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Combining ability in bottlegourd

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INTRODUCTION

Bottlegourd [*Lagenaria siceraria* (Mol.) Standl.] is a popular cucurbit vegetable in India. Inspite of some improved varieties like Pusa Summer Prolific Long (PSPL), Pusa Naveen and Arka Bahar, still local strains of bottlegourd are being cultivated commercially, resulting to low yields. The poor productivity and production is because of poor genetic make-up of open-pollinated mixed seed or local strains. Heterosis breeding in bottlegourd is one of the means to get uniform, early and higher fruit yields. Identification of potential parents based on their combining ability is very essential in heterosis breeding so that the resultant F_1 hybrids can express maximum heterosis for desired traits. Bottlegourd being monoecious is cross-pollinated and heterosis in cross-pollinated crops has long been known to offer good potentialities for increased yield. Therefore, studies were undertaken to identify parental combinations that are likely to produce high yields, early maturing and uniform good quality fruits.

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MATERIAL AND METHODS

The experimental material consisted to nine diverse cultivars of bottlegourd, namely Banswara Local-1 (P_1), Long White Prolific (P_2), Pusa Naveen (P_3), Raichur Local-1(P_4), Udaipur Local-1 (P_5), IC 92353A (P_6), IC 92374 (P_7), IC 42361 (P_8) and PSPL (P_9). These were crossed with each other in all possible combinations (excluding reciprocals). The experimental material was sown under four environments on two different dates at two different locations. The 36 F_1 hybrids along with nine parents were grown in a randomised block design with three replications. The crop was sown in rows 3 m apart and 1 m between plant to plant and five plants were selected for the observations leaving the border plants on both the ends in each treatment. The observations were recorded on days to opening of first male flower, days to opening of first female flower, node number to first male flower appearance, node number to first female flower appearance, number of male flowers per plant, number of female flowers per plant, number of branches per plant, main vine length, days to first harvest, number of fruits per plant, fruit length, fruit girth, fruit weight and fruit yield per plant. Data were statistically analysed for the study of combining ability by following the method 2 model 1 of Griffing (3) and also pooled analysis over the environments.

RESULTS AND DISCUSSION

Analysis of variance for combining ability revealed that mean squares due to gca and sca effects were significant for all the characters. This indicated that both additive and non additive genes played significant role in the inheritance of these characters. Similar result were reported by Chadha and Nandpuri (1), Sirohi *et al.* (6), Sivakami *et al.* (7) and Choudhary and Kale (2) in cucurbits. The GCA : SCA ratio (σ^2 GCA : σ^2 SCA) was more than one for different the traits. This indicated that additive components played relatively greater role in the inheritance of these traits. Similar reports were made by Jankiram and Sirohi (4) and Kesavan and More (5). Mean squares due to interaction, i.e. gca x environment and sca x environment were significant for all the traits. This indicated that both gca and sca were significantly influenced by the environments. The higher magnitude of gca x environment than the sca x environment variance was indicative of the fact that additive components were influenced more by the environments.

In present study, under E_1, E_2 and pooled environment, four cultivars viz. Banswara Local-1, Pusa Naveen, IC 92374 and PSPL were good general combiner for fruit yield per plant. These cultivars were also good general combiner in their respective environment for days to opening of first female flower, node number to first female flower appearance, number of female flower plant and days to first harvest. In addition to above cultivars, the

Table 1. Analysis of variance for combining ability for some characters in bottlegourd

Source of variation	d.f.	Mean squares				
		DFF	NFF	DFH	NFP	FYP
Environment (E)	3	363.13**	41.54**	253.12**	11.24**	4.75**
GCA	8	622.77**	143.60**	906.86**	80.26**	57.50**
SCA	36	21.17**	5.63**	43.74**	8.40**	3.42**
GCA x E	24	11.90**	1.20**	6.83**	0.48**	0.24
SCA x E	108	3.98**	1.54**	6.83**	0.27**	0.20**
Error	252	0.24	0.12	0.54	0.04	0.53
σ^2 GCA : σ^2 SCA		1 : 0.03	1 : 0.03	1 : 0.04	1 : 0.10	1 : 0.05
σ^2 (GCA x E) : σ^2 (SCA x E)		1 : 0.33	1 : 0.95	1 : 0.99	1 : 0.56	1 : 0.83

