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COMBINING ABILITY ANALYSIS IN SPONGE GOURD [*LUFFA CYLINDRICA* (ROEM.) L.]

MV NALIYADHARA, LK DHADUK, AV BARAD AND DR MEHTA
Vegetable Research Station, Junagadh Agril.University, Junagadh - 362 001 (Gujarat) India

Summary

Combining ability analysis was carried out in 9 x 9 diallel cross of sponge gourd excluding reciprocals. The estimated component of variance of sca were higher than gca for all the characters except days to first picking indicating the predominance of non – additive gene actions for most of the characters under study. Three parents viz NSG – 28, JSGL –71 and JSGL – 72 were found good general combines for fruit yield and were also good general combiners for some of fruit yield contributing Characters offer the worth considering in further breeding programme. The crosses NSG-28 x CHSG –1, JSGL – 71 x JSGL – 70 and JSGL – 71 x Pusa Chikni combinations can be tested for promotion of F_1 hybrid in sponge gourd.

सारांश

नेनुआ में 9 x 9 डायलियल के द्वारा संयोजन क्षमता का अध्ययन किया गया। पहली तुड़ाई को छोड़कर सभी गुणों के लियेSCA भिन्नता GCA से अधिक पाया गया जोकि नान एडिटिव जीन सक्रियता को दर्शाता है। फल उपज के लिएNSG – 28, JSGL –71 औरJSGL – 72 ने अच्छा संयाजन क्षमता दर्शाया।

Introduction

The knowledge of combining ability helps in identifying best combiners which may be hybridized either to exploit heterosis or to accumulate fixable genes through selection study of gca helps in selection of superior parents and sca for superior hybrid. In sponge gourd, studies on combing ability have been reported by earlier workers is very scanty. An attempt has therefore been made to study the combining ability for ten characters by diallel cross technique following Griffing's approach.

Materials and Methods

Nine diverse genotypes / cultivars of sponge gourd namely CHSG –2, JSGL –71, JSGL – 1, NSG –28, Avanti green, GHSG – 1, JSGL – 70, JSGL – 72 and Pusa Chikni were crossed in all possible combinations excluding reciprocals. The 36 F_1 hybrids along with their nine parents were evaluated during *Kharif* 2003 and *Kharif* 2004 in a RBD with three replications at Vegetable Research Station, JAU, Junagadh. Observations were recorded on five randomly selected plants from each treatment for yield and yield attributing traits viz days to first picking, days to last picking, length of vine (m) number of branches per vine, number of fruits per vine, weight of fruit (g), length of fruit (cm), girth of fruit (cm), fruit yield per vine (kg) and intensity of downy mildew) (%). Data of both the seasons were pooled and subjected to statistical analysis. The combining ability estimates were calculated according to the method 2 and model 1 of Griffing (1956).

Results and Discussion

The pooled analysis of combining ability mean squares due to GCA, SCA and year were highly significant for all the traits (Table – 1) indicated the important of both additive and non-additive variances for the expression of those traits. Similar findings were reported by Sivakami et al. (1987) in bottle Gourd, Rao et al. (1999) in ridge gourd and Sirohi and Choudhary (1977) in bitter gourd. Mean square due to interactions of gca and sca with years were also highly significant for all the characters except days to last picking no. of primary branches per plant and fruit weight. Though, the interactions of gca with years were observed to be significant, their magnitudes in relation to gca variance were quite lower for most of the traits indicating the negligible contributions of GCA x years interactions towards the expression of these traits in parents. Similarly the magnitudes of SCA x year's interactions were also considerably lower in relation to sca variances themselves indicating the stable expression of crosses over years. The gca / sca variance ratio

Table – 1 Pooled analysis of variance for combining ability in sponge gourd

Source	Days to first picking	Days to last picking	Length of vine (m)	No. of branches/ vine	No. of fruits/ vine	Fruit weight (g)	Fruit length (cm)	Fruit girth (cm)	Fruit yield/ vine (kg)	Intensity of downy mildew (%)
GCA	113.44**	24.86**	8.72**	1.31**	8.03**	241.97**	41.44**	0.25*	0.17**	18.04**
SCA	12.34**	7.69**	1.53**	0.35**	9.21**	67.95**	8.50**	0.31**	0.10**	11.35**
Years	599.76**	944.93**	7.62**	0.00**	55.80**	345.93**	29.54**	5.40**	0.36**	11.36**
GCA x Years	27.95**	8.69	0.52**	0.02	2.77**	15.47	5.26**	0.24*	0.02**	5.57**
SCAX Years	11.20	6.46	0.60**	0.01	2.06**	12.25	3.74**	0.45**	0.05**	5.37**
Error	5.54	4.40	0.10	0.07	0.81	8.71	0.78	0.09	0.01	3.12
6^2gca	9.81	1.86	0.79	0.10	0.66	15.82	3.87	0.02	0.02	1.36
6^2sca	6.80	3.29	1.42	0.27	8.41	59.24	7.72	0.21	0.09	8.23
6^2gca / 6^2sca	1.44	0.57	0.54	0.40	0.08	0.27	0.50	0.07	0.02	0.16

