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Studies on genetic variability and character association in Indian bean [*Lablab purpureus* (L.) Sweet]

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ABSTRACT

Sixty four genotypes of Indian bean [*Lablab purpureus* (L.) Sweet] were evaluated for genetic variability and correlation coefficient analysis for green pod yield and its contributing characters. The analysis of variance revealed significant differences among the genotypes for all the traits. Plant height, seed yield per plant, seed yield q/ha, green pod yield per plant, green pod yield q/ha, pod width, weight of 10 pod, number of green pod per plant, pericarp thickness and days to first flowering exhibited high GCV and PCV values indicating large amount of variation. The highest heritability estimate was observed for days to last picking (99.60 %). In the present study highest value of EGA was observed for the seed yield per plant (194.78%) followed by the green pod yield per plant (175.87%). Green pod yield per plant exhibited positive and significant correlation with green pod yield q/ha, seed yield q/ha, plant height at 60 days, days to first flowering, days to first picking, days to last picking, weight of 10 pod, weight of 100 seed, number of green pod per plant, pod length, pericarp thickness, moisture percentage and seed yield per plant at both genotypic and phenotypic levels.

Key words: Correlation, Genetic advance, Genetic variability, Heritability, Indian bean.

INTRODUCTION

Indian bean [*Lablab purpureus* L. Sweet] is an important vegetable crop. It occupies an unique position for vegetable purpose among the legume vegetables (Biju *et al*., 2001). It is very important as minor vegetable for the fleshy and soft textured green pod, which supplies a good amount of protein, minerals and dietary fiber in vegetarian diet. Its seeds also contain water soluble polysaccharides comprised of rhamnose, xylose, arabinose, galactose, glucose, uronic acid, unidentified sugars and proteins (Basu *et al*., 2002). The knowledge of nature and degree of divergence in existing germplasms is a prerequisite in breeding programme of any crop including Indian bean for effective selection of superior genotypes. 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, since, it indicates the extent of transmissibility of a character in future generations. Knowledge of correlation between yield and its contributing characters are essential to find out guidelines for plant selection. Genetic variability studies of yield components in Indian bean exposed the existence of wide genetic base among the various genotypes. Moreover high heritability, coupled with high genetic gains for most of the characters showed the presence of appropriate genetic background for further selection with a view to improve yield and some of its component characters (Joshi, 1971).

Genetic improvement in Indian bean crop is a continuous demand for higher yield and quality attributes for different agro climatic regions. A large number of Indian bean genotypes with different growth and yield characteristics are grown all over the country as well as in Madhya Pradesh which can be utilized for development of new lines.

MATERIALS AND METHODS

The investigation was carried out at research field department of Vegetable Science, College of Horticulture, Mandsaur during *kharif* season 2012-13. Sixty four Indian bean genotypes *viz*. Bush Type: Arka Jay, Arka Vijay, Konkan Bhushan, MDL-6, MDL-13, MDL-14, MDL-17, MDL-18, MDL-23, MDL-26, MDL-35, MDL40, MDL-50, MDL-53, MDL-58, MDL-64, MDL-68, MDL-82, MDL-83, MDL-84, Pole Type: Pusa Early Prolific, JDL-53, JDL-79, JDL-37, Hissar Kirti, Kashi Haritima, Swarna Utkrisht, MDL-1, MDL-2, MDL-4, MDL-5, MDL-7, MDL-10, MDL-11, MDL-12, MDL-15, MDL-19, MDL-25, MDL-27, MDL-28, MDL-30, MDL-31, MDL-32, MDL-42, MDL-54, MDL-55, MDL-56, MDL-57, MDL-59, MDL-60, MDL-61, MDL-62, MDL-63, MDL-65, MDL-66, MDL-67, MDL-69, MDL-70, MDL-71, MDL-77, MDL-78, MDL-80, MDL-81 and MDL-85 were evaluated in randomized block design with two replications. The sowing was done on ridge with spacing of 1.5×1m for pole type and 90cm×30cm for bush types, respectively. The recommended package of practices was

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followed to raise the crop. Observations were recorded on five randomly taken competitive plants for growth, yield and quality characters.

