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Gene Action and Heterosis Studies for Growth, Earliness, Yield and Downy Mildew Disease [*Pseudoperonospora cubensis* (Berk. and Curt.) Rostow.] in Ridge Gourd [*Luffa acutangula* (Roxb.) L.]

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A B S T R A C T

Thirty five F_1's with their twelve parents in ridge gourd [*Luffa acutangula* (Roxb.) L.] were tested for combing ability and heterosis for growth, earliness, yield and downy mildew disease. The variance due to Specific Combining Ability (SCA) is higher than the General Combining Ability (GCA) for all the characters, suggested that non-additive gene action had greater role in the inheritance of all the characters. Out of 13 parents, COHB-1, COHB-3, COHB-5, Pusa Nutan and Deepthi were adjusted as good general combiners for most of the traits. Regarding to sca effects, COHB-6 × Deepthi for vine length, COHB-4 × Arka Sujat for days to first pistillate flowering, COHB-6 × Pusa Nasdar for days to first harvesting, COHB-1 × Deepthi for fruit yield per vine, COHB-2 × Pusa Nutan for downy mildew per cent disease index exhibited highest sca effects in desirable direction. The extent of heterosis over the three best crosses for fruit yield per vine (155.73 to 185.29 % over better parent and 5.09 to 25.95 % over commercial check) revealed that there is a great scope of realising higher yield in ridge gourd through heterosis breeding. The cross combination COHB-1 × Deepthi registered the highest economic heterosis (25.95 %) for total fruit yield per vine including earliness and downy mildew per cent disease index.

Introduction

The ridge gourd [*Luffa acutangula* (Roxb.) L.] is a vegetable of commercial importance and green immature fruits are cooked as vegetable and used in preparation of chutney and curries. Fruit is demulcent, diuretic and nutritive and it can be grown throughout the year. Ridge gourd being a monoecious and cross pollinated crop, it exhibits considerable heterozygosity in population which suggests a great scope for improvement through heterosis breeding. The important step for exploitation of heterosis is to study the general combining ability of the parents and specific combining ability of hybrids. Although some information is available about heterosis and combining

ability but they are relevant to the specific region, genetic material involved and environmental conditions. Therefore, this study was conducted to generate information about nature and magnitude of heterosis and general and specific combining effects for different economic characters in a Line × tester analysis using seven lines and five testers of ridge gourd.

Materials and Methods

The experimental material consists of seven lines *Viz.,* COHB-1, COHB-2, COHB-3, COHB-4, COHB-5, COHB-6 and COHB-7 and five testers like Pusa Nasdar, Pusa Nutan, Deepthi, Arka Sujat and Arka Sumeet. All the diverse varieties/lines are were crossed in line × tester design (Kempthorne, 1957) during summer 2015 to produce F_1s seeds by hand pollination. In subsequent *Kharif,* 35 F_1s hybrids and 13 parental lines along with commercial check (Naga) were sown in randomised block design with two replications.

All treatments were spaced at 1.2 meter between the rows and 90 cm between the plants. Five plants were selected and tagged for recording the observations on different characters *viz.* Vine length (cm), number of branches, days to first male and female flowering, days to first harvest, fruit yield per plant (kg), days to first appearance of downy mildew symptoms and per cent disease index for downy mildew.

All the cultural operations and plant protection measures were carried out as per the schedule of crop (Anon., 2013). The combining ability analysis was calculated by the method suggested by Griffing (1956). Heterosis was calculated over the better parent and the standard check-Naga from East West Seeds Company.