*, ** Significant at 5% and 1% probability level, respectively.

showed that sca variances higher than gca variances for all the characters, except days to first picking, indicated that non-additive gene effects were more important for most of the characters studied. The predominance of non-additive gene action for fruit yield and its component traits were also reported by Khatra et al. (2000) in bottle gourd and Kadam (1989) and Rao et al. (1999) in ridge gourd.

Estimates of general combining ability (gca) effects of parents are presented in table-2, revealed that none of the parent was found to be good general combiner for all the characters. Among the nine parental lines, the parents CHSG –2 and Avanti Green showed significant negative gca effect for days to first picking but poor combiners for fruit yield per vine and its component traits except fruit length (CHSG-2). Parent JSGL – 71 also showed the significant negative gca effect for days to first picking along with good general combiner for fruit yield per vine. NSG – 28 was observed to be one of the best general combiners as it has shown significant gca effects in desirable direction for fruit yield and all its component traits except girth of fruit. Like wise parent JSGL – 72 was also good general combiners for fruit yield per vine along with length of vine and fruit weight. Parent Pusa Chikni was observed to be the good general combiners for length of vine, fruit weight fruit length and fruit girth, but poor combiners for no. of fruits per vine and fruit yield per vine. In general, it was observed that three parents NSG –28, JSGL –71 & JSGL – 72 were found good general combiners for fruit yield and were also good general combiners for some of fruit yield contributing characters offer the worth considering in future breeding programme. Further, for must of the characters, there was a close agreement between the

Table – 2 Estimates of general combining ability effects of parents.

Character / Parent	Days to first picking	Days to last picking	Length of vine (m)	No. of branches/ vine	No. of fruits/ vine	Fruit weight (g)	Fruit length (cm)	Fruit girth (cm)	Fruit yield/ vine(kg)	Intensity of downy mildew (%)
CHSG –2	-2.61**	-0.83*	-0.81**	-0.25**	-1.71**	-1.98**	0.43*	-0.03	-0.12**	1.39**
JSGL –71	-1.57**	-0.21	-0.38**	-0.08	0.35	2.04**	2.13**	0.06	0.09**	1.10**
JSGL –1	-0.90	0.61	0.12*	-0.27**	0.00	-2.67**	-1.44**	0.00	-0.07**	-0.15
NSG –28	-0.60	2.47**	0.69**	0.11*	0.67**	5.05**	1.90**	0.09	0.12**	-1.48**
Avanti Green	-1.22**	0.65	-0.67**	-0.26**	-0.73**	-6.26**	-1.26**	-0.11	-0.13**	-0.24
CHSG –1	-0.52	-0.74	-0.48**	0.48**	0.32	0.22	0.33	-0.01	0.04*	0.51
JSGL –70	5.05**	-0.73	1.01**	0.10	0.52**	-0.36	-1.14**	0.03	0.03*	-0.91
JSGL –72	0.61	-0.38	0.18**	0.06	0.22	1.72**	-1.46**	-0.19**	0.05**	-0.19
Pusa Chikni	1.76**	0.46	0.35**	0.12*	-0.18	2.23**	0.52**	0.17**	0.01	-0.02
SE (gi)??	0.22	0.17	0.00	0.00	0.03	0.35	0.03	0.00	0.00	0.12

*, ** Significant at 5% and 1% probability level, respectively.

Table – 3 Estimates of specific combining ability effects of F_1 hybrids.

