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STUDIES ON GENETIC VARIABILITY, HERITABILITY AND CHARACTER ASSOCIATION IN DOLICHOS BEAN (*Lablab purpureus*)

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ABSTRACT: The present studies on genetic variability, heritability and character association in Dolichos bean (*Lablab purpureus*) were carried out at vegetable research farm, Department of Horticulture, Allahabad School of Agriculture, SHIATS, Allahabad. The experiment having 20 genotypes was laid out in simple RBD with three replications. It was observed that PUSA SEM-3 genotype was found superior in terms of pod yield per plant (2.319 kg). The phenotypic coefficient of variation (PCV) was higher than GCV for all the traits. Heritability in broad sense was noticed high for all the traits except days to germination. Higher genetic advance was observed for plant height, and high genetic advance as per cent of mean was found in pod yield per plant. The traits like plant height, number of primary branches per plant, number of inflorescence per plant, number of flowers per inflorescence, number of pods per inflorescence, number of pods per plant, number of seeds per pod, pod length, pod width and pod weight showed positive significant correlation with pod yield per plant at both genotypic and phenotypic levels. Number of pods per plant exhibited the highest positive direct effect on yield at both genotypic and phenotypic path level.

Keywords: *Lablab purpureus, GCV, PCV, heritability, genetic advance, path analysis.*

Dolichos bean or Indian bean (*Lablab purpureus* L. (Sweet) or *Dolichos lablab* L.; 2n = 22, a member of the family Fabaceae, is an important food legume which is consumed in many parts of Asia, especially in India. It is one of the most ancient crop known for its food and fodder value and having the various synonyms viz. Hyacinth bean, Country Bean, Bonevist Bean, Tonga Bean, Lablab Bean, Indian Bean, Butter Bean, Field Bean, Poor's man Bean and in Hindi *Sem* or *Semi.* Dolichos bean considered to have originated in the South East Asia or India. The crop is multipurpose; mainly grown for its young pods and green, immature seeds for vegetable purpose, while the dry seeds are used in many food preparations. It is one of the major sources of protein in the dietary in South India. Genetic parameters of variation and correlation association provides information about expected response of various characters and helps in developing suitable breeding procedure for their improvement on nature and magnitude of variability in the existing plant materials. Therefore, an attempt to study genetic variability, heritability and character association in Dolichos bean was made under Allahabad conditions.

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MATERIALS AND METHODS

The present investigation on genetic variability, heritability and character association in Dolichos Bean (*Lablab purpureus*) was carried out during 2012-2013 at vegetable research farm, Department of Horticulture, Allahabad School of Agriculture, SHIATS, Allahabad. There were 20 genotypes viz. IIHR-2, IIHR-5, HA-4, SWARNA UTATE, IIHRPD-101, IIBP-03-3, IS-2010-5, AHDB-03, VRSEM-6, VRSEM-8, VRSEM-11, VRSEM-30, VRSEM-76, VRSEM 186, VRSEM-501, VRSEM-1000, PUSA SEM-2, PUSA SEM-3, RAJNI and LOCAL VARIETY-1 selected for present study. The experiment was laid out in simple Randomized Block Design with 20 treatment replicated thrice. All the recommended cultural and management practices were followed to raise a healthy crop. Observations were recorded on 17 characters viz. days to germination, seed germination per cent, plant height (cm), number of

primary branches per plant, days to initial flowering (days), number of inflorescence per plant, length of inflorescence (cm), number of flowers per inflorescence, number of pods per inflorescence, number of pods per plant, days to First picking after sowing, number of seeds per pod, pod length and width (cm), pod weight (g), pod yield per plant (kg), incidence of bean mosaic (%). Analysis of variance was done by the method suggested by Panse and Sukhatme (11). The phenotypic and genotypic coefficient variation (Burton, 5), heritability (Broad sense) and genetic advance were computed. The phenotypic and genotypic correlation coefficients were calculated as per methods given by Al – Jibouri *et al.* (1). The path coefficients were obtained by method advocated by Dewey and Lu (8).

