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Research Note

Genetic variability and character association studies in Jack bean (*Canavalia ensiformis* (L.) DC.) for yield and yield contributing traits

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Abstract
Fifteen genotypes of Jack bean were studied for variability, correlation and path analysis. The characters *viz.*, plant height at first harvest, number of primaries per plant at first harvest, plant height at last harvest, number of primaries per plant at last harvest, pod weight, number of pods per plant, number of seeds per pod, 100 seed weight and pod yield per plant were observed with high genetic variability, high heritability in conjunction with higher genetic advance as percent mean indicating the predominance of additive gene action on the expression of these traits and hence direct selection will be rewarding for improvement of these traits in Jack bean. This complex set of association between various yield components clearly indicated that selection of early genotypes would be reliable to increase the pod length, pod weight, number of pods and ultimately pod yield per plant.

Keywords
Jack bean, variability, correlation

Jack bean (*Canavalia ensiformis* (L.) DC.) belongs to the family leguminosae is one of the underexploited tropical dry bean however, fairly widely distributed from West Indies (origin) to Central and South America (Anonymous, 1950). The Genus *Canavalia* consisting of 48 species of which, four species are reported from India, *viz*., *C. ensiformis, C. gladiata, C. maritima* and *C. virosa*. Out of these four species, *C. ensiformis* (Jack bean) and *C. gladiata* (Sword bean) were reported to cultivated in North East region of India for the edible pods (Bose *et al*. 2003). The exploitation of genetic variability is a pre-requisite for the effective screening of superior genotypes for improvement of yield and yield related characters. The progress in breeding for the yield and its contributing characters of any crop is polygenically controlled, environmentally influenced and determined by the magnitude and nature of their genetic variability. Hence, it is essential to partition the overall variability into its heritable and non-heritable components with the help of genetic parameters like variability, heritability and genetic advance. Knowledge of correlations among different characters and further partitioning them into direct and indirect effects help to understand the nature and extent of such relationship. Therefore, study of genetic variability, correlation and path coefficient are pre-requisite for improvement of any crop.

Fifteen genotypes were sown in rows with spacing of 3.0 'm' between rows and 0.5 'm' between plants at NBPGR (RS), Hyderabad in a RBD with three replications during the period from August 2013 to February 2014. The climate of Hyderabad is semi arid tropical climate and it lies at latitude of 17.19^0 N and longitude of 79.23^0 E, with an altitude of 542.3m above the Mean Sea Level. All the package of practices to raise the crop was followed as recommended for dolichos bean as Jack bean is under exploited vegetable. The need based plant protection measures was done to raise the healthy crop. Data were collected on randomly selected five plants in each genotype in each replication for yield and 15 yield contributing characters. The genotypic and phenotypic coefficients of variation were calculated according to Falconer (1981). Heritability (h^2) in broad sense was calculated according to the formula given by Allard (1960). From the heritability estimates, the genetic advance was calculated by the formula given by Burton (1952). Phenotypic and genotypic correlation coefficients were calculated using the formulae suggested by Al-Jibouri *et al*. (1958). Path coefficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959) at both phenotypic and genotypic levels was used.

The Estimates of variability, heritability and genetic advance as percent of mean for different characters were presented in Table 1. The results showed that the values of phenotypic variance and phenotypic coefficient of variation were higher than genotypic variance and genotypic coefficient of variance for all the characters studied but the difference was very narrow indicating the low influence of environment for their expression. The phenotypic and genotypic variances were higher (>20) for the traits *viz*., marketable pod yield per plant (24045.14 P, 23091.38 G), plant height at last harvest (12231.78 P, 11593.01 G), plant height at first harvest (10780.83 P, 9892.75 G), 100 seed

weight (5541.80P, 5392.07 G), days to last pod harvest (194.87 P, 187.78 G) and number of pods per plant (28.09 P, 26.43 G). Similar results were also reported by Durga, (2012) in Horse gram for number of pods per plant; Salim *et al.* (2013), Chattopadhyay and Dutta (2010) and Upadhyay and Mehta (2010) in Dolichos bean for number of pods per plant, 100 seed weight and pod yield per plant while, Alemu *et al.* (2013) in French bean for plant height, number of pods per plant and pod yield per plant.

