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Genetic Regulation of Character Expression and its Interaction with Environments in *Lablab purpureus*

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Abstract

Components of genetic variation for pod yield and other associated yield characters in lablab bean have been estimated through six-parent diallel cross in F_2 generation. Additive as well as dominance components were significant for all the characters in both environments. Diallel analysis after Hayman's approach suggested environmental interaction for flowering date, pods/inflorescence, inflorescence/plant and pod yield/plant. Complete dominance was observed for flowering date in environment 2, flowers/inflorescence and pod yield/plant in environment 1 and pods/inflorescence, pod width in both environments. Over dominance was displayed for flowering date in environment 1 and for pod yield/plant in environment 2. Partial dominance was found for flowers/inflorescence in environment 2 only but for inflorescence/plant, pod length and 10-pod weight in both environments.

Introduction

Lablab bean is a protein rich major winter. vegetable in different parts of Asia. Many types and varieties of lablab bean are found in Asia. Little research work has been done to improve its pod yield and other associated characters. Work on genetic improvement of this crop is mainly done in India (Baldev *et al*., 1988), but not much studies on genetic architecture.

The improvement of yield depends on a better understanding of the type of gene action. Evaluation of genotype performance in different environments is important in plant breeding. Genetic studies on lablab bean have been reported by some investigators (Mia *et al*., 1989; Ushakumari and Chandrasekharan, 1992; Newaz *et al*., 1995; Arora and Loodhi, 1998). The differential response of genotypes when subjected to different environments possess a major problem relating phenotypic performance to genetic constitution and make it difficult to decide which genotype should be selected. It is important to understand more fully the nature of genotype x environment (GXE) interaction to make testing and selection of genotypes more efficient. The present investigation about the nature arid magnitude of the components of variation yield and its direct components would be helpful in deciding the most efficient breeding procedure in *Lablab purpureus*.

Materials and Methods

Six genotypes of lablab bean were crossed in all possible combinations excluding reciprocals in Bangladesh Agricultural University Farm at Mymensingh. Seeds of parents and 15 F, families were shown with five replications in RCB design. Two cultural environments lenv.1 was with fertilizer and early sowing and env. 2 was without added fertilizer but had relatively latter sowing date were considered to investigate environmental interaction in the study. Sowing distance was 2 m x 2 m, between and within the rows. Diallel analysis was done following Hayman (1954 a,b) approach. The genetic components of variation in F_2 population were calculated according to Jinks (1956) and heritability was estimated as outlined by Verhalen and Murray (1969) for population.

Results and Discussion

From the Hayman analysis of variance (Table 1) environmental heterogeneity was found for additive (a) genetic effect in inflorescence/plant and pod yield/plant for dominant (b) genetic effect in pods/dnflorescence and for both in flowering date. In both the environments, additive and dominant genetic eornpononts were important in the regulation of almost all the characters except inflorescence/plant and 10-pod weight in environment 2 which showed good agreement with Table 2. Although additive genetic components preponderance in inflorescence/plant, pod length and pod yield/plant, environmental interaction was observed only pod yield/pant for additive component. Environment could not influence upon Flowers/inflorescence, pod length, pod width and 10-pod wt.

Table 2 suggested that in majority of the characters, excess dominant allele was present in their parents except inflorescence/plant, pod length and pod yield/plant because their F value was positively significant. For all the characters differences between parents and crosses were present, which is measured by h value. Degree of dominance was measured by $(H_1/D)/4$ parameter. Complete dominance was observed in pods/inflorescence

Table 1: Hayman analysis of variance following Morley Jones modification for eight plant characters in a 6 x 6 dial experiment on Lablab bean conducted in two environments