RESULTS AND DISCUSSION

Analysis of variance (Table 1) revealed significant differences among genotypes for all the traits studied indicating presence of significant variability in the materials. Maximum pod yield per plant was observed in genotype PUSA SEM-3 (2.319 kg). Higher genotypic and phenotypic variances were observed for characters like plant height, number of pods per plant and days to first picking after sowing, whereas low genotypic and phenotypic variances were observed for characters like pod width, days to germination, pod yield per plant, number of seeds per pod, number of primary branches per plant, pod weight and pod length (Table 2). Therefore, these characters having higher variance may be exploited in breeding programmes since for selection to be effective as the availability of variance for their trait under selection is fundamental requirement.

Higher genotypic and phenotypic coefficient of variances were observed for pod yield per plant (65.90, 66.70), plant height (51.22, 51.32), number of pods per plant (50.50, 51.07), number of pods per inflorescence (42.34, 42.73), number of inflorescence per plant (37.97, 38.32), pod weight (37.48, 37.71), whereas the moderate GCV and PCV were recorded for days to germination (13.99, 18.75), length of inflorescence (17.06, 17.33) and days to first picking after sowing (18.39, 18.44). The present findings are in conformity with the reports of Arunachala (3) for pod yield per plant, plant height and number of pods per plant. It was observed that the difference between GCV and PCV for most of the characters is narrow. Heritability (h^2) in broad sense (bs) was noticed high for all the traits except days to germination. High heritability coupled with high genetic advance (% of mean) was observed for characters like plant height, days to initial flowering, number of pods per plant, pod yield per plant, pod weight, number of pods per inflorescence, number of inflorescence per plant. Similar results for different characters in Dolichos bean were also reported by Arunachala (3), Dahiya and Pandita (6) and Pandita *et al.* (10). Higher genetic advance at 5% was observed for plant height (369.51), whereas minimum was observed for days to germination (0.93).

The association among the various characters are pre-requisite for yield and correlation among different characters utilized in selection of better plant types. The knowledge of the association of yield components and their relative contribution indicated by path analysis has practical significance in selection for yiel, which permits further portioning of correlation coefficient into its components of direct and indirect effects facilitating important traits to be identified. The biometrical approaches used in the present experiment, for studying the various parameters of genetic variation, Correlation and path analysis to make selection strategy for further improvement in yield.

Genotypic and phenotypic correlation among different traits (Table 3) revealed that among the 16 characters studied, the characters such as plant height (0.667), number of primary branches per plant (0.398), number of inflorescence per plant (0.564), number of flowers per inflorescence (0.285), number of pods per inflorescence (0.539), number of pods per plant (0.897), number of seeds

Table 1: Analysis of variance for 17 characters of 20 Dolichos bean genotypes.

Source of variation/characters	Means sum of squares		
	Replication d.f. = 2	Treatment d.f = 19	Error d.f = 38
1.Days to germination	0.816	1.385**	0.290
2.Seed germination %	38.921	1126.678**	57.083
3.Plant height (cm)	17.395	812520.006**	972.141
4.Number of primary branches per plant	0.094	4.889**	0.111
5.Days to initial flowering (days)	1.266	753.808**	0.599
6.Number of inflorescence per plant	0.407	175.472**	1.069
7. Length of inflorescence (cm)	2.343	124.508**	1.323
8.Number of flowers per inflorescence	0.518	78.599**	0.893
9.Number of pods per inflorescence	0.116	25.241**	0.154
10.Number of pods per plant	295.850	24256.723**	182.446
11.Days to first picking after sowing	2.517	1227.102**	2.131
12.Number of seeds per pod	0.153	2.837**	0.105
13.Pod length (cm)	0.111	18.937**	0.040
14.Pod width (cm)	0.010	0.967**	0.004
15.Pod weight (g)	0.013	11.348**	0.046
16.Pod yield per plant (kg)	0.020	1.181**	0.009
17.Incidence of bean mosaic (%)	28.12	1038.75**	3.64