Character / Cross	Days to first pickiry	Days to last picking	Length of vine (m)	No. of branches/ vine	No. of fruit/ vine	Fruit weight (g)	Fruit length (cm)	Fruit girth (cm)	Fruit yield/ vine	Intensity of downy mildew (%)
CHSG-2 x JSGL –71	-1.21	-0.11	-0.24	-0.21	-0.70	-1.66	-1.82**	0.19	-0.20**	0.20
GHSG-2 x JSGL –1	-1.38	3.24*	-0.72**	0.14	0.49	-4.57*	0.35	0.07	0.14**	1.75
CHSG-2 x NSG-28	-1.68	-1.79	-0.53*	-1.14**	0.05	3.69	4.30**	0.33	0.01	-1.09
CHSG-2 x A.G.	-1.06	-0.50	0.28	0.19	-0.70	-1.82	1.65**	-0.73**	-0.11*	-2.36*
CHSG-2 x CHSG-1	2.25	1.42	0.98**	-0.09	0.36	-6.43**	-0.74	0.59**	-0.05	-3.13**
CHSG-2 x JSGL-7-	-5.33**	-0.26	-1.09**	-0.23	0.41	-4.21*	-1.80**	-0.47*	0.06	-0.17
CHSG-2 x JSGL-72	1.11	0.73	-0.07	0.69**	0.59	5.67**	-1.57	-0.28	0.15**	0.13
CHSG-2 x P.C.	4.62**	0.23	-0.11	0.54**	-0.66	8.60**	1.17*	0.09	0.00	-2.58*
JSGL-71 x JSGL-1	0.75	-0.21	-0.74**	-0.10	2.48**	4.43*	-0.09	0.53**	0.17**	-1.65
JSGL-71 x JSG-28	3.94**	1.42	0.55**	0.40*	-0.69	-0.82	-2.00*	-0.68**	-0.17**	1.20
JSGL-71 x A.G.	0.40	2.21	0.38	-0.07	2.07**	4.90*	-1.03	0.67**	0.30**	-0.55
JSGL-71 x CHSG-1	-1.30	-0.86	-0.06	0.27	-1.39*	6.49**	0.09	-0.47*	-0.22**	-1.77
JSGL-71 x JSGL-70	-3.21*	2.29	-1.07**	0.33	2.95**	-0.35	2.95**	-0.60**	0.35**	-2.47*
JSGL-71 x JSGL-72	-2.44	-0.56	-0.26	-0.47**	-0.50	-5.56**	1.26*	0.20	-0.13*	-1.12
JDGL-71 x P.C.	-3.09*	-1.06	0.90**	0.66**	3.54**	4.47*	0.00	0.40	0.38**	-2.28*
JSGL-1 x JSG-28	0.61	-2.23	1.25**	0.38*	-0.47	-0.06	-0.25	-0.29	-0.09	-5.50**
JSGL-1 x A.G.	-1.27	-1.61	0.01	0.22	0.66	7.42**	-1.15	-0.19	0.21**	-1.31
JSGL-1 x CHSG-1	-1.47	3.15**	0.11	-0.05	-0.28	-0.54	1.94	0.81**	-0.06	0.46
JSGL-1 x JSGL-70	2.29	-2.36	-1.34**	-0.02	-0.70	0.74	1.87	-0.51*	-0.06	1.39
Character / Parent	Days to first pickiry	Days to last picking	Length of vine (m)	No. of branches/ vine	No. of fruit/ vine	Fruit weight (g)	Fruit length (cm)	Fruit girth (cm)	Fruit yield/ vine	Intensity of downy mildew (%)
JSGL-1 x JSGL-72	2.90	-3.38*	-0.18	0.05	2.89**	1.80	1.97**	-0.41*	0.28**	-0.84
JSGL-28 x P.C.	2.75	-1.55	0.34	0.31	-2.08*	3.47	-0.50	-0.15	-0.27**	1.45
JSGL-28 x A.G.	-0.57	0.03	0.92**	0.17	0.66	4.16*	-2.43**	-0.18	0.03	0.51
NSG-28 x CHSG-1	-3.27*	-1.55	0.44*	0.10	1.73**	3.10	2.63**	0.05	0.35**	-0.35
NSG-28 x JSGL-70	3.82*	-0.73	1.82**	-0.02	0.67	7.05**	0.74	0.15	0.11*	-3.12**
NSG-28 x JSGL-72	1.43	-0.91	0.35	0.30	1.27**	-1.45	0.66	0.30	0.21**	-0.55
NSG-28 x P.C.	-2.89	3.26*	-1.49**	0.08	-0.67	-3.68*	-1.43*	-0.19	-0.03	-0.72
A.G. xCHSG-1	-2.65	-3.42*	-0.03	-0.17	-0.99	7.87**	2.43**	0.01	-0.05	-2.52*
A.G. x JSGL-70	1.78	2.23	0.10	0.31	2.43**	12.13**	2.39**	0.09	0.19**	1.29
A.G. x JSGL-72	1.22	1.38	-1.15**	-0.39*	-0.29	0.85	3.84**	-0.42**	-0.11*	-0.24
A.G. x P.C.	0.06	-2.95*	-0.59**	-0.76**	-1.13	-5.90**	2.92**	0.14	0.05	3.56**
CHSG-1 x JSGL-70	1.41	1.65	0.17	-0.07	5.84**	7.72**	0.01	-0.04	0.38**	0.73
CHSG-1 x JSGL-72	0.35	-153	-0.47*	0.46**	0.85	2.66	-1.76**	-0.30	0.04	-0.54
CHSG-1 x P.C.	-0.97	0.47	-0.34	0.11	1.51**	2.18	-0.30	-0.27	0.20**	-0.27
JSGL-70 x JSGL-72	-0.56	-0.05	-0.78**	-0.84**	-3.88**	0.29	0.15	0.29	-0.19**	-2.19
JSGL-70 x P.C.	-2.21	-1.38	1.64**	-0.01	-0.80	-1.22	0.24	0.31	-0.12*	0..22
JSGL-72 x P.C.	-1.10	2.44	0.85**	-0.06	0.63	1.41	1.05	-0.08	-0.02	0.99
SE(Sij) ?	2.31	1.84	0.04	0.03	0.33	3.64	0.32	0.04	0.00	1.30