Analysis of variance was done following the standard procedures. The phenotypic and genotypic coefficient of variance (PCV, GCV) was computed as per method described by Burton and Vane (1953) and Johnson *et al*. (1955). Heritability in broad sense was calculated as per Hanson *et al*. (1956). Genetic advance (% of mean) was calculated as per Robinson *et al*. (1949). Estimates of genotypic and phenotypic correlation were obtained using the formulae given by Johnson *et al*. (1955).

RESULTS AND DISCUSSION

The sixty four genotypes evaluated in the study showed remarkable variations for all the horticultural traits under study as revealed by analysis of variance (Table1). The plant height ranged from 40.17-242.33cm with a mean value of 167.75cm. First flowering was observed from 35-104 days. Number of green pod per plant varied from 9-932 with a mean value of 282.80 per plant. The weight of 10 pods per plant ranged from 31.13-166.13g. Pod length varied from 6.08-16.83cm. Crude protein content in fresh pod ranged from 14.20-19.90g/100g. There was great variation among the genotypes for yield which ranged from11.85-398.62q/ha. Seed yield ranged from 4.22-62.67q/ha. The genotypes exhibited a wide range of phenotypic variability for different characters ranging from 3.93 to 99.44 (Table 1). Phenotypic coefficient of variation was highest for the seed yield per plant (99.44) and lowest phenotypic coefficient of variation was observed in case of moisture percentage (3.93). The genotypic coefficient of variation varied from 3.05 (moisture percentage) to 96.97 (seed yield per plant). Plant height, seed yield per plant, seed yield q/h, green pod yield per plant, green pod yield q/ha, pod width, weight of 10 pod, number of green pod per plant, pericarp thickness and days to first flowering exhibited high GCV and PCV values indicating large amount of variation. Moderate to low GCV and PCV values were noted for the characters *viz*., days to first picking, fiber content, weight of 100 seed, pod length, days to last picking, number of seed per pod, protein content, shelling percentage and moisture percentage.

There was not much difference between GCV and PCV values in almost all the characters, indicating less influence of environment. As per expectation, the magnitude of PCV was slightly greater than the GCV for all the characters. These results are in conformity with the findings of earlier workers like Basu *et al*. (1999) who reported that the genotypic coefficients of variation (GCV) as well as phenotypic coefficient of variation (PCV) were high for all the characters and the meager differences between GCV and PCV indicated the importance of the heritable component for their expression. The high magnitude of GCV further revealed the great extent of variability present in the characters, thereby suggesting good scope for improvement through selection. Choudhary and Sharma (2003) had also observed highest phenotypic and genotypic coefficient of variations for plant height, number of pods per plant, first flowering node and pod yield per plant. Rai *et al*. (2009) found high GCV for pod thickness, number of pods per plant,

Table 1: Variability and genetic parameters for different growth, yield and quality traits in Indian bean.