Results and Discussion

The analysis of variance for combining ability and heterosis are presented in Table 1 and 2, respectively. Variance due to GCA is higher than variance due to SCA (Table-1) for all the characters under the study. Low GCA to SCA ratio was observed for character under study *viz.,* vine length (0.021), number of branches (0.030), days to first male flowering (0.029), days to first female flowering (0.026), nodes to first female flowering (0.092), days to first harvest (0.021), yield per vine (0.012), days to first initiation of downy mildew symptoms (0.003) and per cent disease index for downy mildew (0.006). Per cent contribution of line × tester interaction was higher for the traits *viz.,* number of branches (66.88), nodes up to first female flowering (79.63), fruit yield per vine (52.79), days to first initiation of downy mildew symptoms (67.54) and per cent disease index for downy mildew (63.03) compared to lines and testers, thereby indicating preponderance of non-additive variance in expression of these traits. Similar findings were also made by Ahmed *et al.,* (2006) in ridge gourd for vine length (0.34), number of branches (0.12), days to first female flowering (0.37), node to first female flowering (0.04), days to first picking (0.17) and yield per vine (0.10). The disparity may be due to the different genetic backgrounds of the material studied. From the ANOVA, it was observed that the mean squares due to hybrids as well as parents were significant for all the characters (Table 2). This revealed the presence of genetic variability among the crosses as well as parents under study. The variance due to parents against crosses was found significant for all the traits except number of branches. Thus, performance of parents and crosses was completely different from each other for all the traits except number of branches and existence of overall heterosis was evident from significance of parents *vs*. crosses. Hence, there is great scope

for heterosis breeding to exploit the non-additive genetic variance observed for growth, earliness, yield and downy mildew disease parameters.

Estimates of general combining ability effects (Table 3) showed that parent COHB-1 was good general combiner for most of the traits *viz.*, days to first male and female flowering, nodes up to first female flowering, days to first harvest and per cent disease index for downy mildew followed by parents Pusa Nutan and Deepthi which were good general combiners for varying set of six characters each. Parents COHB-3 and COHB-5 were also good general combiners for five and six characters, respectively.

From specific combining ability effects (Table 4), it was observed that out of 35 cross combinations, three crosses for vine length, seven crosses for number of branches, two crosses for days to first female flowering, five for node to first female flowering, four for days to harvest, eight for yield per vine, three for days to first initiation of downy mildew symptoms, 18 crosses for per cent disease index for downy mildew exhibited significant sca effects in desirable direction indicating presence of non-additive type of gene interaction.

Thus, it indicates the possibility of exploitation of hybrid vigor in all the characters studied. The SCA effects showed best specific combination was COHB-1 × Deepthi for fruit yield per vine and days to initiation of downy mildew symptoms, COHB-6 × Deepthi for vine length, COHB-6 × Arka Sujat for days to first female flowering, COHB-4 × Pusa Nutan for nodes up to first female flowering, COHB-6 × Pusa Nasdar for days to first harvesting, COHB-2 × Pusa Nutan for per cent disease index of downy mildew. Several workers (Karmakar *et al.,* 2013 in ridge gourd; Naliyadhara *et al.,* 2010; Sonavane *et al.,* 2013 in sponge gourd; Yadav *et al.,* 2009; Day *et al.,* 2010; Thangamani *et al.,* 2011 in bitter gourd) have also studied specific combining ability in gourds. From these studies, it is evident that sca effects of certain crosses were related with gca of their parents as the best cross combination for most of the characters involved at least one parent with high or average gca effects for particular traits. Similar results have been reported by Mishra *et al.,* (1994) in bitter gourd and Karmakar *et al.,* (2013) in ridge gourd.

Range of mean values of characters of parents, F_1 hybrids and per cent heterosis are given in Table 5. The mean of F_1 crosses was higher than those of the parents in all the characters except per cent disease index for downy mildew. The range of heterosis percentage in F_1 crosses varied from -18.97-34.27 and -45.07-3.10 for vine length, -59.29-44.00 and -49.56-18.58 for number of branches, -10.98-15.58 and -10.00-27.00 for days to first male flowering, -20.88-1.35 and -9.72-31.94 for days to first female flowering, -61.03-75.00 and -43.70-51.85 for nodes up to first female flowering, -29.13-5.88 and -7.78-43.33 for days to first harvest, -62.86-185.29 and -77.74-25.95 for fruit yield per vine, -18.97-43.07 and -41.91-4.78 for days to initiation of downy mildew symptoms, -65.29-53.29 and -78.11-8.78 for per cent disease index for downy mildew over their respective better parent and commercial check (Naga), respectively. Out of 35 hybrids, the significant heterotic effects over their respective better and commercial check were observed in 28 and 6 crosses for fruit yield per plant 7 and 0 for vine length, 11 and 9 for number of branches, 6 and 2 for days to first male flowering, 15 and 14 for nodes up to first female flowering, 29 and 1 for days to first harvest, 17 and 0 for days to first initiation of downy mildew symptoms, 10 and 32 for per cent disease index for downy mildew.