** Indicates significant at 1 % level against respective environmental interactions
DFF - Days to opening of first female flower, NFF - Node to first female flower appearance, DFH - Days to first harvest, NFP - Number of fruits per plant and FYP - Fruit yield per plant

parental line Udaipur Local-1 was also good general combiner for fruit yield per plant in E_3 and E_4 environments. Most of the parents which were good general combiner for fruit yield per plant in E_1, E_2, E_3, E_4 and pooled environment were also good general combiner for yield contributing traits like number of fruits per plant, fruit length and fruit girth. However, four cultivars viz., Banswara Local-1, Pusa Naveen, 1C 92374 and PSPL were good general combiners for fruit yield per plant in all the environments. Since the gca effects are attributed to fixable components, i.e. additive and additive x additive gene effects, the above mentioned parents can be used in hybridization programme.

Table 2. Estimates of general combining ability effects (pooled) for some characters in bottlegourd.

Character	Parent									SE	SED
	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	+ (gi)	+ (gi-gl)
DFF	-1.54**	1.62**	-4.35**	1.56**	-0.35**	4.38**	-4.86**	6.11**	-2.58**	0.07	0.11
NFF	-1.11**	1.01**	-2.66**	1.00**	-0.07	2.07**	-2.29**	2.47**	-0.41**	0.05	0.07
DFH	-1.38**	1.54**	-5.79**	2.09**	-0.25**	5.53**	-5.97**	6.98**	-2.76**	0.11	0.16
NFP	0.25**	-0.41**	1.66**	-1.08**	-0.17**	-1.61**	2.43**	-1.36**	0.29**	0.03	0.04
FYP	1.18**	-0.26**	1.08**	-0.65**	0.01	-2.05**	1.03**	-1.19**	0.84**	0.03	0.04

** Indicates significant at 1% level.

Table 3. Crosses significant sca effects (pooled) for important characters.

Cross	Fruit yield/plant	Fruits/plant	Days to harvest
Banswara Local 1 x Pusa Naveen	1.04	-	-3.12
Banswara Local 1 x 1C 92374	1.86	2.12	-1.87
Long White Prolific x 1C 42361	0.69	-	-2.00
Pusa Naveen x 1C 42361	0.71	0.74	-
Raichur Local 1 x PSPL	0.78	1.46	-2.34
Udaipur Local 1 x 1C 92374	0.64	1.51	-1.47
IC 92353A x IC 42361	0.65	1.16	-
1C 92374 x 1C 42361	1.78	1.17	-5.51
1C 92374 x PSPL	0.81	0.32	-
SE +(Sij)	0.08	0.15	0.34
SED + (Sij - Sik)	0.12	0.22	0.50
SED + (Sii - Ski)	0.12	0.02	0.47

Estimates of specific combining ability effects are attributed to role of dominance and its interaction. Out of thirty-six crosses, only nine crosses exhibited significant positive sca effects for fruit yield per plant in E_1, E_2, E_3, E_4 and pooled environment. Most of these crosses exhibited significant desired sca effects for yield contributing traits like number of fruits per plant, number of female flowers per plant, days to first harvest, fruit length, number of branches per plant, main vine length, days to opening of first female flower and days to opening of first male flower. However, the cross Banswara Local-1 x Pusa Naveen, Banswara Local-1 x 1C 92374 and 1C 92374 x PSPL depicted significant economic heterosis in all the environments for total yield per plant and contributing traits. The response to selection in expected to be best in crosses involving parents having high gca effects. The crosses that showed high specific combining ability could be best utilized in heterosis breeding.

SUMMARY

The present study was undertaken on bottlegourd in a 9x9 diallel cross excluding reciprocals. The 36 F_1 hybrids along with nine parents were sown in RBD with three replication under four environments created by sowing the experimental material on two different dates at two different locations. The mean squares of gca and sca were highly significant for all the traits. This indicated that both additive and non-additive genes played significant role in the inheritance of these traits. The gca:sca ratio was more than one for all the traits. Mean squares due to interaction, i.e. gca x environment and sca x environment were significant for all the traits. Culti Banswara Local-1, Pusa Naveen, 92374 and PSPL were good gene combiners for yield contributing traits ir the environments. Only, nine cros: exhibited significant positive sca effe for fruit yield contributing traits in E_1, E_3, E_4 and pooled environment. The cr combination Banswara Local 1 x Pu Naveen, Banswara Local 1 x IC 92: and IC 92374 x PSPL, exhibited signific economic heterosis for total fruit yi plant and yield contributing characters

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