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Diallel analysis for pod yield and its components traits in vegetable Indian bean (*Dolichous lablab* L.)

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The nature and magnitude of genetic variance for yield and its component traits were studied in Indian bean using diallel analysis. The estimates of general combining ability (GCA) variance were much higher than specific combining ability (SCA) variance except days to 50% flowering, number of pod per cluster and fiber content; this indicated the importance of both additive as well as non-additive gene effects are involved in the expression of these characters. Genotypes NIB-69 and NIB-54 were identified as good general combiner for pod yield per plant. The cross combination viz., NIB-57 x NIB-69, NIB-69 x NIB-80, NIB-32 x NIB-54, NIB-41 x NIB-69 and NIB-23 x NIB-54 were the most promising crosses for improvement of pod yield. In the light of present study, the use of good general combining parents in the hybridization programme, selection of the desirable segregants from the segregating generations by adopting progeny selection method for exploiting additive genetic variance would lead to rapid improvement in this crop.

Key words: Genetic variance, diallel analysis, Indian bean.

INTRODUCTION

Indian bean (*Lablab purpureus* L.) is an important pulse crop of Gujarat. There are two cultivated types of Indian bean *viz.,* typicus and lignosus (Shivashankar et al., 1971). Typicus is a garden type and is cultivated for its soft and edible pods. Lignosus is known as field bean and mainly cultivated for dry seed as pulse and is more popularly recognized as 'Wal', 'Wal–papdi' or 'Valor' in Gujarat state. The green pods are used for vegetable purpose whereas; ripe and dried seeds are consumed as split pulse. The seeds can sometimes be soaked in water overnight and when germination initiates, they can be sun-dried and stored for future use. The fodder has good palatability and the cattles are nourished well. It can also be used as nitrogen fixing pulse crop. The fresh/immature pods contain 4.5% proteins and 10% carbohydrates.

For the development of elite strain, the identification of genetically superior parent is an important prerequisite. Combining ability studies reveal the nature of gene action and lead to identification of parents with high general combining ability effect and the cross combination with high specific combining ability effects. This in turn helps in choosing the parents to be included hybridization or population breeding programme. Among the different biometrical methods employed to study combining is the one proposed by Griffing's (1956).

MATERIALS AND METHODS

Studies were conducted by using 8 genotype being maintained at the Regional Horticulture Research Station, Navsari Agricultural

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Table 1. Analysis of variance for combining ability in Indian bean.

S/N	Characters	Mean squares			
		GCA	SCA	Error	GCA/SCA
1	Days to 50% flowering	18.79	43.23**	9.69	0.45
2	Plant height (cm)	71.53**	64.01**	11.99	1.11
3	Number of branches per plant	0.25**	0.54**	0.05	1.46
4	Number of pods per cluster	3.57	0.58**	0.10	6.1
5	Number of pods per plant	230.19**	124.32**	6.19	1.85
6	Pod length (cm)	0.50**	0.32**	0.04	1.55
7	Seeds per pod	1.07**	0.45**	0.05	2.37
8	Pod yield per plant (g)	1357.91**	1547.64**	21.83	0.87
9	Average pod weight (g)	5.89**	5.41**	0.69	1.08
10	Protein content (%)	4.14**	1.39**	0.16	2.97
11	Fiber content (%)	0.16	0.05	0.04	3.2

*,**Significance at 5 and 1% level respectively.

University, Navsari. Twenty eight F_1's were developed half diallel mating design and evaluated along with parents in randomized block design with three replications during 2009-10. Plant to Plant and row to row distance was maintained as 20 and 60 cm respectively. All the cultural practices were followed to raise the normal crop. Data were recorded on five randomly selected plants in each treatment for eleven characters viz. Days to 50% flowering, plant height, number of branches per plant, number of pod per cluster, number of pods per plant, pod length, seeds per pod, green pod yield per plant, average pod weight, protein content and fiber content. General and specific combining ability effects were estimated according to method describe by Griffing's (1956).

RESULTS AND DISCUSSION

The analysis of variance for combining ability presented in Table 1 revealed that mean squares due to general combining ability were highly significant for all the characters except days to 50% flowering, number of pods per cluster and fiber content. Similarly variance for specific combining ability was highly significant for all the characters except fiber content. The analysis of variance for combining ability revealed that variances due to general combining ability (GCA) and specific combining ability (SCA) were highly significant for plant height, number of branches per plant, number of pods per plant, pod length, seed per pod, pod yield per plant, average pod weight and protein content indicating the importance of both additive as well as non-additive genetic components of variation in the expression of these economic characters. However, the additive variance was considerably higher than non-additive variance for all the attributes except green pod yield per plant indicating predominance of additive variance in controlling expression of these characters. The present findings also supported the results of Kabir and Sen (1990), Basu et al. (2002) and Kannan et al. (2003).