Table.1 Variance due to general combining ability, specific combining ability contribution of lines, testers and their interaction for various characters in ridge gourd

Sl. No.	Characters	GCA	SCA	GCA/SCA	Contribution of lines	Contribution of testers	Contribution of lines × testers
1	Vine length (cm)	31.93	1514.29	0.021	50.97	9.77	39.26
2	Number of branches	0.13	4.18	0.030	20.97	12.16	66.88
3	Days to first male flowering	0.36	12.46	0.029	63.95	16.74	19.32
4	Days to first female flowering	0.48	18.52	0.026	57.16	19.48	23.36
5	Nodes up to first female flowering	0.46	4.96	0.092	10.4	9.97	79.63
6	Days to first harvest	0.67	32.33	0.021	50.31	9.89	39.8
7	Fruit yield per plant (kg)	0.01	1.11	0.012	25.59	21.67	52.74
8	Days to first initiation of downy mildew symptoms	0.11	35.17	0.003	27.52	4.94	67.54
9	Per cent disease index for downy mildew	1.24	221.03	0.006	25.44	11.53	63.03

GCA-Variance due to General Combining Ability, SCA-Variance to Specific Combining Ability

Table.2 Analysis of variance (mean sum of squares) of lines × tester analysis for various characters in ridge gourd

Source of variation	Df	MSS								
		Vine length (cm)	Number of branches	Days to first male flowering	Days to first female flowering	Nodes up to first female flowering	Days to first harvest	Yield per vine (kg)	Days to first initiation of downy mildew	Per cent disease index for downy mildew
Replications	1	501.26	19.21	13.78	10.22	6.43	150.64	0.08	0.04	100.07
Genotypes	46	3079.22**	8.17**	20.64**	29.89**	16.11**	64.50**	2.07**	90.05**	435.02**
Parents	11	2373.69**	8.60**	30.04**	44.31**	23.23**	81.84**	088**	57.81**	587.02**
Parents v/s Crosses	1	34273.69**	0.30 NS	45.82**	61.08**	71.58**	259.37**	25.28**	629.81**	93.21**
Crosses	34	2390.01**	8.26**	16.86**	24.31**	12.17**	53.16**	1.77**	84.60**	395.90**
Lines	6	6903.37**	9.81 NS	61.12**	78.76**	7.17 NS	151.56**	2.57 NS	131.92 NS	570.73 NS
Testers	4	1984.91 NS	8.53 NS	24.00**	40.26**	10.34 NS	44.71 NS	3.27 NS	35.51 NS	387.93 NS
Line × Tester	24	1329.18**	7.84**	4.61*	8.04**	13.73**	29.97**	1.32**	80.95**	353.05**
Error	46	128.50	0.26	2.11	1.51	0.87	5.32	0.07	11.6	5.41

Table.3 General combining ability effects for growth, earliness, yield and downy mildew disease in ridge gourd

