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Combining ability analysis in sponge gourd (*Luffa cylindrica* Roem.)

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Abstract

The present experiment was conducted to study combining ability in sponge gourd. Experiment was laid out in RBD with three replications. The evaluation was done during spring-summer season of 2019 for 12 horticultural traits. The analysis of variance indicated significant difference among all the genotypes for all the characters. Variance due to GCA was significant for all characters except for days to first female flower and number of primary branches. Variance due to SCA was significant for all characters. On the basis of GCA effect for early fruit yield and its components the parents identified as promisingly was PSG-40 and PSG-37. The crosses PSG-15 × PSG-40, PSG-37 × PSG-40 and PSG-84 × PSG-17 were best for sca effects for most of the important economic traits and can be utilized in future breeding programme.

Keywords: Sponge gourd, combining ability, GCA, SCA, variance

Introduction

Sponge gourd (*Luffa cylindrica* Roem., 2n = 2x = 26) an important member of gourd family Cucurbitaceae belongs to *Luffa* species and are indigenous to tropical Asia. Sponge gourd is useful for patients because it is easily digestible. Sponge gourd along with pumpkin, squashes and other gourds has annual production of 27.45 million tonnes in the world. In India, the gourds production is about 5.14 mt (FAO, 2017) [1]. The diallel analysis is widely used and most balanced and systematic experimental design to determine continuous variation. Combining ability analysis is one of the powerful tools available to the plant breeder as it helps in understanding the mode of gene action governing the expression of the character in question and thus helps in deciding upon the future breeding strategy (Griffing, 1956) [3]. Though sponge gourd one of the common cucurbit in the country it has been neglected by the plant breeder so far. Considering the importance of combining ability studies in the improvement of sponge gourd the present investigation was planned.

Material and Methods

Twenty eight crosses developed from half diallel involving 8 parents (PSG-15, PSG-84, PSG-23, PSG-37, PSG-17, PSG-9, PSG-52, PSG-40) were evaluated for 12 horticultural traits namely days to first male flower, days to first female flower, node number to first male flower, node number to first female flower, days to first fruit harvest, main vine length (m), number of primary branches, average fruit weight (g), fruit length (cm), fruit diameter (cm), number of fruits per plant, fruit yield (q/ha). The present investigation was carried out at the Vegetable Research Centre, GBPUAT Pantnagar, Uttarakhand during the spring-summer season of the year 2019. The Experimental design used was Randomized Block Design with three replications and spacing used is 3.0 × 0.60 m. Seed sowing was done in poly bags on 6 February, 2019. Then the seedlings were transplanted in main field on 6 March, 2019 when they were 2-4 leaf stage, thinning was done to retain one plant per pit.

Results and Discussion

The results revealed that the mean squares due to general combining ability were highly significant for all characters except for days to first female flower and number of primary branches. Mean squares due to specific combining ability were highly significant for all the characters. The significant mean squares due to gca and sca for almost all the characters indicated the role of both additive and non-additive gene action in inheritance of these characters. In present study, none of parents exhibited significant gca effect for all the traits.

It would be imperative to mention here that for the characters days to first male and female flower, node number to first male and female flower, days to first harvest the negative gca and sca effects were considered to be desirable, as it indicates earliness. However characters like average fruit weight, fruit length, fruit diameter, number of fruits per plant and fruit yield (q/ha), main vine length, number of primary branches the positive gca and sca effects were considered to be desirable.

Estimation of general combining ability effects

The estimates of general combining ability (gca) effects of 8 parental lines for all the 12 traits are presented in Table 1. Analysis of gca effects for character days to first female flower estimates of gca effects revealed that parents exhibiting significant desirable negative gca effects were PSG-52 (-8.22), PSG-9 (-6.27) and PSG-37 (-2.01). As regards gca effects for nodes to first female flower only three parents viz., PSG-40 (-1.89), PSG-52 (-1.67) and PSG-17 (-0.82) showed significant negative gca values. For trait days to first harvest the parents which showed the gca in favourable direction were PSG-84 (-1.75) and PSG-9 (-1.61). Estimates of gca effects for main vine length (m) revealed that parents showing significant gca effects in desirable direction are PSG-40, PSG-15 and PSG-37 with significant gca values 0.25, 0.23 and 0.08 respectively. Among the eight parents only one parent PSG-37 (0.28) exhibited significant positive gca effect for number of primary branches while, PSG-52 (0.14) showed maximum positive gca value. Among eight parents, for average fruit weight (g) Significant positive gca effect was observed in PSG-23 (6.18). Among the eight parents PSG-17 (1.54) and PSG-52 (0.76) exhibited significant positive gca effect for fruit length. Among the eight parents only two parents exhibited significant positive gca effects for fruit diameter i.e. PSG-15 and PSG-17 (0.07 each) while for number of fruits per plant PSG-40 (0.83) registered the highest gca effect followed by PSG-37 (0.57). The estimate of gca effects for trait fruit yield (q/ha) revealed that PSG-40 (7.64) highly significant positive gca effects.

