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Combining Ability for Flower and Pod Characters of Lablab Bean under Two Sowing Environments

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Abstract: A study on eight flower and pod characters of Lablab bean (*Lablab purpureus*) was conducted in a 6X6 F_2 diallel population grown under two sowing dates, July 1, 2000 (S_1) and August 14, 2000 (S_2). Combining ability studies revealed that both additive and non-additive gene actions controlled the expression of all the characters in both sowings. The parent DSN26 was found to be best general combiner for most of the characters irrespective of sowing dates. KBS2 and KBS3 expressed as good general combiners for early flowering and pod formation in both S_1 and S_2 conditions. In both sowing dates, DS 161 was a good general combiner for flower and pod formation and DS30 for pod length. The F_2 progeny of DS52 x DS161 was the best specific combiner for early flowering in both sowings followed by DS30 x DSN26. Considering the stability of the F_2 genotypes in different sowing dates and their SCA effects, DS30 x DS52 was identified as a promising genotype for inflorescence formation and pod yield. For the rate of pod setting DSN26 x KBS3 was the best specific combiner in both sowings. Significant different results were also found for both GCA and SCA effects due the influence of sowing dates on the genotypes.

Key words: Lablab bean, diallel, GCA (General Combining Ability), SCA (Specific Combining Ability)

INTRODUCTION

As a legume vegetable, Lablab bean (*Lablab purpureous* (L.) Sweet; hitherto *Dolichos lablab*) plays a significant role in providing nutrition to the poor people of Bangladesh. Its green pods and dried seeds are rich source (25%) of protein (on dry basis), vitamins (e.g. vit A, vit C and riboflavin etc.) and minerals such as magnasium, calcium, phosphorus, potassium, iron, sulfur and sodium[1,2] and thus holds the key to alleviate malnutrition and sickness caused by dietary deficiencies. It has also got a potentiality of using as poultry feed in Bangladesh.

Most of the varieties of Lablab bean used in our country are locally grown. Very little progress has been made for the improvement of this crop and thus seeks demand of developing this crop on yield and nutritional perspective. The demand for hybrid varieties is increasing among the farmers due to their high yield potentialities. The analysis of combining ability has got significance of identifying potential inbreed lines to be used to develop hybrid varieties. Combining ability studies also provide information of gene effect controlling the inheritance of various quantitative characters. On the same way, it also helps to identify an effective breeding programme for the improvement of this crop. Based on the objective of analyzing combining ability, the present study was conducted to identify superior parents and their F_2's for eight flower and pod characters of Lablab bean using 6 X 6 diallel population planted in two different sowing dates.

MATERIALS AND METHODS

The study was conducted in a 6x6 F_2 diallel population of Lablab bean (*Lablab purpureus*) grown under two sowing dates, 1 July 2000 (S_1) and 14 August 2000 (S_2) in the Genetics and Plant Breeding field laboratory of Bangladesh Agricultural University. The genotypes used in the study were DS30, DS52, DSN26, KBS3, DS161 and KBS2 and their 15 F_2 progenies derived from half diallel cross. The experiment was set up in a Randomized Complete Block Design with four replications in each sowing date.

Going on with the experiment, pits were prepared with 2 x 2 m spacing about a week ahead of sowing. The size of each pit was approximately 30 x 30 x 30 cm. Three seeds were sown per pit. When the seedling became a month old, they were thinned out keeping only one healthy

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plant in each pit. Climbing support for each plant had been provided by using single bamboo pole with untrimmed side branches. All the intercultural operations were done as and when necessary. Harvesting of green edible pods was started in the first week of January, 2002 and continued up to the last week of March, 2002.

Data were recorded on eight flower and pod characters such as days to first flowering, flowers per inflorescence, inflorescences per plant, pods per inflorescence, pod length (cm), 10-green pod weight (g), rate of pod setting (%) and pod yield per plant (kg). Griffing's[3] methods model 1 (Fixed effect model) was used for combining ability analysis for each of the trait. In model 1 the experimental material is deliberately chosen and regarded as the population about which inferences are to be made; the general objectives are to compare combining abilities of the parents and using parents as testers, to identify better cross combinations.

