Indian J. Genet., **51** (4): 395–399 (1991)

HETEROSIS IN RELATION TO COMBINING ABILITY IN BLACK GRAM

B. C. SOOD AND S. L. GARTAN

Himachal Pradesh Krishi Vishvavidyalaya, Research Substation, Berthin 174 029

(Received: December 19, 1989; accepted: November 30, 1990)

ABSTRACT

Combining ability analysis on a 9 x 9 diallel cross in black gram revealed that high per se performance of parents does not necessarily reflect their good general combining ability. The parents HPU 392 and UH 27 were judged as good general combiners for seed yield. The hybrids UH 45 x UH 27, HPU 392 x UH 22, UH 27 x Pant U 19, HPU 384 x UH 45, and HPU 392 x UH 2 were identified as potential cross combinations on the basis of heterosis and specific combining ability. The predominance of nonadditive components in the inheritance of the characters studied was also observed.

Key words: Diallel, combining ability, heterosis, black gram.

Black gram *Vigna mungo* (L.) Hepper, is an important grain legumes of the tropical areas. The breeding of black gram has mainly remained confined to the selection of promising lines from the existing variability. The studies on heterosis and combining ability are useful in formulating effective breeding strategies and choice of suitable parents for crosses in breeding programmes. The present investigation has been undertaken to study gene action and selection of parents and crosses in a 9 x 9 diallel cross of black gram.

MATERIALS AND METHODS

A diallel cross, excluding reciprocals, involving nine genotypes of black gram, viz., HPU 392, T 9, HPU 394, HPU 384, UH 45, UH 27, UH 2, Pant U 19, and UH 22, was attempted. The material comprisng 36 F_1s and 9 parents was raised during kharif, 1986, at the Research Substation, Berthin, of the Himachal Pradesh Krishi Vishvavidyalaya in randomized complete block design with two replications. Each entry was accommodated in a single-row plot of 4 m length with 30 and 10 cm as inter- and intrarow spacings, respectively. The data were recorded on 10 random plants from each entry for plant height, primary branches/plant, pods and grain yield/plant, and 100-seed weight. The data were subjected to combining ability analysis following Method II, Model I of Griffing [1]. For the hybrids, the per cent heterosis over the best check (Pant U 19) was also worked out.

RESULTS AND DISCUSSION

Analysis of variance (Table 1) indicated that significant differences existed among the genotypes. Significant mean squares due to gca for plant height and grain yield revealed the importance of additive component of genetic variance in the inheritance of these characters. On the other hand, mean squares due to sca were significant for all the characters, revealing the importance of nonadditive components for the expression of all these characters. The gca/sca (σ^2g/σ^2s) ratio was less than unity, showing predominance of nonadditive components for all the characters. The importance of both additive as well as nonadditive components for plant height and grain yield has also been reported earlier [2–4]. The preponderance of nonadditive components in the inheritance of grain yield and other yield components was observed by various workers [4–6] in black gram.

Table 1. Analysis of variance for five quantitative characters in black gram

Source	d.f.	Mean squares				
		plant height	primary branches per plant	Pods per plant	Grain yield per plant	100-seed weight
Replications	1	1396.3	18.9	9535.7	594.9	15.71
Genotypes	44	2150.2**	1.6**	1021.3**	48.7**	0.80**
Gca	8	3759.5**	0.47	328.6	80.6**	0.53
Sca	36	479.3**	0.86**	534.1**	15.0**	0.37*
Error	44	139.8	0.26	123.7	4.8	0.20
σ^2_g/σ^2_s		0.88	–0.07	–0.05	0.58	0.06

*,**Significant at 5% and 1% levels, respectively.

σ^2_g, σ^2_s—Estimates of variances due to gca and sca, respectively.

The highest heterosis (113.7%) for grain yield over the best check (Pant U 19) was recorded in the hybrid UH 45 x UH 27, followed by HPU 392 x UH 22 (108.8%), UH 27 x Pant U 19 (100.0%), HPU 384 x UH 45 (85.3%) and HPU 392 x UH 2 (78.4%). On the other hand, lowest heterosis over the best check was observed in the cross HPU 394 x UH 45 (–69.7%). Similar trend of heterosis in black gram was reported earlier also [2–7]. The high heterotic effects as observed in most of the hybrids further supported the predominating role of nonadditive component in the inheritance of the characters studied.

The gca effects for different characters under study are presented in Table 2. The parents HPU 392 and UH 27 were judged as good general combiners for grain yield. Besides grain yield, HPU 392 for primary branches, and UH 27 for pods/plant displayed positive and significant gca effects. This situation further confirms the importance of these two characters for their contribution to grain yield. The parent Pant U 19 (the best check), though gave the

Table 2. General combining ability effects of nine parents in black gram for seed yield and component characters

Parents	Gca effects				
	plant height	primary branches per plant	pods per plant	grain yield	100-seed weight
HPU 392	5.1	0.34**	3.25	1.81**	0.14
T 9	-18.1**	-0.13	-9.75**	-2.81**	-0.11
HPU 394	30.6**	0.02	-2.50	-1.32*	-0.08
HPU 384	28.0**	0.02	-0.60	-0.21	0.41**
UH 45	-2.1	0.08	-3.11	0.48	0.15
UH 27	-4.2	-0.10	8.95**	1.93**	0.03
UH 2	-3.3	0.05	3.95	-0.68	-0.12
Pant U 19	-18.0**	0.14	3.16	0.91	-0.37**
UH 22	-17.9**	-0.42**	-3.36	-0.18	-0.05
$SE_{(gi)}$	3.4	0.14	3.16	0.62	0.13
$SE_{(gi-gj)}$	5.0	0.22	4.74	0.93	0.19

*,**Significant at 5% and 1% levels, respectively.

highest mean yield, was an average general combiner, confirming the earlier views that high per se performance may not necessarily be a reflection of good general combining ability. Apart from these, the parents HPU 384 for 100- seed weight and plant height, and HPU 394 plant height were found to be good general combiners.