Item	a	b	b_1	b_2	b_3	Error
d.f	5	15	1	5	9	80
Environment 1						
Flowering date	277.63***	89.947***	210.40***	82.553***	80.671***	10.565
Flowerslinflores	6.864***	2.140***	0.639	4.770***	0.624	0.437
Pods/inflores	5.174***	1.728***	0.604	3.934***	0.627*	0.303
Intlores/plant	747.967***	82.270	229.639	32.562	93.116	109.700
Pod length (cm)	10.729***	1.040*	2.112*	1.343*	0.752	0.499
Pod width (cm)		0.057**	0.099*	0.096**	0.031	0.021
10-Pod wt (g)	1630.78***	129.613**	53.909	220.237**	87.678	52.854
Pod yield/plant (kg)	4.075***	0.167*	0.343	1.135**	0.360	0.275
Environment 2						
Flowering date	647.407***	84.324***	4.999	1842.49***	-883.62**	4.062
Flovversiinflores	7.913***	1.198***	0.056	2.559**	0.569	0.665
Pods/infiores	6.690***	1.445**	0.220	2.892***	0.777	0.604
Intlores/plant	296.945***	67.427	420.043**	23.364	52.727	53.567
Pod length (cm)	11.841***	0.480*	1.909**	0.539	0.289	0.247
Pod width (cm)	0.116*	0.40**	0.174**	0.033	0.029	0.017
10-Pod wt (g)	1522.85***	68.158	2.835	98.923	58.324	48.322
Pod yield/plant (kg)	1.251***	0.410*	1.165*	0.296	0.391	0.211
I x Eng. Interaction	a x Env	b x Env.	b_1 x Eriv	b_2 x Env.	b_3 x Eriv.	Pooled en
df	5	15	1	5	9	160
Flowering date	91.03***	21.666***	75.269**	1739.400***	938.600***	7.314
Flowers/inflores	0.677	0.560	0.537	0.845	0.404	0.551
Podslinflores	0.583	1.026**	0.717	2.539***	0.212	0.545
Inflores/plant	307.633**	37.586	14.264	25.798	46.725	81.388
Pod length (cm)	0.668	0.521	0.003	0.406	0.644	0.373
Pod Width (cm)	0.030	0.024	-0.262***	0.039	0.049	0.019
10-Pod wt (g)	92.271	50.648	16.009	31.911	64.907	50.588
Pod yield/plant (kg)	1.371***	0.226	0.122	0.913***	-0.144	0.243

*p<0.05; **p<0.01; ***p<0.001

and pod width for both environments, in flowering date for environment 2, in flowers/inflorescence and pod yield/plant for environment 1. In both environments, inflorescence/plant, pod length, 10-pod weight and in environment 1, flowers/inflorescence was controlled by partial dominance. Partial dominance was also reported by Jacob (1983) for flowers/inflorescence, inflorescence /plant and pod yield/plant whereas Khondker (1995) for pods/ inflorescence, pod length and 10-pod weight in lablab bean. Over dominance was found only flowerings date in environment 1 and pod yield/plant in environment 2. Singh *et al.* (1986) reported over dominance in lablab bean for flowering date. All traits were governed by asymmetrical distribution, of positive and negative alleles. Positive and negative alleles were in equal proportion in the parents for yield character as $H_2/4H_1$ values were 0.25 and 0.2 environment 1 respectively. Unequal distributions dominant and recessive genes were observed for all characters except pod yield/plant. Dominant and reces were equally distributed in yield character because $[v(4DH_1)/4 + F/2]/(4DH_1)/4\text{-}F/2]$ ratio was nearly equal unity. Gene group present in the parent of different treatment governed by h^2/H_2. One or two genes or gene groups v involved in all traits. High narrow sense heritability observed in pods/inflorescence, pod length and 10-pod weight. High broad heritability was in flowering day flowers/inflorescence, pod length and 10-pod weight. Joshi (1971) and Reddy (1982) also reported high heritability pods/plants inflorescence and Nayer (1984) for 10-pod were Heritability was moderate in both sense for pod yield/plant Gangadharappa (1981) also found that in lablab bean.