PCV and GCV were higher (> 20) for the traits viz., plant height at first harvest (34.69 P, 33.23 G), number of primary branches per plant at first harvest (36.65 P, 35.26 G), plant height at last harvest (33.02 P, 32.14 G), number of primary branches per plant at last harvest (34.72 P, 33.47 G), pod weight (24.28 P, 23.50 G), number of pods per plant (21.56 P, 20.92 G), number of seeds per pod (21.39 P, 20.09 G), 100 seed weight (41.07 P, 40.51 G) and marketable pod yield per plant (40.31 P, 39.51 G). Parmar *et al.* (2013) and Chattopadhyay and Dutta (2010) reported the higher PCV and GCV values for 100 seed weight, pod yield per plant and number of pods per plant in Dolichos bean.

High heritability for the characters might be useful for plant breeder for making effective selection. In the present study all the characters studied recorded high heritability (>60) except days to first pod harvest (54%) which recorded the moderate heritability (40 – 60%). In French bean, Alemu *et al.* (2013) recorded the high heritability for days to 50 percent flowering, pod length, pod width whereas in Dolichos bean, Parmar *et al.* (2013), Singh *et al.* (2011) and reported for days to first flowering, days to 50 percent flowering, number of pods per plant, pod weight, pod length, pod width, number of seeds per pod, 100 seed weight and pod yield per plant. Though heritability gives a useful indication of relative value of selection based on phenotypic expression, it cannot be reliable conclusion, unless genetic advance under selection is not taken into consideration along with heritability. Genetic advance was noticed higher (> 20) for the traits like pod yield per plant (306.76), plant height at last harvest (215.93), plant height at first harvest (196.27), 100 seed weight (149.21) and days to last pod harvest (27.71) suggesting the important role of genetic factors in the expression of these characters as genetic advance was estimated on the basis of heritability in broad sense. Similar results were reported by Salim *et al.* (2013) in Dolichos bean.

Plant height at first harvest (65.58), number of primary branches per plant at first harvest (69.88), plant height at last harvest (64.47), number of primary branches per plant at last harvest (66.48), days to last pod harvest (23.75), pod length (30.13), pod weight (46.89), number of pods per plant (41.80), number of seeds per pod (38.89), 100 seed weight (82.31) and marketable pod yield per plant (79.76) recorded high (> 20) GA as percent of mean in coupled with high heritability indicating the suitability of characters for phenotypic selection.. The higher values of GA as percent of mean was reported by Parmar *et al.* (2013) and Salim *et al.* (2013) reported in Dolichos bean.

From the correlation studies (Table 2) it was apparent that pod weight had significantly positive correlation coefficient with pod yield per plant (0.8459 P, 0.8520 G). The results were in conformity with the studies of Upadhyay and Mehta (2010), Chattopadhyay and Dutta (2010), Parmar *et al.* (2013) in Dolichos bean and Akande and Balogun (2007) in French bean. However, the significant negative correlation was observed with days to 50% flowering (-0.5245 P, -0.5962 G). The character number of pods per plant was positively and significantly associated with pod yield per plant (0.8077 P, 0.8156 G). The results were in concordance with the findings of Chattopadhyay and Dutta (2010) in Dolichos bean. Thus it indicates direct selection based on these characters would help in effective improvement in yield of jack bean. Further, the significant and negative association between plant height, days to flowering, days to 50% flowering, days to first fruit set and days to fruit harvest on yield indicating selection of genotypes showing earliness in flowering and fruit set would be reliable to increase the number of pods per plant and hence yield per plant.

Knowledge on the interrelationship among the yield components is needed in a selection programme. In the present study, plant height and pod width were strongly and positively correlated with each other phenotypically and genotypically. Positive and highly significant correlation were also observed between days to first flowering and days to 50% flowering, days to fruit set, days to first pod harvest, days to last pod harvest; between days to 50% flowering and days to fruit set, days to first pod harvest; between days to flowering and days to first pod harvest. Further, these traits had significant negative association with number of pods per plant, pod length and pod weight at genotypic level. This complex set of association between various yield components clearly indicated that selection of early genotypes would be reliable to increase the pod length, pod weight, number of pods and ultimately pod yield per plant.

References

Akande, S. R. and Balogun, M. O. 2007. Evaluation and heritability studies of local Lima bean (Phaseolus lunatus L.) cultivars from south-west Nigeria. Revista UDO Agricola, 7(1): 22 – 28.

Alemu, Y., Alamirew, S. and Dessalegn, L. 2013. Genetic variability in Snap bean (Phaseolus vulgaris L.) genotypes in central rift valley of Ethiopia. Internat. J. Plant Breed. Genet., 7(2): 124 – 131.

Al-Jibouri, H. A., Miller, P. A. and Robinson, H. F. 1958. Genotypic and environmental variances and covariances in an upland cotton cross of interspecific origin. Agron. J., 50: 633 – 636.

