0.492**	0.101
	G										0.590**	0.117
100-seed	P											0.177
weight (g)	G											0.182

Table 3. Direct and indirect effects of different traits on yield in Indian bean

Characters		Days to first flower	Days to first picking	Pods per plant	Fruit set per Cluster %	Pod length cm	Pod width cm	Seeds per pod	Seed length cm	Seed width cm	100 seed weight (g)	Yield per plant Kg
Days to first	G	-0.275	-0.218	0.149	-0.022	0.005	-0.068	-0.029	0.002	-0.021	0.065	-0.435
flower No.	P	-0.232	-0.184	0.126	-0.018	0.005	-0.056	-0.019	0.002	-0.016	0.053	-0.436
Days to first	G	0.266	0.336	-0.187	0.028	0.001	0.100	0.018	0.012	0.053	0.038	-0.332
picking	P	0.229	0.289	-0.160	0.024	0.001	0.083	0.011	0.007	0.040	0.030	-0.333
Pods per	G	-0.501	-0.512	0.921	-0.152	-0.131	-0.131	-0.014	-0.117	-0.094	0.025	0.799
plant	P	-0.493	-0.503	0.909	-0.142	-0.130	-0.127	-0.007	-0.095	-0.085	0.024	0.800
Fruit set per	G	-0.007	-0.007	0.015	-0.088	0.034	-0.015	0.040	0.000	0.002	0.014	-0.243
cluster (%)	P	-0.005	-0.005	0.009	-0.059	0.021	-0.009	0.018	-0.001	0.001	0.008	-0.255
Pod length	G	-0.006	0.001	-0.043	-0.114	0.299	-0.014	0.155	0.054	0.082	0.069	0.161
(cm)	P	-0.005	0.001	-0.039	-0.100	0.274	-0.012	0.105	0.043	0.069	0.060	0.162
Pod width	G	0.061	0.072	-0.035	0.041	-0.011	0.246	-0.002	0.004	0.037	0.010	0.123
(cm)	P	0.057	0.069	-0.033	0.037	-0.010	0.237	-0.006	0.003	0.029	0.009	0.126
Seeds per	G	-0.008	-0.004	0.001	0.036	-0.040	0.001	-0.078	-0.001	-0.008	-0.004	0.072
pod	P	-0.002	-0.001	0.000	0.009	-0.011	0.001	-0.028	-0.001	0.000	-0.002	0.087
Seed length	G	-0.001	0.003	-0.012	0.000	0.017	0.002	0.002	0.093	0.067	0.050	0.023
(cm)	P	0.000	0.001	-0.006	0.001	0.008	0.001	0.001	0.053	0.032	0.022	0.026
Seed width	G	0.005	0.010	-0.007	-0.002	0.018	0.010	0.001	0.047	0.066	0.039	0.101
(cm)	P	0.004	0.008	-0.005	-0.001	0.015	0.007	0.000	0.035	0.058	0.029	0.117
100-seed	G	0.029	-0.014	-0.003	0.019	-0.028	-0.005	-0.006	-0.067	-0.073	-0.124	0.177
weight (g)	P	0.013	-0.006	-0.001	0.008	-0.012	-0.002	-0.003	-0.024	-0.028	-0.056	0.182

revealed the importance of characters such as number of pods per plant, pod length and pod width in selection of superior genotypes for pod yield per plant.

Multivariate Classification

The multivariate approach increases the precision and decreases the complexity introduced by increasing the number of variables. Multivariate hierarchical clustering was carried out for eleven different morphological characters (Fig. 1). Distance between all pairs of genotypes was calculated using squared Euclidean distance method and genotypes were clustered based on Ward's method. Figure 1 the classification of 46 genotypes in 2 groups with 17 and 29 genotypes. First group further divided into 2 groups with 7 (VRSEM-765 is genetically different from 6 other genotypes) and 10 genotypes, while 29 genotypes divided into 2 clusters with 13 and 16 genotypes respectively. Actually, the group of individuals possessing similar characters mathematically gathered