Characters	Range		Grand mean	Genotypic coefficient of variance	Phenotypic coefficient of variance	Heritability per cent	Genetic advance (K=2.06)	Genetic advance per cent
	Min.	Max.						
Plant height	40.17	242.33	167.75	43.80	44.39	97.36	149.37	89.04
Days to first flowering	35.00	104.00	72.14	33.48	33.60	99.25	49.56	68.70
Days to first picking	54.00	135.00	100.04	27.32	27.86	96.19	55.23	55.21
Days to last picking	104.00	223.00	190.13	18.27	18.31	99.60	71.43	37.57
Number of green pod per plant.	9.00	932.00	282.80	84.97	85.60	98.54	491.39	173.75
Weight of 10 pod	31.13	166.13	66.71	41.16	41.55	98.13	56.04	83.99
Pod length (cm)	6.08	16.83	12.47	18.57	18.99	95.60	4.66	37.39
Pod width (mm)	8.53	40.23	17.57	45.63	45.95	98.61	16.40	93.35
Pericarp thickness (mm)	0.65	2.37	1.34	34.21	35.76	91.49	0.90	67.40
Moisture per cent	77.65	94.91	86.51	3.05	3.93	60.23	4.21	4.87
Crude protein content (dry weight basis g/100g) in fresh pod	14.20	19.90	16.66	7.19	8.83	66.22	2.01	12.05
Fiber content (fresh weight basis g/100g) in fresh pod	0.50	2.59	1.52	20.45	24.98	67.00	0.53	34.48
Green pod yield per plant	32.00	6230.00	1810.98	86.11	85.74	99.14	3185.05	175.87
Green pod yield (q/ha)	11.85	398.62	134.23	67.08	67.37	99.17	184.72	137.62
Number of seed per pod	3.25	5.83	4.54	10.12	11.91	72.13	0.80	17.70
Shelling per cent	61.14	89.97	76.51	7.19	7.21	99.27	11.29	14.75
Weight of 100 seed	20.70	61.17	37.02	24.03	24.21	98.53	18.19	49.15
Seed yield per plant (g)	11.40	940.12	255.25	96.97	99.44	95.09	497.17	194.78
Seed yield (q/ha)	4.22	62.67	18.72	80.38	82.87	94.10	30.07	160.63

pod width, pod weight, pod length and yield/plant. Islam *et al*. (2011) had recorded high genotypic coefficient of variation for 100-green seed weight, pod yield per plant, number of pods per plant and harvesting duration.

In the present investigation heritability (%) ranged from 60.23 to 99.60 (Table 1). Higher heritability estimates were observed for days to last picking (99.60 %) followed by shelling percentage (99.27%), days to first flowering (99.25%), green pod yield q/ha (99.17%), green pod yield per plant (99.14%), pod width (98.61%), number of green pod per plant (98.54%), weight of 100 seed (98.53%), weight of 10 pod (98.13%), plant height (97.36%), days to first picking (96.19%), pod length (95.60%), seed yield per plant (95.09%), seed yield q/ha (94.10%) and pericarp thickness (91.49%), indicating less influence of environment on the expression of these characters. These results indicated the presence of high heritability for majority of the characters. High heritability estimates suggest the major role of genetic constitution in the expression of the character and such traits are considered to be dependable from breeding point of view. Similarly Gnanesh *et al*. (2006) had also recorded high heritability for majority of characters. Golani *et al*. (2007) reported high heritability for pod width, 10-pod weight, plant spread and pod length. Singh *et al*. (2011) noted high heritability for days to first flower, days to first picking, pod length and pod yield/plant. The expected genetic advance (EGA) expressed as per cent of mean ranged from 4.87 % (moisture percentage) to 194.78 % (seed yield per plant). In this study high values of EGA were observed for the characters viz., seed yield per plant (194.78%) followed by the green pod yield per plant (175.87%), number of green pod per plant (173.75%), seed yield q/ha. (160.63%), green pod yield q/ha (137.6%), pod width (93.35%), plant height (89.04%), weight of 10 pod (83.99 %), days to first flowering (68.70 %), pericarp thickness (67.40 %), days to first picking (55.21 %) and weight of 100 seed (49.15 %). Similar findings with high genetic advance as per cent of mean were reported by Joshi (1971). During the present investigation low values of expected genetic advance as per cent of mean was observed for the characters *viz*., number of seed per pod (17.70%), shelling percentage (14.75%), protein content (12.05%) and moisture percentage (4.87%) indicating considerable influence of environment on the expression of all these characters.

Generally higher heritability accompanied with high genetic advance as per cent of mean in a character suggests that the inheritance of such character is governed mainly by additive gene effects and therefore selection based on phenotypic performance may prove useful. In the present study characters like plant height, days to first flowering, days to first picking, pod width, green pod yield per plant, green pod yield q/ha, seed yield per plant (g), seed yield q/ha, weight of 10 pod, weight of 100 seed, pericarp thickness and number of green pod per plant exhibited high heritability values along with the high genetic advance. Thus the expression of these traits is predominantly governed by additive gene effects and therefore selection based on phenotypic performance will be helpful to improve these characters in future. More over it is seen that these traits have less influence of the environment. The estimates of high heritability along with low genetic advance were observed for the characters like days to last picking, pod length and shelling percentage.