** Significant at 0.1%

per pod (0.559), pod length (0.649), pod width (0.411) and pod weight (0.556) showed positive significant correlation with pod yield per plant at genotypic level. Plant height (0.658), number of primary branches per plant (0.379), number of inflorescence per plant (0.547), number of flowers per inflorescence (0.281), number of pods per inflorescence (0.529), number of pods per plant (0.873), number of seeds per pod (0.516), pod length (0.639), pod width (0.397) and pod weight (0.548) showed positive significant correlation with pod yield per plant at phenotypic level. The present findings are in line with reports of by Arunachala (3), Pandey *et al.* (9), Dahiya *et al*. (7), Uddin and Newaz (12), Basavarajappa and Byre Gowda (4) and Ali *et al.* (2).

The results obtained from path analysis by taking seed yild as dependent and other characters as independent variable (Table 4) revealed that days to germination, seed germination per cent, number of inflorescence per plant, number of flowers per inflorescence, number of pods per plant, days to first picking after sowing, pod length (cm), pod weight (g) had positive direct effect at genotypic path level. Seed germination per cent, number of inflorescence per plant, number of flowers per inflorescence, number of pods per plant, days to first picking after sowing, pod length (cm) and pod weight (g) had positive direct effect at phenotypic path level.

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Table 2: Range, mean, variance, coefficient of variation, heritability, genetic advance and genetic advance as percent of mean for 16 characters of Dolichos bean.

Characters	Range		Mean	GV	PV	CV		h^2 (bs) (%)	GA 5%	GAM 5%
	Min	Max				GCV%	PCV%			
1.Days to germination	3.00	5.67	4.32	0.36	0.66	13.99	18.75	56	0.93	21.51
2.Seed germination %	13.33	97.78	84.77	356.53	413.62	22.27	23.99	86	36.11	42.60
3.Plant height (cm)	66.69	1635.33	1015.38	270515.97	271488.09	51.22	51.32	100	369.51	36.39
4.Number of primary branches per plant	2.55	6.67	4.39	1.59	1.70	28.74	29.72	94	2.51	57.24
5.Days to initial flowering (days)	41.22	112.78	69.61	251.07	251.67	22.76	22.79	100	32.60	46.83
6.Number of inflorescence per plant	6.55	30.00	20.08	58.13	59.20	37.97	38.32	98	15.56	77.51
7.Length of inflorescence (cm)	22.89	46.44	37.56	41.06	42.38	17.06	17.33	97	12.99	34.59
8.Number of flowers per inflorescence	13.22	32.44	20.34	25.90	26.80	25.02	25.44	97	10.31	50.67
9.Number of pods per inflorescence	3.66	15.00	6.83	8.36	8.52	42.34	42.73	98	5.90	86.43
10.Number of pods per plant	39.33	371.00	177.40	8024.76	8207.21	50.50	51.07	98	152.47	85.95
11.Days to first picking after sowing	69.00	151.67	109.87	408.32	410.45	18.39	18.44	99	41.52	37.79
12.Number of seeds per pod	2.32	6.00	4.44	0.91	1.02	21.48	22.68	90	1.86	41.91
13.Pod length (cm)	5.20	14.46	10.73	6.30	6.34	23.40	23.47	99	5.15	48.05
14.Pod width (cm)	1.25	3.59	1.97	0.32	0.32	28.81	28.98	99	1.16	58.98
15.Pod weight (g)	1.83	10.13	5.18	3.77	3.81	37.48	37.71	99	3.97	76.75
16.Pod yield per plant (kg)	0.175	2.319	0.95	0.39	0.40	65.90	66.70	98	0.94	98.95

GV= Genotypic variance, PV= Phenotypic variance, GCV= Genotypic coefficient of variation, PCV= Phenotypic coefficient of variation, h2 (bs) = Heritability (broad Sense), GA=Genetic advance, GAM= Genetic advance as per cent of mean.