Sl. No.	Parents	Vine length (cm)	Number of branches	Days to first male flowering	Days to first female flowering	Nodes up to first female flowering	Days to first harvest	Fruit yield per vine	Days to first appearance of downy mildew symptoms	Per cent disease Index for downy mildew
Lines										
1	COHB-1	-7.48	0.79**	-1.86**	-1.24*	-1.29**	-2.26*	-0.06	-2.6	-2.24**
2	COHB-2	13.28*	-0.50*	-0.96	-1.54**	-0.13	1.94	0.02	-0.04	9.30**
3	COHB-3	28.74**	1.47**	-1.46*	2.24**	0.35	-4.06**	0.28*	-3.34*	-3.39**
4	COHB-4	0.48	0.35	1.74*	2.56**	0.47	4.34**	-0.45**	2.28	-10.12**
5	COHB-5	21.44**	-0.31	-2.16**	-3.14**	1.31**	-4.46**	0.66**	1.14	8.28**
6	COHB-6	-50.92**	-1.61**	4.74**	4.56**	0.05	5.14**	-0.83**	-3.78*	4.86**
7	COHB-7	-5.56	-0.21	-0.06	1.06	-0.75	-0.66	0.37**	6.36**	-6.68**
	C.D. @5%	10.2	0.46	1.31	1.1	0.84	2.08	0.24	3.07	2.09
	C.D@1%	13.62	0.62	1.75	1.47	1.12	2.77	0.32	4.09	2.8
	S.Em±	3.58	0.16	0.46	0.39	0.29	0.73	0.08	1.08	0.74
Testers										
1	A. Nasdar	-8.06	-0.09	1	1.20*	0.53	0.07	-0.32**	-1.32	2.28*
2	P. Nutan	-0.72	0.59**	-2.00**	-2.66**	-1.14**	-2.93**	0.60**	-1.02	2.79**
3	Deepthi	12.65**	0.97**	1.29*	1.56**	0.11	1.79*	0.44**	2.54	-9.40**
4	A. Sujat	10.98*	-0.90**	-0.43	-0.59	-0.54	0.07	-0.25*	0.57	2.04*
5	A. Sumeet	-14.86**	-0.57**	0.14	0.49	1.03**	1	-0.46**	-0.77	2.30*
	C.D.@5 %	8.65	0.39	1.11	0.93	0.71	1.76	0.2	2.59	1.77
	C.D@1 %	11.51	0.52	1.48	1.25	0.95	2.34	0.27	3.46	2.36
	S.Em±	3.03	0.14	0.39	0.33	0.25	0.62	0.07	0.91	0.62

*and ** -Significance at 5 and 1 per cent, respectively, A-Arka, P-Pusa

Table.4 Specific combining ability for growth, earliness, yield and downy mildew disease in ridge gourd

Sl. No.	Crosses	Vine length (cm)	Number of branches	Days to first male flowering	Days to first female flowering	Nodes up to first female flowering	Days to first harvest	Fruit yield per vine	Days to first appearance of downy mildew symptoms	Per cent disease index for downy mildew
1	COHB-1 × P. Nasdar	-2.98	0.81	-0.5	-1.4	-1.59	-1.67	-0.71*	-1.98	-9.80**
2	COHB-1 × P. Nutan	6.88	0.83	2	2.46	0.58	0.83	0.15	0.32	-2.64
3	COHB-1 × Deepthi	19.81	0.85	-1.29	-0.76	-0.17	0.61	1.64**	11.26**	-8.28**
4	COHB-1 × A. Sujat	-29.02*	-2.58**	0.43	1.39	1.18	1.33	-0.91	-5.17	-8.89**
5	COHB-1 × A. Sumeet	5.32	0.09	-0.64	-1.69	0.01	-1.1	-0.17	-4.43	29.61**
6	COHB-2 × P. Nasdar	-11.74	1.25*	-0.4	-0.6	0.55	-3.37	0.37	-3.94	23.37**
7	COHB-2 × P. Nutan	11.92	1.02	1.1	1.26	0.12	2.63	0.45	6.86*	-16.93**
8	COHB-2 × Deepthi	-16.95	-0.86	-0.19	-0.96	0.77	-4.65*	0.91**	0.8	-9.49**
9	COHB-2 × A. Sujat	4.22	-1.29*	1.03	1.19	-0.38	6.13*	-0.13	-3.73	13.90**
10	COHB-2 × A. Sumeet	12.56	-0.12	-1.54	-0.89	-1.05	-2.8	0.21	0.01	-10.86**
11	COHB-3 × P. Nasdar	10.8	0.78	-0.9	-0.9	-1.03	1.13	1.03**	11.16**	-7.31**
12	COHB-3 × P. Nutan	-14.54	1.10*	0.6	0.96	5.14**	-1.87	0.01	0.06	-8.74**
13	COHB-3 × Deepthi	-6.41	-1.83**	0.31	-0.26	-1.51	4.91*	-0.67*	-5.6	4.87*
14	COHB-3 × A. Sujat	-2.24	0.64	0.03	-0.11	-1.96*	-2.87	-0.11	-3.53	2.92
15	COHB-3 × A. Sumeet	12.4	-0.69	-0.04	0.31	-0.63	-1.3	-0.25	-2.09	8.26**
16	COHB-4 × P. Nasdar	19.06	-4.65**	2.4	2.80*	5.75**	8.23**	-1.51**	-6.16	5.09*
17	COHB-4 × P. Nutan	21.72	0.17	-2.1	-2.34	-5.48**	-4.67*	1.04**	5.64	-4.92*
18	COHB-4 × Deepthi	-21.15	0.99	2.11	3.44**	-2.43*	-1.99	-0.84**	-5.12	5.75*
19	COHB-4 × A. Sujat	-28.48*	2.46**	-1.17	-1.41	-0.28	-1.77	0.18	0.95	-2.24
20	COHB-4 × A. Sumeet	8.86	1.03	-1.24	-2.49*	2.45*	-2.2	1.12**	4.69	-6.68**
21	COHB-5 × P. Nasdar	18.7	3.71**	-1.2	-1	-0.79	1.03	0.70*	4.38	-6.40**