RESULTS AND DISCUSSION

Significant variations for GCA (General Combining Ability) and SCA (Specific Combining Ability) (Table 1) for all the traits in both S_1 and S_2 suggested the importance of both additive and dominant components for the expression of the characters. However the higher magnitude of GCA variances than the corresponding SCA variances indicated the predominant role of additive effects in the genetic system of the concerned traits. This result agrees with the reports of Kabir and Sen[4], Hossain[5], Khondker[6], Khanam[7] and Hossain[8] in Lablab bean and of Patil and Patil[9] in cowpea. But, Singh and Singh[10] and Singh *et al.*[11,12] differed with the results for inflorences per plant in *Lablab purpureus*. This adaptivity of gene effect is desirable in selecting individual plants with improved characters from segregating populations.

General Combining Ability (GCA) effects: The negative GCA effects for days to first flowering was an indicator for desirable genotypes for early flowering. Where as for the other characters positive GCA effects were prefer.

The combining ability effects of the parental lines (Table 2 and 3) revealed that KBS2 and KBS3 were good general combiners for early flowering and pod bearing habit in the inflorescence in both sowings. KBS2 also showed good combining ability effects for flowers per inflorescence and pod yield in both S_1 and S_2 and for inflorescences per plant in S_2 condition. However, KBS3 showed good combining ability for flowers per inflorescence in S_1 and for pod length in S_2. The parent DS161 was a good general combiner for flower and pod formation as it exhibited significant positive effects for flowers per inflorescence and pods per inflorescence in

Table 1: Combining ability ANOVA for eight flower and pod characters in a 6 x 6 diallel cross of Lablab bean at S_1 and S_2

Sources of variation	S/D	df	Days to first flowering (No.)	Flowers inflor-escence^{-1} (No.)	Inflorescences plant^{-1} (No.)	Pods inflor-escence^{-1} (No.)	Pod length (cm)	10 pod weight (g)	Rate of pod setting (%)	Pod yield plant^{-1} (kg)
GCA	S_1	3	292.74***	168.40***	280.81***	1.79***	12.28***	1914.0***	07.776***	2.984***
	S_2	3	042.45**	067.02***	188.63***	1.095***	30.61***	1794.0***	10.61***	2.10***
SCA	S_1	20	195.14***	013.79***	230.48***	0.203**	00.556	0451.5***	06.024**	1.807***
	S_2	20	025.84*	004.70**	061.92**	0.209***	01.483*	0106.0*	04.426**	0.375**
Error	S_1	60	003.51	000.386	007.656	0.039	00.287	0007.96	00.937	0.134
	S_2	60	008.22	000.998	008.499	0.025	00.5995	0054.96	00.829	0.073
GCA : SCA	S_1		001.5: 1	012.2: 1	001.22: 1	8.82: 1	22.09:1	0004.24: 1	01.29: 1	1.65: 1
	S_2		001.62: 1	04.26:1	003.04: 1	5.24: 1	20.84:1	0106.93: 1	02.40: 1	5.6: 1

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

Table 2: GCA effect and mean performance (in parenthesis) for different flower and pod related characters of Lablab bean at S_1