Allard, R. W. 1960. Principles of Plant Breeding. John Wiley and Sons Inc, New York, USA, pp 485.

Anonymous. 1950. The Wealth of India, Council of Scientific and Industrial Research, New Delhi, Volume II, pp 56.

Bose, T. K., Kabir, J., Maity, T. K., Parthasarathy, V. A. and Som, M. G. 2003. Vegetable crops, Volume II, Published by Partha sankar basu, Naya Udyog, Printed by New Sarada Press, pp 293-295.

Burton, G. W. 1952. Quantitative inheritance in grasses. Proceedings of 6th International Grassland Congress, 1: 277 – 283.

Chattopadhyay, A. and Dutta, S. 2010. Characterization and identification of selection indices of pole type dolichos bean. Vegetable crops Res. bull., 73: 33 – 45.

Dewey, J. R. and Lu, K. H. 1959. Correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J., 51: 515 – 518.

Dubey, A. K., Singh, N. P. and Srivastava, J. P. 2009. Character association and coefficient analysis in French bean (Phaseolus vulgaris L.). Vege. Sci., 36(3): 378 – 379.

Durga, K. K. 2012. Variability and divergence in horse gram (Dolichos uniflorus). J. Arid Land. 4(1): 71−76.

Falconer, D. S. 1981. Introduction to quantitative genetics. Oliver and Boyd, London, pp 340.

Karasu, A. and Oz, M. 2010. A study on coefficient analysis and association between agronomical characters in dry bean (Phaseolus vulgaris l.). Bulgarian J. Agric. Sci.,. 16(2): 203 – 211.

Kulaz, H. and Ciftci, F. 2012. Relationships among yield components and selection criteria for seed yield improvement in Bush Bean (Phaseolus vulgaris L.). J. Agric.Sci., 18: 257 – 262.

Lal, H, Rai, M, Verma, A. and Vishwanath. 2005. Analysis of genetic divergence of Dolichos bean (lablab purpureus) genotypes. Veg. Sci., 32(2): 129 – 132.

Mehra, D. and Singh, D. K. 2012. Path analysis for pod yield in French bean (Phaseolus vulgaris L.). Veg. Sci., 39(2): 192 – 194.

Parmar, A. M., Singh, A. P., Dhillon N.P.S. and Jamwal, M. 2013. Genetic variability studies for morphological and yield traits in dolichos Bean (Lablab purpureus L.). World J. Agric. Sci., 9(1): 24 – 28.

Salim, M, Hossain, S, Alam, S, Rashid, J. A. and Islam, S. 2013. Estimation of genetic divergence in lablab bean (Lablab purpureus L.) genotypes. Bangladesh J. Agril. Res., 38(1): 105 – 114.

Singh, Pramod, K, Rai, N, Lal, Hira, Bhardwaj, D. R, Singh, Rashmi, Singh and Anand Prakash. 2011. Correlation, path and cluster analysis in hyacinth bean (Lablab purpureus (L.) Sweet). J. Agric. Technol., 7(4): 1117 – 1124.

Upadhyay, D. and Mehta, N. 2010. Biometrical Studies in Dolichos Bean (Dolichos lablab L.) for Chhattisgarh Plains. Res. J. Agric. Sci., 1(4): 441-447.

Wright, S. 1921. Correlation and causation. J. Agric. Res., 20: 557 – 585.

Table 1. Estimates of variability, heritability and genetic advance as percent of mean for different characters of jack bean

Sl. No.	Character	PCV (%)	GCV (%)	h^2 (%) (Broad sense)	Genetic Advance	GA as percent of mean
1.	Plant height at first harvest (cm)	34.69	33.23	91	196.27	65.58
2.	No. of primary branches per plant at first harvest	36.65	35.26	92	2.25	69.88
3.	Plant height at last harvest (cm)	33.02	32.14	94	215.93	64.47
4.	No. of primary branches per plant at last harvest	34.72	33.47	92	2.23	66.48
5.	Days to first flowering	6.29	5.31	71	5.061	9.24
6.	Days to 50 per cent flowering	6.86	6.17	80	6.90	11.44
7.	Days to fruit set (for first formed flowers)	6.10	4.96	65	4.73	8.29
8.	No. of days to first pod harvest	6.49	4.79	54	5.09	7.29
9.	No. of days to last pod harvest	11.96	11.74	96	27.71	23.75
10.	Pod length (cm)	15.46	15.04	94	4.95	30.13
11.	Pod width (cm)	11.07	9.32	70	0.30	16.16
12.	Pod weight (g)	24.28	23.50	93	7.19	46.89
13.	No. of pods per plant	21.56	20.92	94	10.27	41.80
14.	No. of seeds per pod	21.39	20.09	88	3.65	38.89
15.	100 seed weight (g)	41.07	40.51	97	149.20	82.31
16.	Pod yield per plant (g)	40.31	39.51	96	306.76	79.76