Table 2: Components of variation and genetic parameters for eight plant characters from a 6 x 6 diallel experiment oh Lablab bean conducted in two environments

Items		Flowering date	Flowers/inflores	Pods/inflores	Inflores/plant	Pod length (cm)	Pod width (cm)	10-Pod wt. (g)	Pod yield/plant (kg)
D									
	E_1	209.1 ± 752.4	10.1 ± 0.4***	6.91 ± 0.59	328.66 ± 21.45	5.51 ± 3.74	5.96 ± 0.22**	0.13 ± 0.018	1103.61 ± 77.06
	E_2	518.9 ± 859.6	8.0 ± 0.6***	6.94 ± 0.93	117.96 ± 27.67	5.96 ± 0.22	0.11 ± 0.007	967.3 ± 27.30***	0.377 ± 0.2
F									
	E_1	300.9 ± 144.0	24.2 ± 2.0***	15.0 ± 2.87	-80.54 ± 104.31	2.16 ± 18.20	0.196 ± 0.088	1062.2 ± 374.7	0.411 ± 1.80
	E_2	686.2 ± 153.9	14.4 ± 2.98**	13.4 ± 4.52	-49.57 ± 134.5	-0.3952 ± 1.076	0.19 ± 0.037	682.7 ± 132.7	-0.263 ± 1.2
H1									
	E_1	1309.2 ± 300.8***	34.8 ± 4.17**	26.8 ± 6.0	-620.64 ± 217.8	9.42 ± 38.02	0.68 ± 0.18	1525.2 ± 782.5	5.4 ± 3.76
	E_2	1497.2 ± 321.5***	12.15 ± 6.23*	17.69 ± 9.44	5.18 ± 281.0	1.079 ± 2.24	0.337 ± 0.078	-385.8 ± 277.2	2.1 + 2.5
H2									
	E_1	1058.0 ± 268.7***	19.6 ± 3.73***	18.68 ± 5.36***	-299.62 ± 194.5	-6.643 ± 33.96	0.424 ± 0.263	953.6 ± 699.0	5.5 ± 3.36
	E_2	1072.1 ± 287.2***	5.7 ± 5.55	9.83 ± 9.79	136.38 ± 251	2.59 ± 2.00	0.281 ± 0.069	269.1 ± 247.6	2.7 ± 2.2
h2									
	E_1	21848.7 ± 180.8***	284.2 ± 2.5***	107.19 ± 3.61***	7127.0 ± 130.9***	177.2 ± 22.86***	10.39 ± 0.11	114.6 ± 470.5***	13.4 ± 2.26***
	E_2	15659.8 ± 193.3***	290.9 ± 3.74***	115.64 ± 5.66	2675.6 ± 198.9***	196.4 ± 1.35***	11.98 ± 0.04*	12946.0 ± 166.7***	5.2 ± 1.5***
E									
	E_1	11.83	0.429	0.29	108.03	0.49	0.02	52.83	0.2665
	E_2	4.03	0.681	0.61	53.79	0.24	0.016	49.00	0.214
[¼(H1/D)]$^{1/2}$									
	E_1	1.251	0.926	0.98	-0.68	0.65	1.14	0.58	0.81
	E_2	0.849	0.613	0.798	0.105	0.384	0.86	0.332	1.39
H2/4H1									
	E_1	0.202	0.141	0.17	0.21	0.17	0.15	0.15	0.25
	E_2	0.180	0.117	0.13	6.58	0.18	0.21	0.15	0.23
¼(4DH1)^{12} + ½ F									
¼(4DH1)^{12}-½ F									
	E_1	3.707	-7.839	-20.188	1.43	1.85	4.91	10.03	1.28
	E_2	8.026	-5.374	-10.29	-0.33	1.44	389.02	33.49	0.60
h^2/H2									
	E_1	20.649	14.453	5.73	-23.79	26.67	24.51	11.98	2.43
	E_2	14.606	50.95	11.75	19.61	25.72	42.65	48.10	1.93
h^2n		1/2D							
		1/4D 1/16H_2 1/8F.E							
	E_1	0.48	1.2	0.95	0.51	0.63	0.46	0.95	0.48
	E_2	0.92	1.2	0.98	0.33	0.80	0.69	1.04	0.18
		1/4D 1/16H_1 1/8F							
h^2b		1/4D/1/16H_1 1/8F.E							
	E_1	0.89	0.80	0.84	0.33	0.77	0.72	0.82	0.75
	E_2	0.97	0.59	0.65	0.40	0.87	0.61	0.79	0.59

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