Parents	Days to first flowering (No.)	Flowers inflor-escence^{-1} (No.)	Inflorescences plant^{-1} (No.)	Pods inflor-escence^{-1} (No.)	Pod length (cm)	10 pod weight (g)	Rate of pod setting (%)	Pod yield plant^{-1} (kg)
DS30	10.13**	-5.45**	-6.46**	-0.534**	0.718**	-1.186	0.585	6.357**
	(131.50)	(19.90)	(69.25)	(3.25)	(15.36)	(116.63)	(16.26)	(2.64)
DS52	0.65	2.67**	0.047	-0.108	-0.696**	10.526**	-1.675**	0.105
	(126.25)	(35.68)	(93.75)	(4.30)	(13.64)	(157.25)	(12.04)	(6.28)
DSN26	2.66**	-6.07**	10.13**	-0.574**	2.19**	23.83**	1.021**	6.143**
	(109.25)	(22.30)	(116.5)	(3.23)	(19.29)	(194.50)	(14.89)	(7.26)
KBS3	-3.63**	1.39**	-7.79**	0.440**	-0.935**	-11.66**	0.823**	0.105
	(88.75)	(35.78)	(77.00)	(5.45)	(11.73)	(131.25)	(15.26)	(5.50)
DS161	-2.49**	4.62**	-3.12**	0.416**	-0.929**	-12.29**	-0.715*	5.351**
	(108.75)	(45.25)	(89.00)	(5.65)	(12.23)	(92.75)	(12.51)	(4.66)
KBS2	-7.32**	2.85**	1.38	0.361**	-0.350*	-8.82**	-0.061	5.242**
	(80.50)	(33.43)	(118.00)	(5.51)	(13.19)	(126.00)	(16.51)	(8.25)
SE (±)	0.601	0.2	0.893	0.063	0.173	1.707	0.312	0.118

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

Table 3: (GCA) effects and mean performance (in parenthesis) for different flower and pod related characters of Lablab bean at S_2

Parents	Days to first flowering (No.)	Flowers inflor-escence^{-1} (No.)	Inflorescences plant^{-1} (No.)	Pods inflor-escence^{-1} (No.)	Pod length (cm)	10 pod weight (g)	Rate of pod setting (%)	Pod yield plant^{-1} (kg)
DS30	4.56**	-3.54**	-3.52**	-0.439**	0.830**	-2.75	0.165	-0.518**
	(96.00)	(17.75)	(50.00)	(2.95)	(15.50)	(107.75)	(16.61)	(1.55)
DS52	-0.313	1.74**	-3.68**	-0.098	-1.02**	-4.91*	-1.40**	-0.345**
	(86.00)	(16.70)	(52.75)	(3.95)	(11.41)	(110.00)	(14.82)	(2.23)
DSN26	-0.719	-3.20**	8.20**	-0.415**	3.62**	28.56**	0.593*	0.795**
	(91.75)	(19.28)	(84.00)	(3.26)	(22.65)	(185.75)	(17.02)	(5.05)
KBS3	-2.44**	-0.063	-1.93*	0.337**	1.61**	-0.219	1.31**	0.169
	(82.75)	(26.90)	(67.00)	(5.18)	(10.89)	(120.00)	(19.26)	(4.15)
DS161	0.844	3.81**	-2.80**	0.251**	-1.09**	-15.69**	-1.42**	-0.411**
	(89.50)	(35.50)	(57.00)	(4.95)	(11.83)	(83.00)	(14.07)	(2.25)
KBS2	-1.94**	1.25**	3.67*	0.365**	-0.732**	-5.13*	0.751*	0.31**
	(79.75)	(26.05)	(62.75)	(5.20)	(12.35)	(98.00)	(19.96)	(3.45)
SE (±)	0.925	0.322	0.941	0.051	0.250	2.48	0.294	0.087

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

Table 4: Significant SCA effects in desirable direction for different flower and pod related characters of Lablab bean at S_1