*, ** significant level at 5% and 1% respectively
A.G. = Avanti Green, P. C. = Pusa Chikni

ranking on the basis of gca and the *per se* performance of the parents. There for, both gca effect and *per se* performance should be taken to gather for assessing true breeding potential. Similar finding were also reported by Sharma et al. (2002) in bottle gourd, Shala et al. (1999) in ridge gourd and Tewari et al. (2001) in bitter gourd.

The estimates of sca effects are given in table-2. The numbers of crosses having desirable significant sca estimates were 14 for fruit yield, 7 for no. of fruits per vine, 11 for fruit weight, 10 for fruit length,4 for fruit girth, 4 for days to first picking, 3 for days to last picking, 9 for length of vine, 6 for no. of branches per vine and 8 for intensity of downy mildew. The three best performing crosses showing highest sca effects in desirable direction in order of merit were CHSG – 2 x JSGL –7-, NSG –28 x CHSG –1 and JSGL –71 x JSGL – 70 for days to first picking, NSG – 28 x Pusa

Chikni, CHSG –2 x JSGL –1 and JSGL – 1 x CHSG – 1 for days to last picking ,NSG – 28 x JSGL –30, JSGL – 70 x Pusa Chikni and JSGL – 1x NSG – 28 for length of vine, CHSG – 2 x JSGL – 72, JSGL – 71 x Pusa Chikni and CHSG –2 x Pusa Chikni for no. of branches per vine, CHSG –1 x JSGL – 70, JSGL – 71 x Pusa Chikni and JSGL – 71 x JSGL – 70 for no. of fruits per vine, Avanti Green X JSGL – 70, CHSG – 2 x Pusa Chikni and CHSG – 1 x JSGL – 70 for weight of fruit, CHSG – 2 x NSG –28, Avanti Green x JSGL – 72 and JSGL – 71 x JSGL – 70 for length of fruit, JSGL – 1 x CHSG – 1, JSGL – 71 x Avanti Green, CHSG – 2 x CHSG – 1 for girth of fruit, JSGL – 71 x Pusa Chikni, CHSG – 1 x JSGL – 70 and JSGL – 71 x JSGL – 70 for fruit yield per vine and JSGL – 1 x NSG – 28, CHSG – 2 x CHSG – 1 and NSG – 28 JSGL – 70 for intensity of downy mildew. It is clear from the results obtained that in majority of the crosses which showed the best sca effect having at least one of the 3 most outstanding parental lines namely NSG – 28, JSGL – 71 and JSGL – 72, which have high gca effect for one or more for the yield contributing characters. Such observation has also been made by Sharma et al. (2002) in bottle gourd, Shaha and Kale (2003) in ridge gourd and Tewari et al. (2001) in bitter gourd. For assessing the superiority of a hybrid generally its sca effects and *per se* performance should be taken into account. In the present study, it was clear that there was a close correspondence between sca effects and *per se* performance for most of the economic characters. It was also evident that best cross combination for most of the characters generally involve one good and one poor general combiner with high sca effects may be due to a complementary type of gene action which can be fixed to a great extent in the segregating generations whereas crosses with high sca effects which involved good x good and poor x poor combiners, may be utilized for exploitation of hybrid as the non additive, non fixable genes seems to play at greater role.

Parents like NSG – 28, JSGL – 71 and JSGL – 72 in general were proved to be good general combiners for most of the yield contributing characters. Among combinations based on the sca values and F1 *per se* performance the hybrid namely NSG – 28 x CHSG – 1, JSGL – 71 x JSGL – 70 an JSGL – 71 x Pusa Chikni has been found superior and these combinations can be tested for promotion of F_1 hybrids in sponge gourd.

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