Results obtained in the present study revealed that plant height exhibited positive and significant correlation with days to first flowering, days to first picking, days to last picking, pod length, number of seed per pod, green pod yield per plant, green pod yield q/ha, seed yield q/ha, weight of 10 pod, weight of 100 seed, shelling percentage, moisture percentage, pericarp thickness, number of green pod per plant and seed yield per plant (g) at both genotypic and phenotypic levels (Table 2 & 3). These findings were corroborated by Dahiya *et al*. (1991) and Bagade *et al*. (2004). Days to first flowering exhibited positive and significant correlation at both genotypic and phenotypic levels with plant height, days to first picking, days to last picking, pod length, number of seed per pod, green pod yield per plant, green pod yield q/ha, seed yield q/ha, weight of 10 pod, weight of 100 seed, moisture percentage, pericarp thickness, number of green pod per plant and seed yield per plant. Similar results were reported by Bagade *et al*. (2004). Days to first picking exhibited positive and significant association at both genotypic and phenotypic levels with plant height, days to first flowering, days to last picking, pod length, number of seed per pod, green pod yield per plant, green pod yield q/ha, seed yield q/ha, weight of 10 pod, weight of 100 seed, moisture percentage, pericarp thickness (mm), number of green pod per plant and seed yield per plant. Similar observations were recorded by Tikka *et al*. (2003) and Bagade *et al*. (2004). Days to last picking had positive and significant correlation at both genotypic and phenotypic levels with plant height, days to first flowering, days to first picking, pod length, number of seed per pod, green pod yield per plant, green pod yield q/ha, seed yield q/ha, weight of 10 pod, weight of 100 seed, moisture percentage, pericarp thickness, number of green pod per plant and seed yield per plant. Similar trend was also observed by Tikka *et al*. (2003). Number of green pod per plant recorded positive and significant correlation with plant height, days to first flowering, days to first picking, days to last picking, green pod yield per plant, green pod yield q/ha, seed yield per plant (g) and seed yield q/ha at both genotypic and phenotypic levels. Similar results were also reported by Gnanesh *et al*. (2006) and Singh *et al*. (2011) in Indian bean. Weight of 10 pod exhibited positive and significant association with plant height, days to first flowering, days to first picking,

TABLE 2. Estimates of genotypic correlation coefficient between different horticultural traits in Indian bean

Characters	DFF	DFP	DLP	NGP /plant	W 10 P	PL (cm)	PW (mm)	PT (mm)	M%	PC (g)	FC (g)	GPY /P(g)	GPY (q/h)	NS/P	S %	W 100 S	Seed yield per plant (g)	SY (q/h)
PH	0.839**	0.759**	0.830**	0.678**	0.620**	0.520**	-0.065	0.547**	0.471**	0.124	-0.333*	0.715**	0.717**	0.416*	0.333*	0.643**	0.627**	0.627**
DFF		0.880**	0.734**	0.728**	0.548**	0.530**	-0.032	0.461**	0.510**	0.015	-0.386*	0.708**	0.712**	0.409*	0.241	0.536**	0.690**	0.690**
DFP			0.648**	0.718**	0.491**	0.521**	-0.026	0.376*	0.515**	0.041	-0.371*	0.644*	0.64**	0.468**	0.145	0.419*	0.661**	0.661**
DLP				0.621**	0.534**	0.422*	-0.034	0.471**	0.386*	0.186	-0.244	0.652**	0.655**	0.346*	0.281	0.491**	0.552**	0.552**
NGP/plant					0.237	0.257	-0.111	0.280	0.185	0.009	-0.036	0.805**	0.808**	0.238	0.077	0.233	0.735**	0.735**
W 10 P						0.478**	0.380*	0.517**	0.560**	0.181	-0.527**	0.606**	0.611**	0.473**	0.004	0.768**	0.238	0.238
PL (cm)							-0.201	0.530**	0.427*	-0.050	-0.415*	0.435**	0.435**	0.563**	0.278	0.543**	0.362*	0.362*
PW (mm)								-0.086	0.049	0.164	-0.026	0.075	0.079	0.079	-0.489*	0.092	-0.177	-0.177
PT (mm)									0.388*	0.046	-0.369	0.527**	0.526**	0.211	0.232	0.629**	0.275	0.275
M%										0.070	-0.887**	0.391*	0.393*	0.395*	0.169	0.508**	0.245	0.245
PC (g)											-0.125	0.129	0.124	0.145	-0.054	0.060	-0.059	-0.059
FC (g)												-0.323	-0.324	-0.380*	-0.175	-0.527**	-0.151	-0.151
GPY /P(g)													0.999**	0.423*	0.065	0.597**	0.637**	0.637**
GPY (q)/h														0.423*	0.062	0.597**	0.639**	0.639**
NS/P															0.134	0.393*	0.255	0.255
S %																0.280	0.186	0.186
W 100 S																	0.331*	0.331*
Seed yield																		1.00**