Characters	Crosses	SCA effects	GCA effect of parents	Character mean
Days to first flowering	DS52X DS161	-16.13***	Medium X High	96.13
	DS30 X DSN26	-15.12**	Low X Low	111.75
	DS52 X KBS 3	-12.11**	Medium X High	99.00
	DS30 X DS161	-09.68**	Low X High	112.06
	DSN26 X DS161	-08.87**	Low X High	123.13
	SE (±)	1.78		
Flowers inflorescence^{-1}	DS52 X KBS2	4.64**	High X High	41.95
	KBS3 X KBS2	4.00**	High X High	40.02
	DS30 X KBS3	3.965**	Low X High	31.69
	DS30 X DS161	3.56**	Low X High	34.52
	DSN26 X KBS2	2.81**	Low X High	31.36
	DS52 X DSN26	0.99**	High X Low	29.37
	SE (±)	0.45		
Inflorescences plant^{-1}	DS30 X DS161	17.21**	Low X Low	98.50
	DS30 X DS52	11.85**	Low X Medium	96.31
	DS30 X KBS3	08.19**	Low X Low	84.81
	DS52 X KBS3	05.25**	Medium X Low	82.56
	SE (±)	2.02		
Pods inflorescence^{-1}	DS30 X DS161	0.316*	Low X High	3.70
	DS52 X DS161	0.303*	Low X High	4.14
	DS52 X DSN26	0.297*	Low X Low	3.75
	DS30 X KBS2	0.288*	Low X High	4.25
	SE (±)	0.145		
Pod length	DS161 X KBS2	1.258*	Low X Low	13.82
	SE (±)	0.392		
10- pod weight	DSN26 X KBS3	43.12**	High X Low	103.56
	DS30 X KBS2	27.463**	Medium X Low	152.44
	DS52 X DSN26	25.689**	High X High	194.56
	KBS3 X DS161	18.846**	Low X Low	129.81
	DS30 X DS161	12.935**	Medium X Low	134.38
	SE (±)	3.87		
Rate of pod setting	DSN26 X KBS3	3.519**	High X High	12.45
	KBS3 X DS161	2.850**	High X High	16.22
	DS30 X KBS2	1.929**	Medium X Medium	15.72
	SE (±)	0.72		
Pod yield	DS30 X DS52	1.065**	High X Medium	05.15
	DSN26 X KBS3	1.043**	High X Medium	06.59
	SE (±)	0.268		

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

both sowing conditions. It also showed good GCA for days to first flowering and pod yield at early sowing condition DS52 exposed itself as a good general combiner for flower per inflorescence in both environments, but for pod yield only in S_1.On the same way DS30 was a good general combiner for pod length in both conditions and for pod yield in early sowing.

Though, none of the parents showed good combining ability for all the traits, DSN26 was considered as the best general combiner for most of the flower and

Table 5: Significant SCA effect in desirable direction for different flower and pod related characters of Lablab bean at S_2

Characters	Crosses	sca effects	gca effect of parents	Character mean
Days to first flowering	DS52X DS161	-9.78***	Medium X Medium	075.50
	DS30 X DSN26	-9.34**	High X Medium	079.25
	KBS 3 X KBS 2	-7.88**	Low X Low	072.50
	DS52 X DSN26	-5.47**	Medium X Medium	078.25
	SE (±)	2.09		
Flowers inflorescence^{-1}	DS30 X KBS3	4.88**	Low X Medium	021.38
	DS52 X KBS2	3.82**	High X High	031.38
	DS52 X DSN26	1.29**	High X Low	024.40
	SE (±)	0.535		
Inflorescences plant^{-1}	DS30 X KBS2	13.69**	Low X High	074.75
	DS30 X DS52	08.78**	Low X Low	062.50
	DSN26 X DS161	08.69**	High X Low	075.00
	SE (±)	2.13		
Pod length	DS30 X DS52	01.91*	High X Low	016.29
	SE (±)	0.567		
Ten pod weight	DS30 X DS52	17.44**	Medium X Low	130.00
	DS161 X KBS2	13.79**	Low X Low	130.00
	SE (±)	5.62		
Rate of pod setting	DS30 X DSN26	01.64**	Medium X High	018.09
	DS52 X DS161	01.38**	Low X Low	014.25
	SE (±)	0.667		
Pod yield	DS30 X KBS 2	0.729**	Low X High	3.28
	DS30 X DS52	0.654**	Low X Low	2.55
	SE (±)	0.197		

pod characters irrespective of sowing dates. It also showed good combining ability for days to flowering in early sowing but poor in late sowing. Different types of combining ability in different sowings were also found in case of some other genotypes. These differential results may be due to genotype-environment interaction.

The comparison between mean performance and GCA effects of the parents for days to flowering showed a close positive relationship in both sowings (Table 2 and 3). Among the genotypes, DS30 was late flowering in both sowings and showed significant positive effect for this trait. On the contrary, KBS2 and KBS3 had early flowering habit with negative GCA effects at both environments. Similar trends of relationship between per se performance and GCA effects was found
for pods per inflorescence and 10-pod weight in both sowing date conditions; for flowers per inflorescence, inflorescence per plant and pod length in S_1; for rate of pod setting and pod yield in S_2 condition. In some other cases, invert relationship between per se performance and GCA effects were also found.