Contd...

Sl. No.	Crosses	Vine length (cm)	Number of branches	Days to first male flowering	Days to first female flowering	Nodes up to first female flowering	Days to first harvest	Fruit yield per vine	Days to first appearance of downy mildew symptoms	Per cent disease index for downy mildew
22	COHB-5 × P. Nutan	-13.34	-3.47**	-0.7	-0.64	0.08	0.53	-1.09**	-8.42*	3.54
23	COHB-5 × Deepthi	-8.81	0.05	-0.99	-1.36	-1.93*	-4.69*	0.63*	-6.68*	-9.05**
24	COHB-5 × A. Sujat	-14.94	0.42	1.73	2.29	0.78	0.03	0.11	9.69**	16.84**
25	COHB-5 × A. Sumeet	18.4	-0.71	1.16	0.71	-1.39	1.1	-0.05	1.03	-4.92*
26	COHB-6 × P. Nasdar	-11.94	0.61	0.4	1.8	0.67	-7.57**	0.36	3.5	4.39
27	COHB-6 × P. Nutan	-10.88	-0.87	-1.6	-1.34	1.84	0.93	-0.61*	-9.2	7.60**
28	COHB-6 × Deepthi	52.15**	1.65**	-0.39	-0.06	-1.41	2.21	0.56*	4.34	10.63**
29	COHB-6 × A. Sujat	31.42*	-1.48**	-1.67	-3.91**	-1.76	-3.57	0.47	2.21	-16.16*
30	COHB-6 × A. Sumeet	-60.74**	0.09	3.26**	3.51**	0.67	8.00**	-0.77**	-0.85	-6.46**
31	COHB-7 × A. Nasdar	-21.9	-2.49**	0.2	-0.7	-3.53**	2.23	-0.24	-6.94*	-9.34**
32	COHB-7 × P. Nutan	-1.74	1.23*	0.7	-0.34	-2.26*	-0.77	0.55*	4.76	19.08**
33	COHB-7 × Deepthi	-18.61	-0.85	0.41	-0.06	3.39**	-0.49	-0.11	1.00	5.58*
34	COHB-7 × A. Sujat	39.06**	1.82**	-0.37	0.59	2.44*	0.73	0.39	-0.43	-6.37**
35	COHB-7 × A. Sumeet	3.2	0.29	-0.94	0.51	-0.03	-1.7	-0.09	1.61	-8.95**
	C.D. @5 %	22.82	1.04	2.93	2.47	1.87	4.64	0.54	6.86	4.68
	C.D@1 %	30.46	1.39	3.91	3.3	2.5	6.2	0.72	9.15	6.25
	S.Em±	8.02	0.36	1.03	0.87	0.66	1.63	0.19	2.41	1.65