** 1% level of significance
* 5% level of significance

TABLE 3: Estimates of phenotypic correlation coefficient between different horticultural traits in Indian bean

Characters	DFF	DFP	DLP	NGP /plant	W 10 P	PL (cm)	PW (mm)	PT (mm)	M%	PC (g)	FC (g)	GPY /P(g)	GPY (q/h)	NS/P	S %	W 100 S	Seed yield per plant (g)	SY (q/h)
PH	0.839**	0.759**	0.830**	0.678**	0.620**	0.520**	-0.065	0.547**	0.471**	0.124	-0.333*	0.715**	0.717**	0.416*	0.333*	0.643**	0.627**	0.627**
DFF		0.880**	0.734**	0.728**	0.548**	0.530**	-0.032	0.461**	0.510**	0.015	-0.386*	0.708**	0.712**	0.409*	0.241	0.536**	0.690**	0.690**
DFP			0.648**	0.718**	0.491**	0.521**	-0.026	0.376*	0.515**	0.041	-0.371*	0.644*	0.64**	0.468**	0.145	0.419*	0.661**	0.661**
DLP				0.621**	0.534**	0.422*	-0.034	0.471**	0.386*	0.186	-0.244	0.652**	0.655**	0.346*	0.281	0.491**	0.552**	0.552**
NGP/plant					0.237	0.257	-0.111	0.280	0.185	0.009	-0.036	0.805**	0.808**	0.238	0.077	0.233	0.735**	0.735**
W 10 P						0.478**	0.380*	0.517**	0.560**	0.181	-0.527**	0.606**	0.611**	0.473**	0.004	0.768**	0.238	0.238
PL (cm)							-0.201	0.530**	0.427*	-0.050	-0.415*	0.435**	0.435**	0.563**	0.278	0.543**	0.362*	0.362*
PW (mm)								-0.086	0.049	0.164	-0.026	0.075	0.079	0.079	-0.489*	0.092	-0.177	-0.177
PT (mm)									0.388*	0.046	-0.369	0.527**	0.526**	0.211	0.232	0.629**	0.275	0.275
M%										0.070	-0.887**	0.391*	0.393*	0.395*	0.169	0.508**	0.245	0.245
PC (g)											-0.125	0.129	0.124	0.145	-0.054	0.060	-0.059	-0.059
FC (g)												-0.323	-0.324	-0.380*	-0.175	-0.527**	-0.151	-0.151
GPY /P(g)													0.999**	0.423*	0.065	0.597**	0.637**	0.637**
GPY (q)/h														0.423*	0.062	0.597**	0.639**	0.639**
NS/P															0.134	0.393*	0.255	0.255
S %																0.280	0.186	0.186
W 100 S																	0.331*	0.331*
Seed yield per plant(g)																		1.00**