From the above discussion on GCA effects and mean performance of the parents, it can be suggested that KBS2 was an excellent general combiner for early flowering and pod yield and DSN26 was the best general combiner considering the number of characters under study. There also existed genotype-sowing date interactions for most of the characters.

Specific combining ability effects: DS52 X DS 161 had the highest significant SCA effect in desirable direction followed by DS30 X DSn26 in both sowings for early flowering. The crosses DS52 X KBS2, DS30 X KBS3 and DS52 X DSN26 showed significant positive SCA effect for flowers per inflorescence in both environments. In both sowings, DS30 X DS52 exhibited significant specific combining ability for inflorescence per plant and pod yield. However, some other crosses gave significant positive effects in early sowing but non-significant or significant negative effect in late sowing for the same traits and vise versa (Table 4 and 5).

From the crosses showing significant SCA effect, it was found that there existed all possible combination of GCA effects of the parents i.e. High X High, High X Medium, High X Low, Medium X Medium, Medium X Low and Low X Low for the expression of the characters. This result suggested the involvement of both additive and non-additive gene actions in the expression of the characters of Lablab bean. So, breeders should take care about the efficient exploitation of these non-additive gene actions to develop early maturing high yielding variety.

There were some dissimilarities between per see performance of the F_2's and their SCA effects, which suggested that both parameters i.e. per see performance and SCA effect should be considered simultaneously in selecting suitable hybrids and their advanced generations. Genotypic expressions of the F_2's were also found to be different in different sowing dates indicating the presence of genotype-environment interaction. Thus, before going on with the selection of suitable advanced generation plant breeders should also think about stable genotypes in different environments.

REFERENCES

1. Deka, R.K. and C.R. Sarkar, 1990. Nutritional composition and anti-nutritional factors of *Dolichos lablab* L. seeds. Food Chem., 38: 239-246.
2. Newaz, N., 1992. The composition of germinating *Lablab* bean seed and the functional characteristics of its flour. Proc. BAU Res. Prog., 6: 230-237.
3. Griffing, B., 1956. Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci., 6: 463-493.
4. Kabir, J. and S.K. Sen, 1990. Diallel analysis for combining ability in Dolichos bean (*Lablab niger* Medik: and *Dolichos uniflorus* lam.). Trop. Agric., 67: 123-126.
5. Hossain, M.A., 1993. Genetic studies on flowering time and pod yield attributes in Lablab bean. MS Thesis. Bangladesh Agric. Univ. Mymensingh.
6. Khondker, S., 1995. Diallel analysis in lablab bean (*Lablab purpureus*) following added nutrients. MS. Thesis. Bangladesh Agric. Univ. Mymensingh.
7. Khanam, S., 1999. Genetic regulation of character expression and its interaction with environments in *Lablab purpureus*. Pak. J. Biol. Sci., 2: 647-650.
8. Hossain, M.M., 2000. Genetic investigation and selection for pod and seed characters in Lablab bean. MS. Thesis. Bangladesh Agric. Univ. Mymensingh.
9. Patil, S.B. and R.S. Patil, 1986. Genetic studies in cowpea. J. Maharastra Agric. Univ., 11: 51-53.
10. Singh, S.P. and H.N. Singh, 1981. Gene system involved and their implication in breeding of lablab bean (*Dolichos lablab* L). Zeitschrift fun pjflanzenzuchtung, 87: 240-247.
11. Singh, S.P., H.N. Singh and J.P. Srivastava, 1986. Genetic studies of flowers and pods/raceme in hyacinth bean (*Dolichos lablab*). Farm Sci. J., 1: 85-88.
12. Singh, S.J.P., H.N. Singh and J.P. Srivastava, 1980. Combining ability in lablab bean (*Lablab purpureus* L. Sweet). Ind. Agric., 30: 147-152.