The top five crosses selected separately on the basis of sca effects and their heterotic effects over the best check, are presented characterwise in Table 3. Most of these cross combinations were uniformly superior both from sca as well as heterosis point of view. In case of grain yield, the best hybrids mostly involved high x average general combiners. The better performance of these hybrids over the best check may be ascribed to the complementary gene effects.

The lines HPU 392 and UH 27 for grain yield, HPU 392 for primary branches, UH 27 for pods/plant and HPU 384 for 100-seed weight, were good general combiners. Utilization of these lines in breeding programme may prove useful for improvement of yield and other component characters. The hybrid UH 45 x UH 27 for primary branches, pods, and seed yield/plant; UH 27 x Pant U 19 for seed yield and pods/plant; and HPU 384 x UH 45 for seed yield and primary branches manifested high sca as well as heterotic effects. Such crosses are expected to throw better segregates for yield and yield components in the subsequent generations which can be exploited effectively for black gram improvement. Analysis of combining ability and heterosis depicted the importance of both additive and nonadditive components in the inheritance of yield and other characters. Therefore,

Table 3. Top five hybrids selected separately on the basis of heterosis over the best check and sca effects

Character	Cross	Heterosis (%)	Cross	Sca effects
Plant height	HPU 394 x HPU 384	162.7**	HPU 392 x T 9	50.9**
	HPU 384 x UH 2	113.4**	HPU 384 x UH 2	36.3**
	HPU 392 x HPU 394	111.9**	HPU 394 x HPU 384	34.8**
	HPU 394 x UH 27	108.5**	HPU 394 x UH 27	31.2**
	HPU 394 x UH 2	93.3**	HPU 392 x HPU 394	24.1*
Branches/plant	UH 45 x UH 27	100.0**	UH 45 x UH 27	2.8**
	HPU 384 x UH 45	65.6**	HPU 384 x UH 45	1.6*
	HPU 392 x T 9	43.7**	HPU 394 x HPU 384	1.0*
	HPU 394 x HPU 384	43.7**	HPU 394 x UH 2	1.9*
	HPU 394 x UH 2	43.7**	HPU 392 x UH 22	1.8*
Pods/plant	UH 27 x Pant U 19	106.6**	HPU 394 x UH 22	37.6**
	UH 45 x UH 2	95.0**	UH 45 x UH 2	34.7**
	UH 45 x UH 27	94.6**	UH 45 x UH 27	29.5**
	HPU 394 x UH 22	87.2**	UH 27 x Pant U 19	29.0**
	HPU 394 x Pant U 19	81.0**	HPU 394 x UH 2	28.1**
Yield/plant	UH 45 x UH 27	113.7**	HPU 392 x UH 22	8.1**
	HPU 392 x UH 22	108.8**	UH 45 x UH 27	7.8**
	UH 27 x Pant U 19	100.0**	HPU 384 x 45	7.1**
	HPU 384 x UH 45	85.3**	UH 27 x Pant U 19	6.0**
	HPU 392 x UH 2	78.4**	HPU 392 x UH 2	5.5**
100-seed wt.	HPU 384 x UH 2	47.4**	HPU 384 x UH 2	1.5**
	HPU 392 x UH 45	42.1**	HPU 392 x UH 45	1.3**
	HPU 392 x T 9	21.0**	HPU 392 x T9	0.7*
	T 9 x HPU 384	21.0**	HPU 392 x UH 27	0.5
	HPU 392 x UH 27	18.4**	HPU 392 x UH 22	0.5

*,**Significant at 5% and 1% levels, respectively.

breeding procedures like repeated crossing and modified recurrent selection in the segregating generations may prove useful in improving seed yield and other contributing characters in black gram.

REFERENCES

1. B. Griffing. 1956. Concepts of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci., 99: 463–493.

2. P. Sagar and S. Chandra. 1977. Heterosis and combining ability in urdbean. Indian J. Genet., 37: 420–424.

3. R. S. Malhotra. 1983. Combining ability in urdbean. Indian J. Genet., 43: 324–327.

4. S. Lal and R. S. Waldia. 1980. Combining ability in urdbean. Indian J. Genet., **40**: 295–299.

5. M. F. Haque, D. K. Ganguly and A. K. Mishra. 1988. Combining ability and heterosis in urdbean. Indian J. Pulses Res., **1**: 6–11.

6. P. Seenaiah, A. Satyanarayana, N. V. Naidu, S. S. N. Murthy and A. Rohini. 1989. Combining ability analysis in black gram. National Symposium on New Frontiers in Pulses Research and Development, Kanpur, 10–12 November.

7. K. B. Singh and J. K. Singh. 1971. Heterosis and combining ability in black gram. Indian J. Genet., **31**: 491–498.