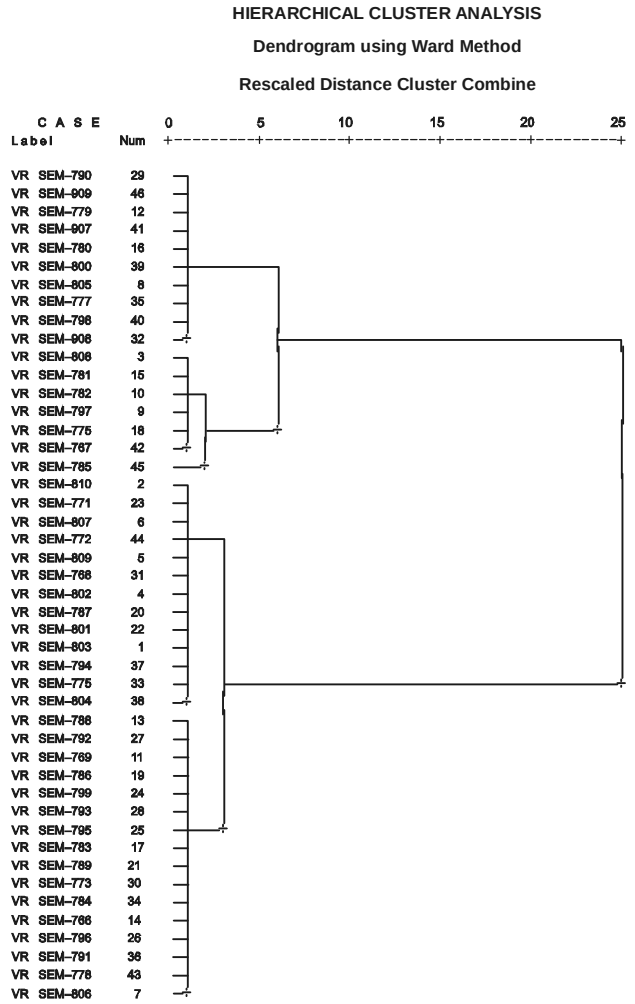

Fig. 1: Multivariate clustering of Indian bean genotypes based on Ward's method

into the same cluster and, all individuals of same cluster supposed to exhibit higher homogeneity. It is inferred from the present investigation that hybridization involving the inter-cluster representatives of clusters would be more useful in Indian bean breeding programme.

Acknowledgements

The authors are grateful to the Dr. Mathura Rai, Director of Indian Institute of Vegetable Research, Varanasi for providing all facilities in conducting the experiment at Indian Institute of Vegetable Research, Varanasi.

References

Al-Jibouri HA, PA Miller and HF Robinson (1958) Genotypic and environmental variances and covariance in an upland cotton cross of interspecific origin. *Agron. J.* **50:** 632-636.

Basawana KS, ML Pandita, BS Dhankhar and PS Pratap (1980) Genetic variability and heritability studies on Indian bean (*Dolichos lablab* var. *lignosus* L.). *Haryana J. Hort. Sci.* **9:** 52-55.

Basu AK, SK Samantha and AC Sasmala (2002) Genetic analysis for some seed parameters in Lablab bean. *Veg. Sci.* **29(1):** 17-19.

Biju MG, KP Prasanna and S Rajan (2001) Genetic divergence in hyacinth bean. *Veg. Sci.* **28:** 163-64.

Burton GW and EH De vane (1953) Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agron. J.* **45:** 578-81.

Deka RK and CR Sarkar (1990) Nutrient composition and anti-nutritional factors of *Dolichos lablab* L. seeds. *Food Chemistry* **38:** 239-246.

Dewey DR and KH Lu (1959) A correlation with path coefficient analysis of components of creasted wheat grass seed production. *Agron. J.* **51:** 515-518.

Fisher RA (1981) The correlation among relative on the supposition of Mendelian Inheritance. *Trans. Royal Soc. Edinberg* **52:** 399-433.

Johnson HW, HE Robinson and RE Comstock (1955) Estimate of genetic and environmental variability in soybean. *Agron. J.* **47:** 314-318.

Lal H, M Rai, A Verma and Vishwanath (2005) Analysis of genetic divergence of Dolichos Bean (*Lablab purpureus*) genotypes. *Veg. Sci.* **32(2):** 129-132.

Lal H, M Rai, Shivkaran, A Verma and D Ram (2007) Multivariate hierarchical clustering of cowpea germplasm (*Vigna ungiculata* L.) Walp. *Acta Hort.* **752:** 413-416.

Panse VG and PV Sukhatme (1985) Statistical methods for Agricultural Workers. 4th edn. ICAR, New Delhi.

Peter JP and JA Martinalli (1989) Hierarchical cluster analysis as a tool to manage variation in germplasm collection. *Theor. Appli. Genet.* **78:** 42-48.

Rai N, DS Yadav and BS Asati (2003) Genetic divergence and path analysis for yield and its traits in Indian bean (*Lablab purpureus* L.). *Veg. Sci.* **30(2):** 115-119.

Wright S (1935) The analysis of variance and the correlations between relative with respect to deviations from an optimum. *J. Genet.* **30:** 243-256.