Indian J. Genet., 50 (4): 333–337 (1990)

GENETIC ANALYSIS OF HOMOGENEOUS AND HETEROGENEOUS POPULATIONS GROWN OVER ENVIRONMENTS IN MUNGBEAN

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(Received: December 17, 1988; accepted: October 7, 1989)

ABSTRACT

Combining ability analysis for yield and yield components of mungbean (*Vigna radiata* (L.) Wilczek) was attempted using a 7 x 7 diallel mating system both in F_1 and F_2 generations at three locations. Both gca and sca mean squares were significant for all the six characters in F_1 and F_2 generations, the former being more pronounced, except that nonadditive gene effect was predominant for cluster, pods and grain yield/plant in F_1. The estimates of interaction of gca and sca with environments were significant in all cases except both the interaction for 100-seed weight in F_1 and sca x environment for clusters/plant in F_2. The parent ML 5 was a good general combiner for seed yield, pods/plant, clusters/plant and tallness. While cv. Sabarmati was good general combiner for seed yield, pods/plant, and short stature. K 851 and Gujarat 2 were the best combiners for pod length and seed size in both generations. For inducing dwarfness, 12/333 was found out to be the best parent. The crosses showing high sca effects for yield also had significant and positive effects for at least two important yield components.

Key words: Diallel, combining ability, environmental interactions, mungbean.

Information on gene effects controlling various characters is of utmost importance in deciding efficient breeding plans over time and space. Combining ability analyses, besides yielding this information, identify the desirable parents and crosses for further exploitation. Since no information on simultaneous evaluation of homogeneous and heterogeneous but heterozygous mungbean populations over environments is available, this study was planned.

MATERIALS AND METHODS

A 7 x 7 diallel cross was made without reciprocals during kharif 1982 using seven mungbean parents. These parents, their 21 F_1s and 21 F_2s were sown in randomized block design replicated thrice at Sardar Krushinagar, Talod and Vadodara, during kharif 1983. In each replication, parents and F_1 were grown in 1.5-m long single rows and F_2 in five-row

plots with 45 x 15 cm spacing. Observations for six characters (Table 1) were recorded on five random plants of the parents and F_1 and 20 plants in each F_2 population. The character means were subjected to combining ability analysis following Model 1, Method 2 of Griffing [1] as extended by Singh [2].

Table 1. Analysis of variance for combining ability pooled over environments in F_1 and F_2 generations of mungbean

Source	d.f.	Population	Plant height	Clusters per plant	Pods per plant	Pod length	100-seed weight	Yield/ plant
Gca	6	F_1	828.0**	13.8**	311.3**	1.31**	0.99**	21.3**
		F_2	525.2**	4.9**	2224.7**	1.74**	1.05**	6.6**
Sca	21	F_1	112.1**	18.0**	389.3**	0.28**	0.10**	50.1**
		F_2	77.4**	1.6**	39.0**	0.08**	0.10**	3.3**
Environments	2	F_1	5196.9**	42.5**	7410.1**	5.41**	0.74**	723.7**
		F_2	7021.3**	41.6**	7742.1**	3.09**	0.68**	665.3**
Gca x environments	12	F_1	27.7**	2.8**	120.0**	0.22**	0.01	12.1**
		F_2	11.6**	3.0**	93.8**	0.14**	0.05**	5.2**
Sca x environments	42	F_1	15.7**	4.5**	107.4**	0.08**	0.01	11.2**
		F_2	16.6**	0.6	20.4**	0.06**	0.01*	3.3**
Error	162	F_1	3.6	0.7	3.7	0.05	0.01	0.9
		F_2	1.8	0.5	2.6	0.03	0.01	0.6

*, **P = 0.05 and 0.01, respectively.

RESULTS AND DISCUSSION

The mean square due to general combining ability (gca) and specific combining ability (sca) were highly significant in F_1 and F_2 generations for all the six characters at each location as well as in the combined analysis over locations (Table 1). As regards their magnitude, the former was relatively higher for plant height, pod length and 100–seed weight in F_1 and for all the characters in F_2 generation. The present findings are in close agreement with earlier reports [3–6]. The mean squares due to interaction of gca and sca with environments were significant for all the characters in both the generations, except both the interactions for 100–seed weight in F_1 and sca x environment for clusters/plant in F_2 generation. This suggested significant effect of environment on the estimates of gca and sca mean squares.

The estimates of gca effects (Table 2) revealed Sabarmati, T 44, 12/333 and Gujarat 2 in F_1, and Sabarmati, 12/333 and K 851 in F_2 generation, with significant and negative values, to be good general combiners for short stature. For clusters/plant, cv. ML 5 and A 36-4 in F_1 and T 44 and ML 5 in F_2 were good general combiners. Significant and positive gca effects for pods/plant were exhibited by Sabarmati and ML 5 in both the generations, A 36-4 in F_1,

Table 2. General combining ability effects for six traits in F_1 and F_2 pooled over location