Table 3: Genotypic and phenotypic correlation for 16 characters in Dolichos bean (*Lablab purpureus*).

Traits	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	G	1.000	-0.757**	-0.001	0.336**	0.086	0.037	-0.298*	-0.001	-0.381**	-0.061	0.129	0.006	0.460**	0.181	0.373**	-0.090
	P	1.000	-0.471**	-0.001	0.282*	0.052	0.018	-0.208	0.038	-0.287*	-0.070	0.091	-0.013	0.355**	0.125	0.297*	-0.075
2	G		1.000	0.063	-0.147	-0.183	-0.154	0.027	-0.140	0.183	0.184	-0.213	0.016	0.012	-0.217	-0.100	0.163
	P		1.000	0.063	-0.126	-0.173	-0.144	0.028	-0.119	0.165	0.164	-0.203	-0.001	0.009	-0.196	-0.099	0.158
3	G			1.000	0.540**	0.713**	0.830**	-0.096	-0.668**	-0.751**	0.735**	0.813**	0.664**	0.513**	0.359**	0.481**	0.667**
	P			1.000	0.522**	0.711**	0.819**	-0.092	-0.653**	-0.742**	0.726**	0.810**	0.628**	0.511**	0.356**	0.478**	0.658**
4	G				1.000	0.446**	0.500**	-0.378**	-0.249	-0.455**	0.402**	0.513**	0.260*	0.105	0.259*	0.394**	0.398**
	P				1.000	0.430**	0.479**	-0.364**	-0.238	-0.442**	0.378**	0.497**	0.218	0.103	0.247	0.378**	0.379**
5	G					1.000	0.720**	-0.046	-0.519**	-0.603**	0.340**	0.959**	0.459**	0.235	0.238	0.295*	-0.278*
	P					1.000	0.712**	-0.048	-0.511**	-0.596**	0.337**	0.956**	0.439**	0.234	0.237	0.293*	-0.274*
6	G						1.000	-0.168	-0.631**	-0.751**	0.618**	0.797**	0.661**	0.388**	0.290*	0.401**	0.564**
	P						1.000	-0.166	-0.615**	-0.737**	0.609**	0.788**	0.625**	0.383**	0.286*	0.390**	0.547**
7	G							1.000	0.254*	0.194	-0.112	-0.036	0.223	0.030	0.151	0.104	0.060
	P							1.000	0.253	0.191	-0.104	-0.036	0.210	0.032	0.152	0.106	0.061
8	G								1.000	0.676**	-0.374**	-0.582**	-0.569**	-0.354**	-0.068	-0.269*	0.285*
	P								1.000	0.661**	-0.369**	-0.574**	-0.525**	-0.345**	-0.069	-0.260*	0.281*
9	G									1.000	-0.472**	-0.713**	-0.650**	-0.501**	-0.492**	-0.579**	0.539**
	P									1.000	-0.465**	-0.705**	-0.600**	-0.492**	-0.485**	-0.566**	0.529**
10	G										1.000	0.459**	0.524**	0.451**	0.138	0.211	0.897**
	P										1.000	0.454**	0.489**	0.445**	0.135	0.204	0.873**
11	G											1.000	0.609**	0.344**	0.363**	0.416**	-0.431**
	P											1.000	0.574**	0.342**	0.358**	0.413**	-0.424**
12	G												1.000	0.469**	0.453**	0.520**	0.559**
	P												1.000	0.447**	0.425**	0.496**	0.516**
13	G													1.000	0.303*	0.612**	0.649**
	P													1.000	0.301*	0.612**	0.639**
14	G														1.000	0.803**	0.411**
	P														1.000	0.792**	0.397**
15	G															1.000	0.556**
	P															1.000	0.548**

* and ** indicate significant at 5% and 1% level, respectively.