** 1% level of significance
* 5% level of significance

days to last picking, weight of 100 seed, pod length, pod width, green pod yield per plant, green pod yield q/ha, number of seed per pod, moisture percentage and pericarp thickness at both genotypic and phenotypic levels. Similar results were reported by Nahar and Newaz (2005) in Indian bean. The character pod length showed positive and significant association with pericarp thickness, moisture percentage, green pod yield per plant, green pod yield q/ha, number of seed per pod, weight of 10 pod, weight of 100 seed, seed yield q/ha, and seed yield per plant at both genotypic and phenotypic levels. Similar finding were observed by Tikka *et al.* (2003), Bagade *et al*. (2004) and Patel *et al*. (2011). Pod width exhibited positive and significant correlation at both genotypic and phenotypic levels with plant height at 60 days, days to first flowering, days to first picking, days to last picking, weight of 10 pod and pod length. These results are in agreement with those of Patel *et al.* (2011). The character pericarp thickness exhibited positive and significant correlation at both genotypic and phenotypic levels with plant height at 60 days, days to first flowering, days to first picking, days to last picking, moisture percentage, green pod yield per plant, pod length, green pod yield q/ha, weight of 100 seed and weight of 10 pod Similar results were reported by Patel *et al.* (2011). The moisture percentage in both had positive and significant correlation with green pod yield per plant, green pod yield q/ha, weight of 100 seed and number of seed per pod at both genotypic and phenotypic levels. Green pod yield per plant exhibited positive and significant correlation with green pod yield q/ha, seed yield q/ha, plant height, days to first flowering, days to first picking, days to last picking, weight of 10 pod, weight of 100 seed, number of green pod per plant, pod length, pericarp thickness, moisture percentage and seed yield per plant at both genotypic and phenotypic levels. Similar results were reported by Bagade *et al*. (2004) and Islam *et al.* (2011) in Indian bean. Green pod yield per hectare exhibited positive and significant correlation with green pod yield per plant, seed yield q/ha, number of seed per pod, weight of 100 seed, plant height at 60 days, days to first flowering, days to first picking, days to last picking, weight of 10 pod, pod length, moisture percentage and seed yield per plant at both genotypic and phenotypic levels. Similar results were reported by Bagade *et al*. (2004) and Islam *et al.* (2011) in Indian bean. Number of seed per pod exhibited significantly positive association with weight of 100 seed and plant height at both genotypic and phenotypic levels. These findings are in line with Tikka *et al.* (2003), Bagade *et al*. (2004) and Patel *et al.* (2011). Shelling per cent exhibited significantly positive association with plant height, days to first flowering, days to first picking, days to last picking, weight of 10 pod, pod length, green pod yield q/ha, green pod yield per plant, moisture percentage, Number of seed per pod and pericarp thickness at both genotypic and phenotypic levels. These findings are in line with Tikka *et al.* (2003), Bagade *et al*. (2004) and Patel *et al.* (2011). Weight of 100 seed recorded positive and significant correlation with plant height, days to first flowering, pod length, days to first picking, days to last picking, green pod yield per plant, green pod yield q/ha, seed yield per plant and seed yield per hectare at genotypic and phenotypic levels. Tikka *et al.* (2003), Bagade *et al*. (2004) and Gnanesh *et al*. (2006) had also observed similar findings in Indian bean. Seed yield per plant exhibited positive and significant correlation with plant height, days to first flowering, days to first picking, days to last picking, weight of 100 seed, number of green pod per plant, pod length green pod yield per plant, green pod yield q/ha and seed yield q/ha at both genotypic and phenotypic levels. These findings are in agreement with those of Bagade *et al*. (2004) in Indian bean. Seed yield q/ha exhibited positive and significant correlation with plant height, days to first flowering, days to first picking, days to last picking, weight of 100 seed, number of green pod per plant, pod length green pod yield per plant, green pod yield q/ha, and seed yield per plant at both genotypic and phenotypic levels. Bagade *et al*. (2004) had also observed similar findings in Indian bean.

It is concluded from the study that a wide range of variability is present for all the characters in the germplasm of Indian bean. The characters like days to first flower, days to first picking, weight of 10 pod, number of pod per plant, pod length, pod width, green pod yield per plant (g), green pod yield (q/h), seed yield per plant (g) and seed yield (q/h) can further be improved through selection.

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