Table 2. Phenotypic (P) and genotypic (G) correlation coefficients among yield and yield attributing traits in Jack bean

Character		P ht F Harv	No. Pri/pl F Harv	P ht L Harv	No. Pri/pl L Harv	DFFL	DFL 50%	DFS	D F P Harv	D L P Harv	P length	P Width	P weight	No. of P/P	No. of S/P	100 SW	Pod Y/P (gm)
P ht F Harv	**P**	**1.0000**	-0.6331*	0.9489**	-0.6343*	0.2562	0.1494	0.2931	0.1230	0.4880	-0.5899*	0.4438	- 0.1330	0.2808	-0.5484*	0.1934	0.0983
	G	**1.0000**	-0.6698**	0.9860**	-0.6726**	0.3459	0.1901	0.4101	0.1601	0.5066	-0.6335*	0.5625*	-0.1393	0.3016	-0.6330*	0.2111	0.1032
No. Pri/pl F Harv	**P**	-0.6331*	**1.0000**	-0.6472**	0.9961**	-0.3707	- 0.3826	- 0.4218	- 0.2605	-0.3557	0.4845	-0.4099	- 0.0768	-0.1051	0.4127	- 0.4345	-0.1623
	G	-0.6698**	**1.0000**	-0.6753**	1.0003**	-0.4297	-0.4291	-0.5138	-0.3174	-0.3595	0.5288*	-0.5244*	-0.0699	-0.1121	0.4949	-0.4616	-0.1630
P ht L Harv	**P**	0.9489**	-0.6472**	**1.0000**	-0.6498**	0.1814	0.1117	0.2255	0.1119	0.4143	-0.5941*	0.4534	- 0.1645	0.2830	-0.5976*	0.2140	0.0891
	G	0.9860**	-0.6753**	**1.0000**	-0.6747**	0.2530	0.1354	0.3133	0.1515	0.4281	-0.6340*	0.5297*	-0.1745	0.3205	-0.6407*	0.2259	0.1013
No. Pri/pl L Harv	**P**	-0.6343*	0.9961**	-0.6498**	**1.0000**	-0.3724	- 0.3836	- 0.4224	- 0.2593	-0.3736	0.5080	-0.4276	- 0.0778	-0.0932	0.4293	- 0.4258	-0.1579
	G	-0.6726**	1.0003**	-0.6747**	**1.0000**	-0.4426	-0.4360	-0.5245*	-0.3279	-0.3820	0.5502*	-0.5492*	-0.0633	-0.1055	0.4979	-0.4544	-0.1584
DFFL	**P**	0.2562	-0.3707	0.1814	-0.3724	**1.0000**	0.8454**	0.9797**	0.7932**	0.1051	-0.4638	0.1433	-0.2554	-0.4392	- 0.4506	0.1023	-0.4002
	G	0.3459	-0.4297	0.2530	-0.4426	**1.0000**	0.8604**	0.9850**	0.7545**	0.0481	-0.6150*	0.2466	-0.3313	-0.5455*	-	0.0823	-0.4944
DFL 50%	**P**	0.1494	- 0.3826	0.1117	- 0.3836	0.8454**	**1.0000**	0.8232**	0.6216*	0.0227	-0.4128	- 0.0018	-0.4534	- 0.4618	- 0.3161	0.0878	-0.5245*
	G	0.1901	-0.4291	0.1354	-0.4360	0.8604**	**1.0000**	0.8435**	0.6024*	-0.0196	-0.5204*	0.0369	-0.5239*	-0.5277*	-0.4101	0.0916	-0.5962*
DFS	**P**	0.2931	- 0.4218	0.2255	- 0.4224	0.9797**	0.8232**	**1.0000**	0.8271**	0.0836	-0.4283	0.1290	-0.2498	- 0.3511	-0.4182	0.1968	-0.3541
	G	0.4101	-0.5138	0.3133	-0.5245*	0.9850**	0.8435**	**1.0000**	0.7999**	0.0197	-0.5937*	0.1978	-0.3372	-0.4520	-0.6156*	0.2032	-0.4542
D F P Harv	**P**	0.1230	- 0.2605	0.1119	- 0.2593	0.7932**	0.6216*	0.8271**	**1.0000**	-0.1378	-0.2163	0.0360	-0.2085	-0.2698	-0.2267	0.1601	-0.2880
	G	0.1601	-0.3174	0.1515	-0.3279	0.7545**	0.6024*	0.7999**	**1.0000**	-0.3052	-0.3707	0.0922	-0.2997	-0.3911	-0.4142	0.1457	-0.4069