1. Days to germination, 2. Seed germination (%), 3. Plant height (cm), 4.No. of primary branches/plant, 5. Days to initial flowering 6. No. of inflorescences/plant, 7.Length of inflorescence (cm), 8. No. of flowers/inflorescence, 9. No. pods/inflorescence, 10. No. of pods/plant, 11. Days to first picking after sowing, 12. No. of seeds/pod, 13.Pod length (cm), 14. Pod width (cm), 15. Pod weight, 16. Pod yield/plant (kg)

Table 4: Genotypic and phenotypic direct (diagonal) and indirect effect of 16 characters of Dolichos bean.

Traits		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	G	0.0952	-0.0721	-0.0001	0.0320	0.0082	0.0035	-0.0284	-0.0001	-0.0362	-0.0058	0.0123	0.0006	0.0438	0.0172	0.0355	0.0086
	P	-0.0315	0.0148	0.0000	-0.0089	-0.0016	-0.0006	0.0065	-0.0012	0.0090	0.0022	-0.0029	0.0004	-0.0112	-0.0039	-0.0093	-0.0023
2	G	-0.1687	0.2228	0.0141	-0.0327	-0.0408	-0.0342	0.0060	-0.0312	0.0407	0.0411	-0.0475	0.0036	0.0027	-0.0483	-0.0222	0.0364
	P	-0.0625	0.1327	0.0084	-0.0167	-0.0230	-0.0191	0.0037	-0.0158	0.0219	0.0217	-0.0270	-0.0001	0.0012	-0.0260	-0.0132	0.0210
3	G	0.0003	-0.0268	-0.4241	-0.2290	-0.3025	-0.3520	0.0409	0.2834	0.3183	-0.3116	-0.3449	-0.2815	-0.2175	-0.1524	-0.2041	-0.2830
	P	0.0002	-0.0231	-0.3651	-0.1905	-0.2596	-0.2990	0.0337	0.2382	0.2710	-0.2649	-0.2957	-0.2294	-0.1865	-0.1301	-0.1745	-0.2403
4	G	-0.0490	0.0214	-0.0788	-0.1459	-0.0650	-0.0730	0.0551	0.0363	0.0664	-0.0587	-0.0749	-0.0379	-0.0153	-0.0377	-0.0575	-0.0580
	P	-0.0228	0.0102	-0.0422	-0.0809	-0.0348	-0.0387	0.0295	0.0193	0.0357	-0.0306	-0.0402	-0.0176	-0.0083	-0.0200	-0.0306	-0.0306
5	G	-0.0424	0.0900	-0.3503	-0.2189	-0.4912	-0.3537	0.0226	0.2548	0.2963	-0.1672	-0.4710	-0.2253	-0.1153	-0.1167	-0.1451	-0.1368
	P	-0.0181	0.0603	-0.2477	-0.1500	-0.3484	-0.2482	0.0169	0.1780	0.2077	-0.1175	-0.3330	-0.1529	-0.0817	-0.0826	-0.1022	-0.0953
6	G	0.0042	-0.0174	0.0939	0.0566	0.0815	0.1132	-0.0190	-0.0715	-0.0850	0.0700	0.0902	0.0748	0.0439	0.0328	0.0454	0.0638
	P	0.0002	-0.0019	0.0107	0.0063	0.0093	0.0131	-0.0022	-0.0081	-0.0097	0.0080	0.0103	0.0082	0.0050	0.0037	0.0051	0.0072
7	G	0.0160	-0.0014	0.0052	0.0203	0.0025	0.0091	-0.0538	-0.0137	-0.0104	0.0060	0.0019	-0.0120	-0.0016	-0.0081	-0.0056	0.0032
	P	0.0187	-0.0025	0.0083	0.0328	0.0044	0.0150	-0.0901	-0.0227	-0.0172	0.0094	0.0033	-0.0189	-0.0029	-0.0137	-0.0095	0.0055
8	G	-0.0001	-0.0222	-0.1062	-0.0396	-0.0824	-0.1003	0.0404	0.1588	0.1074	-0.0593	-0.0925	-0.0904	-0.0563	-0.0108	-0.0427	-0.0453