The estimates of general combining ability effects of parental lines (Table 2) revealed that the NIB-54 showed significant positive GCA effects for green pod yield per plant, days to 50% flowering, plant height, number of branches per plant, number of pod per cluster, number of pods per plant, pod length, seeds per pod, average pod weight and protein content, which indicates the best general combiner among the parents. Among the parents, NIB-69 was also found to be the good general combiner for all the characters under study except days to 50% flowering, pod length, protein content and fibre content. Whereas, NIB-80 for number of pod per plant, average pod weight and protein content. Similar result also recorded by earlier workers, Kannan et al. (2003) and Gavali et al. (2011) for number pods per plant, pod yield per plant, Basu et al. (2002) and Virja et al. (2006) for average pod weight, Sawant et al.(2006) for pod length.

The SCA effects for hybrids pertaining to different characters are given in Table 3. In the present study, best cross combinations involved good x good, good x poor and even poor x poor SCA effects. The top cross combinations NIB-57 x NIB-69 (poor x Good), NIB-69 x NIB-80 (Good x poor) and NIB-32 x NIB-54 (Poor x Good) had exhibited highest significant specific combining ability effects for green pod yield per plant, plant height, branches per plant, pod per plant and average pod weight, having at least one parent is good general combiner. Which indicating that hybrids having one parent with high GCA effect are expected to produce segregants of fixable nature in segregating generations though simple pedigree method. The hybrids *viz.,* NIB-57 x NIB- 80, NIB-23 x NIB- 54 and NIB-41 x NIB-69 showed highest significant positive SCA effects for days to 50% flowering, indicates earliness for vegetable purpose. For protein content NIB-41 x NIB-54, NIB-69 x NIB- 80 and NIB-41 x NIB-69 and the cross NIB-69 x NIB- 80 for fibre content appeared highest SCA effects in desired direction. Similar results also obtained by Singh et al. (1980), Bagade et al. (2002), Valu et al. (1999) and

Table 2. Estimation of general combining ability (GCA) effects of parents for various characters in Indian bean.

Parent	DFF	PH	NBP	NPC	NPPP	PL	SPP	PYPP	APW	PC	FC
NIB 23	1.234	0.116	-0.182*	-0.111	-5.767**	-0.008	-0.378**	-11.609**	-0.342	0.562**	0.202**
NIB 32	1.262	1.571	0.036	0.072	-3.758**	-0.063	-0.254**	-4.649**	0.237	-0.011	-0.073
NIB 41	0.669	2.376*	-0.133	-0.281**	-3.380**	0.329**	0.316**	-7.565**	-0.065	-0.809**	0.128*
NIB 54	-1.894*	-2.630*	0.165*	0.394**	3.682**	0.238**	0.142*	15.226**	0.634*	0.888**	-0.085
NIB 56	1.476	1.484	-0.117	0.278**	4.077**	-0.063	-0.083	-3.221*	-1.055**	-0.166	-0.185**
NIB 57	-0.094	1.305	-0.060	0.649**	-4.041**	-0.122	0.493**	-4.622**	0.612*	-0.731**	0.095
NIB 69	-1.641	-5.444**	0.284**	0.293**	7.204**	0.088	0.156*	21.224**	1.004**	-0.389**	-0.070
NIB 80	-1.044	1.224	0.007	-1.292**	1.983**	-0.399**	0.392**	-4.785**	-1.025**	0.654**	-0.011
S.E (g_i) ±	0.92122	1.02452	0.06911	0.09517	0.73627	0.06155	0.06688	1.38227	0.24619	0.12184	0.05989
S.E (g_i-g_j) ±	1.39276	1.54893	0.10449	0.14389	1.11313	0.09306	0.10112	2.08979	0.37221	0.18421	0.09055

DFF = Days to 50% flowering; PH = plant height (cm); NBPP = number of branches per plant; NPC = number of pod per cluster; NPPP = number of pods per plant; PL = pod length (cm); SPP = seeds per pod; PYPP = pod yield per plant (g); APW = average pod weight (g); PC = protein content (%); FC = fiber content (%).*,**Significance at 5 and 1% level respectively.

Table 3. Estimation of specific combining ability (specific combining ability (SCA) effect of hybrids for various characters in Indian bean.