Patent		Plant height	Clusters per plant	Pods per plant	Pod length	100-seed weight	Yield per plant
Sabarmati	F_1	-1.96**	-0.07	2.46**	-0.18**	0.01	1.04**
	F_2	-0.78**	-0.14	1.39**	-0.05	0.02	0.45**
T 44	F_1	-2.89**	-0.40*	-0.37	-0.08*	-0.03	-0.31
	F_2	1.94**	0.42**	2.40**	-0.24**	-0.09*	0.54**
K 851	F_1	-0.18	0.09	-0.80*	0.27**	0.17**	0.47**
	F_2	-0.61*	-0.24	-1.66**	0.22**	0.13*	-0.12
ML 5	F_1	3.75**	1.21**	5.06**	-0.16**	-0.12**	0.82**
	F_2	1.70**	0.68**	3.41**	-0.20**	-0.08*	0.51**
A 36-4	F_1	9.81**	0.64**	1.09**	-0.12**	0.17**	0.21
	F_2	5.95**	0.13	-0.79**	-0.13**	-0.18*	-0.32**
12/333	F_1	-7.81**	-0.65**	-1.73**	-0.09*	-0.19**	-1.39**
	F_2	-8.57**	-0.41**	0.45	-0.07*	-0.17*	-0.39**
Gujarat 2	F_1	-0.72*	-0.79**	-5.71**	0.36**	0.33**	-0.84**
	F_2	0.37	-0.43**	-5.20**	0.47**	0.37*	-0.67**

*, **P = 0.05 and 0.01, respectively.

and T 44 in F_2 generation. These parents, therefore, possess favourable genes for more pods/plant. Desirable gca effects for increased pod length and seed size were observed in K 851 and Gujarat 2. For grain yield/plant, good general combiners identified were Sabarmati and ML 5 in both the generations, K 851 in F_1, and T 44 in F_2 generation. Though none of the parents was a good general combiner for all the characters, however, the breeding material generated using the parents like Sabarmati, ML 5, T 44 and K 851 would be promising for isolation of high yielding lines.

As regards sca effects, 16 crosses, in F_1 and 6 in F_2 generation gave significantly positive sca effects for grain yield, which was reflected through significant and desirable sca effects in at least two component characters (Table 3). These crosses also registered significant heterosis over mid- and better parents suggesting that sca effects and heterotic response are highly related. As regards gca effects of the parents involved in these crosses, 11 combinations in F_1 and 3 in F_2 were high x low or high x medium type. Such combinations are expected to produce desirable transgressive segregants in subsequent generations if the additive genetic system present in the good combiner and the complementary epistatic effects in the F_1 are in the same direction [7]. On the other hand, the high x high combiners in the F_1 of Sabarmati x K 851 and K 851 x ML 5 could be utilised for production of high yielding homozygous lines through straight selection as their high significant sca effects are expressed due to additive and additive x additive gene effects, which are fixable.

Table 3. Best crosses exhibiting maximum sca effect for grain yield and other characters, gca effects of parents involved and heterosis for grain yield in pooled analysis

Cross	Sca effect	Gca effect		Heterosis, %		Components with significant sca effect
		P_1	P_2	MP	BP	
F_1 generation:						
Sabarmati x K 851	1.82**	1.04**	0.47**	89.4**	64.8**	—
Sabarmati x A 36-4	6.80**	1.04**	0.21	129.6**	110.3**	CP, PP
Sabarmati x 12/333	1.32**	1.04**	-1.39**	83.9**	42.2**	PH, SW
Sabarmati x Gujarat 2	2.35**	1.04**	-0.84**	109.0**	57.3**	PP, PL
T 44 x K 851	2.61**	0.31	0.47**	94.0**	76.6**	CP, PP
T 44 x ML 5	1.83**	0.31	0.82**	68.8**	65.8**	PH, CP, PL
T 44 x A 36-4	1.58**	0.31	0.21	69.5**	62.8**	PH, PL, SW
T 44 x Gujarat 2	2.69**	0.31	-0.84**	80.6**	63.4**	CP, PP
K 851 x ML 5	2.60**	0.47**	0.82**	104.1**	82.7**	CP, PP
K 851 x A 36-4	1.43**	0.47**	0.21	94.6**	83.9**	CP, PP
K 851 x 12/333	2.00**	0.47**	-1.39**	122.6**	93.4**	CP, PP, PL, SW
K 851 x Gujarat 2	3.50**	0.47**	-0.84**	121.2**	119.9**	CP, PP
ML 5 x A 36-4	1.14*	0.82**	0.21**	73.8**	64.0**	CP, PP
ML 5 x 12/333	2.24**	0.82**	-1.39**	100.9**	58.1**	CP, PP, PL, SW
ML 5 x Gujarat 2	2.85**	0.82**	-0.84**	91.8**	70.8**	CP, PP
A 36-4 x 12/333	3.43**	0.21	-1.39**	124.2**	85.7**	CP, PP
F_2 generation:						
Sabarmati x 12/333	1.38**	0.45**	-0.39**	—	—	PP, SW
T 44 x 12/333	1.34**	0.54**	-0.39**	—	—	CP, PP
K 851 x 12/333	1.07*	0.12	-0.39**	—	—	PH, PP
K 851 x Gujarat 2	1.21**	0.12	-0.67**	—	—	CP, PP
ML 5 x A 36-4	1.02*	0.51**	-0.32**	—	—	PP
12/333 x Gujarat 2	1.07*	-0.39**	-0.67**	—	—	CP, PP, PL, SW

*, **P = 0.05 and 0.01, respectively.

PH—plant height, CP—clusters/plant, PP—pods/plant, PL—pod length, SW—100-seed weight.

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