	P	0.0066	-0.0208	-0.1143	-0.0417	-0.0895	-0.1077	0.0442	0.1751	0.1158	-0.0645	-0.1005	-0.0920	-0.0605	-0.0120	-0.0455	-0.0493
9	G	0.0167	-0.0080	0.0329	0.0199	0.0264	0.0329	-0.0085	-0.0296	-0.0438	0.0207	0.0312	0.0285	0.0219	0.0216	0.0253	0.0236
	P	0.0292	-0.0167	0.0753	0.0448	0.0605	0.0748	-0.0194	-0.0670	-0.1014	0.0471	0.0715	0.0609	0.0498	0.0492	0.0574	0.0537
10	G	-0.0596	0.1792	0.7139	0.3909	0.3306	0.6007	-0.1089	-0.3630	-0.4585	0.9716	0.4463	0.5089	0.4378	0.1341	0.2052	0.8714
	P	-0.0641	0.1490	0.6605	0.3446	0.3071	0.5543	-0.0949	-0.3355	-0.4232	0.9104	0.4136	0.4453	0.4047	0.1232	0.1854	0.7949
11	G	0.0975	-0.1610	0.6144	0.3876	0.7245	0.6022	-0.0269	-0.4399	-0.5384	0.3471	0.7555	0.4603	0.2596	0.2745	0.3143	0.3258
	P	0.0501	-0.1120	0.4461	0.2737	0.5264	0.4338	-0.0200	-0.3160	-0.3881	0.2502	0.5507	0.3159	0.1885	0.1973	0.2277	0.2338
12	G	-0.0007	-0.0018	-0.0741	-0.0290	-0.0512	-0.0738	-0.0249	0.0635	0.0726	-0.0585	-0.0680	-0.1116	-0.0524	-0.0506	-0.0580	-0.0624
	P	0.0007	0.0001	-0.0333	-0.0115	-0.0232	-0.0331	-0.0111	0.0278	0.0318	-0.0259	-0.0304	-0.0529	-0.0237	-0.0225	-0.0263	-0.0273-
13	G	0.0027	0.0001	0.0030	0.0006	0.0014	0.0023	0.0002	-0.0021	-0.0030	0.0027	0.0020	0.0028	0.0059	0.0018	0.0036	0.0039
	P	0.0298	0.0008	0.0430	0.0087	0.0197	0.0322	0.0027	-0.0290	-0.0413	0.0374	0.0288	0.0376	0.0841	0.0253	0.0515	0.0537
14	G	-0.0088	0.0105	-0.0175	-0.0126	-0.0116	-0.0141	-0.0074	0.0033	0.0240	-0.0067	-0.0177	-0.0221	-0.0147	-0.0487	-0.0391	-0.0200
	P	-0.0110	0.0172	-0.0313	-0.0217	-0.0208	-0.0251	-0.0133	0.0060	0.0426	-0.0119	-0.0314	-0.0373	-0.0264	-0.0877	-0.0695	-0.0349
15	G	0.1865	-0.0498	0.2410	0.1972	0.1479	0.2009	0.0523	-0.1345	-0.2899	0.1058	0.2083	0.2602	0.3063	0.4023	0.5007	0.2783
	P	0.1490	-0.0497	0.2397	0.1897	0.1471	0.1957	0.0531	-0.1303	-0.2837	0.1021	0.2072	0.2487	0.3067	0.3971	0.5014	0.2746

Genotypic Path Residual Effect = SQRT (1-1.0095); Phenotypic Path Residual Effect = 0.1893

1. Days to germination, 2. Seed germination (%), 3. Plant height (cm), 4.No. of primary branches/plant, 5. Days to initial flowering 6. No. of inflorescences/plant, 7.Length of inflorescence (cm), 8. No. of flowers/inflorescence, 9. No. pods/inflorescence, 10. No. of pods/plant, 11. Days to first picking after sowing, 12.No. of seeds/pod, 13.Pod length (cm), 14. Pod width (cm), 15. Pod weight, 16. Pod yield/plant (kg).

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