D L P Harv	**P**	0.4880	-0.3557	0.4143	-0.3736	0.1051	0.0227	0.0836	-0.1378	**1.0000**	-0.3440	0.4636	0.2009	0.2071	-0.2141	0.0498	0.2949
	G	0.5066	-0.3595	0.4281	-0.3820	0.0481	-0.0196	0.0197	-0.3052	**1.0000**	-0.3792	0.5547*	0.2048	0.2127	-0.2664	0.0420	0.3010
P length	**P**	-0.5899*	0.4845	-0.5941*	0.5080	-0.4638	-0.4128	-0.4283	-0.2163	-0.3440	**1.0000**	-0.4938	0.2279	0.1062	0.8218**	-0.0560	0.1370
	G	-0.6335*	0.5288*	-0.6340*	0.5502*	-0.6150*	-0.5204*	-0.5937*	-0.3707	-0.3792	**1.0000**	-0.6271*	0.2319	0.1086	0.8670**	-0.0554	0.1345
P Width	**P**	0.4438	-0.4099	0.4534	-0.4276	0.1433	- 0.0018	0.1290	0.0360	0.4636	-0.4938	**1.0000**	0.0974	-0.1098	-0.4787	-0.3037	0.0579
	G	0.5625*	-0.5244*	0.5297*	-0.5492*	0.2466	0.0369	0.1978	0.0922	0.5547*	-0.6271*	**1.0000**	0.1798	-0.1127	-0.6199*	-0.3981	0.1165
P Weight	**P**	- 0.1330	- 0.0768	- 0.1645	- 0.0778	-0.2554	-0.4534	-0.2498	-0.2085	0.2009	0.2279	0.0974	**1.0000**	0.3931	0.1907	0.0396	0.8459**
	G	-0.1393	-0.0699	-0.1745	-0.0633	-0.3313	-0.5239*	-0.3372	-0.2997	0.2048	0.2319	0.1798	**1.0000**	0.4148	0.2047	0.0564	0.8520**
No. P/P	**P**	0.2808	-0.1051	0.2830	-0.0932	-0.4392	- 0.4618	- 0.3511	-0.2698	0.2071	0.1062	-0.1098	0.3931	**1.0000**	0.2717	0.4062	0.8077**
	G	0.3016	-0.1121	0.3205	-0.1055	-0.5455*	-0.5277*	-0.4520	-0.3911	0.2127	0.1086	-0.1127	0.4148	**1.0000**	0.2993	0.4231	0.8156**
No. of S/P	**P**	-0.5484*	0.4127	-0.5976*	0.4293	- 0.4506	- 0.3161	-0.4182	-0.2267	-0.2141	0.8218**	-0.4787	0.1907	0.2717	**1.0000**	0.0602	0.2362
	G	-0.6330*	0.4949	-0.6407*	0.4979	-0.6501**	-0.4101	-0.6156*	-0.4142	-0.2664	0.8670**	-0.6199*	0.2047	0.2993	**1.0000**	0.0613	0.2511
100 SW	**P**	0.1934	- 0.4345	0.2140	- 0.4258	0.1023	0.0878	0.1968	0.1601	0.0498	-0.0560	-0.3037	0.0396	0.4062	0.0602	**1.0000**	0.2752
	G	0.2111	-0.4616	0.2259	-0.4544	0.0823	0.0916	0.2032	0.1457	0.0420	-0.0554	-0.3981	0.0564	0.4231	0.0613	**1.0000**	0.2948

*significant at 5% ** significant at 1 %

P ht F Harv= Plant height at first harvest (cm); No. Pri/pl F Harv = Number of primary branches per plant at first harvest; P ht L Harv= Plant height at last harvest (cm); No. Pri/pl L Harv = Number of primary branches per plant at last harvest; DFFL= Days to first flowering; DFL 50% = Days to 50% flowering; DFS = Days to fruit set (for first formed flowers); D F P Harv = Days to first pod harvest; D L P Harv = Days to last pod harvest; P length = Pod length (cm); P Width = Pod width (cm); P Weight = Pod weight (g); No. P/P = Number of pods per plant; No. of S/P = Number of seeds per pod; 100 SW= 100 seed weight; Pod Y/P (gm) = Marketable pod yield per plant (gm)