Table 1: Estimates of general combining ability effects of parents for various horticultural traits in sponge gourd

Name of parent	Days to first female flower	Node number to first female flower	Days to first fruit harvest	Main vine length (m)	No. of primary branches	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	No. of fruits per plant	Yield q/ha
PSG-15	0.27	0.07	0.67	0.23**	-0.16	3.18	-1.83**	0.07*	0.00	-2.26
PSG-84	5.91**	0.61**	-1.75*	-0.06	0.01	3.45	0.52	-0.01	0.07	-2.93*
PSG-23	4.30**	1.73**	0.22	-0.05	0.01	6.18*	0.10	0.02	-0.30	-2.71*
PSG-37	-2.01*	0.12	1.41*	0.08*	0.28**	-7.50*	0.23	-0.05	0.57**	0.35
PSG-17	-1.09	-0.82**	0.06	0.06	-0.09	4.55	1.54**	0.07*	-0.57**	1.96
PSG-9	-6.27**	1.86**	-1.61*	-0.25**	-0.09	1.77	-0.32	-0.07	-0.37	-2.47
PSG-52	-8.22**	-1.67**	-0.68	-0.25**	0.14	-6.39*	0.76*	0.02	-0.23	0.42
PSG-40	4.28**	-1.89**	1.69*	0.25**	-0.09	-5.24	-0.99**	-0.05	0.83**	7.64**
SE (gi)	-0.91	0.16	0.71	0.04	0.10	2.98	0.34	0.03	0.20	1.27
SE (gi-gj)	5.39	0.25	1.07	0.06	0.15	4.50	0.52	0.05	0.30	1.92

Estimation of specific combining ability effects

For earliness (days to anthesis and nodal position of first female flower and days to first harvest), PSG-37×PSG-40, PSG-15×PSG-40, PSG-37×PSG-40, PSG-37×PSG-9 and PSG-15×PSG-37 proved to be good specific combiners. For vegetative characters (main vine length, number of primary branches), PSG-37×PSG-40, PSG-15×PSG-40 and PSG-17×PSG-9 gave considerable sca effects. For fruit characters (fruit weight, fruit length and fruit diameter), PSG-17×PSG-9, PSG-15×PSG-40, PSG-84×PSG-17, PSG-9×PSG-40 and PSG-15×PSG-17 emerged as the best specific combiner and for number of fruits per plant and fruit yield (q/ha), the promising crosses were PSG-15×PSG-23, PSG-37×PSG-40, PSG-37×PSG-9, PSG-15×PSG-37, PSG-37×PSG-52, PSG-17×PSG-52. The result of present study were supported by Patel and Desai (2008) [7], Maurya *et al.* (2009) [5], Islam *et al.* (2012) [4], Devi *et al.* (2016) [2], Sarkar *et al.* (2016) [8] and Malav *et al.* (2018) [6].

It is noteworthy that the crosses which manifested greater sca effects in desirable direction also exhibited favourably high heterosis over batter parent. Hence, the mean performance of hybrid could be envisaged as criteria of sca effect and selection of promising crosses. The present investigation corroborated the earlier work of Patel and Desai (2008) [7], Islam *et al.* (2012) [4] and Sarkar *et al.* (2016) [8].

Conclusion

On the basis of GCA effect for early fruit yield and its components the parents identified as promisingly were PSG-40 and PSG-37 however, crosses PSG-15 × PSG-40, PSG-37 × PSG-40 and PSG-84 × PSG-17 were best specific combiner for most of the important economic traits and can be utilized in future breeding programme of sponge gourd.