S/N	Crosses	Days to 50% flowering	Plant height (cm)	No. of primary branches/ plant	No. of pods per cluster	No. of pods per plant	Pod length (cm)	Seeds per pod	Pod yield per plant (g)	Average pod weight (g)	Protein content (%)	Fiber content (%)
1	NIB-23 x NIB- 32	1.313	0.539	0.215	0.014	2.921	0.274	0.704**	7.399	1.082	-0.084	0.251
2	NIB-23 x NIB- 41	4.875	4.594	0.311	-0.302	-8.357**	-0.634**	0.370	14.006**	3.081**	0.623	-0.140
3	NIB-23 x NIB- 54	-13.272**	-13.740**	1.056**	1.013**	18.291**	0.680**	0.810**	58.244**	2.491**	0.400	0.207
4	NIB-23 x NIB-56	-0.901	3.304	0.318	0.169	5.623*	-0.822**	0.375	2.911	-0.097	0.950*	-0.233
5	NIB-23 x NIB-57	3.668	1.185	0.151	0.418	4.184	0.207	0.249	8.292	0.703	0.686	0.167
6	NIB-23 x NIB-69	0.215	6.490*	-0.363	0.114	-11.574**	0.067	-1.234**	-44.863**	-2.372**	0.023	-0.128
7	NIB-23 x NIB-80	0.718	1.026	-0.933**	-0.222	-9.763**	0.364	0.154	-19.355**	-0.276	-0.350	0.233
8	NIB-32 x NIB-41	1.847	2.070	-0.973**	0.064	-11.722**	-0.549**	0.182	-4.985	-1.071	0.697	-0.232
9	NIB-32 x NIB-54	-3.443	-14.417**	1.022**	0.859**	19.236**	0.745**	1.062**	64.284**	3.166**	1.120**	-0.258
10	NIB-32 x NIB-56	1.707	1.335	0.130	0.455	3.724	0.283	0.280	-2.049	-2.225**	0.027	0.161
11	NIB-32 x NIB-57	0.770	4.898	0.103	0.204	-1.295	0.112	0.095	-7.658	-0.388	0.520	-0.128
12	NIB-32x NIB-69	1.897	4.969	0.079	-0.310	-0.929	-0.301	-2.259**	-19.194**	-1.754*	-0.303	0.137
13	NIB-32x NIB-80	-1.080	3.109	0.036	-0.489	3.271	-0.337	-0.760**	-1.375	0.062	0.324	0.328
14	NIB-41x NIB-54	6.003*	3.574	-1.062**	0.403	2.078	0.660**	-0.254	-28.570**	-3.556**	2.247**	0.101
15	NIB-41x NIB-56	-4.647	2.847	-0.661**	0.499	3.260	0.271	0.011	3.627	0.120	0.191	-0.090
16	NIB-41x NIB-57	1.383	-0.647	0.572**	0.608*	-0.793	0.380*	-0.425*	-7.332	0.083	-0.063	0.251
17	NIB-41x NIB-69	-12.594**	-5.666	1.111**	1.364**	18.929**	0.541**	0.702**	63.383**	3.092**	1.591**	0.006

Table 3. Contd.

18	NIB-41x NIB-80	-1.687	2.77	0.565**	-1.052**	4.557**	-0.669**	0.390	-7.188	0.991	-0.709	0.167
19	NIB-54 x NIB-56	-11.547**	-13.160**	0.888**	0.724*	6.844**	0.629**	0.294	42.886**	3.567**	0.674	0.014
20	NIB-54 x NIB-57	0.542	9.879**	-1.116**	-0.177	-13.475**	-0.942**	-0.291	-46.983**	-2.290**	0.680	-0.305
21	NIB-54 x NIB-69	7.463**	10.100**	0.080	-0.641*	-9.059**	-0.169	-0.305	-29.709**	-0.318	-0.063	-0.050
22	NIB-54 x NIB-80	8.076**	5.503	-0.033	-0.657*	-2.495	-0.652**	-0.676**	0.830	-1.422	-1.206**	0.101
23	NIB-56 x NIB-57	3.726	4.478	-0884**	-0.611*	3.630	0.392*	-0.017	-1.966	-1.104	0.144	-0.286
24	NIB-56 x NIB-69	4.973	5.626	-0.099	-0.515	-8.108**	-0.388*	-0.140	-20.692**	0.401	-0.249	0.069
25	NIB-56 x NIB-80	3.496	1.459	0.438*	0.039	-3.054	-0.051	-0.622**	-1.523	0.580	0.738*	0.110
26	NIB-57 x NIB- 69	-3.457	-18.585**	1.525**	1.454**	24.080**	0.281	1.444**	102.849**	4.924**	-1.293**	0.120
27	NIB-57 x NIB- 80	-13.611**	-1.502	0.272	0.308	5.060*	0.088	0.289	1.748	-1.217	1.394**	-0.289
28	NIB-69 x NIB- 80	-10.857**	-16.537**	0.047	0.954**	15.889**	1.345**	1.469**	70.992**	3.682**	1.991**	-0.644**
S.E (s_{ij}) ±		2.82394	3.14059	0.21186	0.29174	2.25697	0.18868	0.20502	4.23724	0.75468	0.37350	0.18359
S.E (s_{ij}-s_{ik}) ±		4.17828	4.64678	0.31347	0.43166	3.33939	0.27917	0.30335	6.26938	1.11662	0.55263	0.27164
S.E (s_{ij}-s_{kl}) ±		3.93932	4.38103	0.29554	0.40697	3.14841	0.26321	0.28600	5.91082	1.05276	0.52103	0.25611

*,**Significance at 5 and 1% level respectively.

Gavali et al. (2011).

Therefore, the present investigation revealed that the parents NIB-54 and NIB-69 were good general combiners for pod yield per plant and they can be use for future breeding programme for vegetable purpose. Among specific combinations NIB-57 x NIB- 80, NIB-23 x NIB- 54 and NIB-41 x NIB-69 were identified as most promising hybrids for pod yield per plant for vegetable lablab bean.

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