Table 2: Estimates of specific combining ability effects

Crosses	Days to first female flower	Node number to first female flower	Days to first fruit harvest	Main vine length (m)	No. of primary branches	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	No. of fruits per plant	Fruit yield (q/ha)
PSG-15×PSG-84	3.07*	-0.34	-6.00**	-0.30**	0.42	8.71	-0.85	0.16	0.27	-9.05*
PSG-15×PSG-23	-7.42**	-1.70**	0.81	0.28**	-0.25	-42.99**	-0.62	-0.01	2.97**	1.47
PSG-15×PSG-37	-0.39	-0.69	-7.76**	-0.27**	-0.52	2.63	-1.09	0.19	0.43	27.12**
PSG-15×PSG-17	0.79	-1.81**	5.31*	-0.19	0.52	1.61	2.40*	-0.20	-0.77	-16.72**
PSG-15×PSG-9	0.33	-3.74**	-2.90	0.08	0.52	-17.76	0.19	0.01	0.37	5.67
PSG-15×PSG-52	4.07**	1.90**	-0.52	-0.15	-0.72*	-12.73	-4.72**	-0.21*	0.57	8.15*
PSG-15×PSG-40	-7.84**	0.47	-1.63	0.53**	0.85**	40.73**	3.23**	0.29**	0.83	10.19*
PSG-84×PSG-23	0.48	-3.66**	-0.76	-0.64**	0.59	2.06	-0.17	-0.26*	-0.77	2.50
PSG-84×PSG-37	-5.42**	-1.41**	1.96	-0.78**	-0.02	-16.11	-6.07**	-0.19	-0.97	-11.29**

PSG-84×PSG-17	-4.64**	3.23**	-3.39	0.06	-0.32	27.62**	1.69	-0.01	1.17	13.21**
PSG-84×PSG-9	-6.60**	-0.70	-1.15	-0.51**	-0.65*	-19.95*	0.18	0.03	-0.37	-8.29*
PSG-84×PSG-52	4.83**	0.41	5.34*	0.27*	-0.55	12.18	-4.00**	0.08	0.83	4.74
PSG-84×PSG-40	2.38	3.54**	4.58*	0.78**	-0.65*	-23.38*	-0.32	0.04	0.77	-2.11
PSG-23×PSG-37	3.31*	3.08**	7.99**	-0.03	-0.02	2.74	-1.81	-0.02	-1.27*	-7.99*
PSG-23×PSG-17	4.44**	-4.31**	-3.57	0.16	-0.32	-4.89	-3.16**	0.06	0.20	11.88**
PSG-23×PSG-9	1.41	9.35**	3.25	0.24	0.35	16.79	-1.83	-0.10	1.33*	14.27**
PSG-23×PSG-52	4.56**	-0.06	-7.41**	-0.62**	0.45	20.17*	-0.51	0.01	-0.13	8.04*
PSG-23×PSG-40	4.20**	0.34	-0.57	-0.23	0.02	12.46	2.14*	0.08	-1.53	-6.96
PSG-37×PSG-17	1.93	-1.23*	-5.00*	-0.23	0.42	11.79	1.91	-0.01	0.00	1.97
PSG-37×PSG-9	0.69	-6.41**	2.75	-0.45**	0.09	-10.46	-0.16	-0.17	2.13**	2.88
PSG-37×PSG-52	-4.28**	-3.15**	4.72*	-0.61**	-0.15	-7.30	-2.24	-0.15	1.00	24.99**
PSG-37×PSG-40	-0.03	1.78**	0.61	1.56**	0.09	-1.64	-0.50	-0.09	2.93**	9.99*
PSG-17×PSG-9	-5.41**	-5.27**	-1.33	-0.84**	0.79**	42.95**	-1.14	0.08	-1.73**	5.34
PSG-17×PSG-52	2.13	4.26**	-3.92	0.27*	0.22	3.39	1.55	0.12	0.47	15.23**
PSG-17×PSG-40	-5.85**	0.89	-0.42	0.01	-0.22	-32.72**	-0.31	-0.18	-0.27	3.93
PSG-9×PSG-52	-5.47**	3.91**	-1.33	-0.27*	0.22	5.93	-0.99	-0.13	1.27*	-1.46
PSG-9×PSG-40	1.53	-5.24**	-4.04	-0.74**	-0.22	8.97	0.65	0.30**	-1.13	-7.20
PSG-52×PSG-40	2.76*	-3.68**	-2.28	-0.16	0.55	21.23*	-1.53	-0.09	-1.60**	-19.53**
SE (Sij)	1.41	0.50	2.16	0.13	0.30	9.12	1.05	0.10	0.61	3.90
SE (Sij –Sik)	2.09	0.74	3.20	0.19	0.44	13.50	1.56	0.15	0.90	5.77
SE (Sij – Skl)	1.97	0.70	3.02	0.18	0.41	12.73	1.47	0.14	0.85	5.44

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