*and **-Significance at 5 and1 per cent level, respectively, A-Arka, P-Pusa

Table.5 Range and mean parents and hybrids and three heterotic cross combinations for nine characters in ridge gourd

		Vine length (cm)	Number of branches	Days of first male flowering	Days to first female flowering	Nodes up to First female flowering	Days to first harvest	Yield per vine (kg)	Days to first initiation of downy mildew symptoms	Per cent disease index for downy mildew
Range	Parents	227.50-327.00	6.85-14.00	33.50-44.50	35.00-49.00	8.10-19.50	45.50-63.50	0.92-2.97	31.30-48.70	12.78-70.33
	Hybrids	195.00-366.00	5.70-13.40	31.50-47.50	32.50-47.50	7.60-20.50	41.50-64.50	0.65-4.95	31.60-57.00	13.83-68.72
Range of heterosis (%)	BP	-18.97-34.27	-59.29-44.00	-10.98-15.58	-20.88-1.35	-61.03-75.00	-29.13-5.88	-62.86-185.29	-18.97-43.07	-65.29-53.29
	SP	-45.07-3.10	-49.56-18.58	-10.00-27.00	-9.72-31.94	-43.70-51.85	-7.78-43.33	-77.74-25.95	-41.91-4.78	-78.11-8.78
Number of heterotic crosses over	BP	7	11	6	5	15	29	28	17	10
	SP	-	9	2	2	14	1	6	-	32
Top parent on mean value		COHB-7	Pusa Nasdar	Pusa Nutan	COHB-5	COHB-5	COHB-2	COHB-1	COHB-2	Deepthi
Three top F1's with heterosis per cent over BP		COHB-3 × Pusa Nutan (34.27 %)	COHB-5 × Deepthi (44.00 %)	COHB-4 × Arka Sujat (-10.98 %)	COHB-3 × Arka Sujat (-20.88 %)	COHB-4 × Pusa Nutan (-61.03 %)	COHB-5 × Deepthi (-29.13 %)	COHB-5 × Deepthi (185.29 %)	COHB-1 × Deepthi (43.07 %)	COHB-3 × Pusa Nutan (-65.29 %)
		COHB-5 × Pusa Nutan (33.43 %)	COHB-4 × Deepthi (33.33 %)	COHB-4 × Pusa Nutan (-5.97 %)	COHB-5 × Deepthi (-20.88 %)	COHB-4 × Deepthi (-38.97 %)	COHB-1 × Pusa Nutan (-22.69 %)	COHB-1 × Deepthi (180.00 %)	COHB-5 × Arka Sujat (41.44 %)	COHB-4 × Pusa Nutan (-65.19 %)
		COHB-4 × Pusa Nutan (32.84 %)	COHB-6 × Deepthi (27.59 %)	COHB-6 × Arka Sujat (-4.88 %)	COHB-4 × Pusa Nutan (-20.65 %)	COHB-4 × Arka Sujat (-31.28 %)	COHB-1 × Pusa Nasdar (-21.83 %)	COHB-4 × Pusa Nutan (-155.23 %)	COHB-6 × Deepthi (34.90 %)	COHB-4 × Arka Sumeet (-60.03 %)
Three top F1's with heterosis per cent over SP		-	COHB-5 × Pusa Nasdar (18.58 %)	COHB-5 × Pusa Nutan (-10.00 %)	COHB-5 × Pusa Nutan (-9.72 %)	COHB-4 × Pusa Nutan (-43.70 %)	COHB-3 × Pusa Nutan (-7.78 %)	COHB-1 × Deepthi (25.95 %)	-	COHB-1 × Deepthi (-78.11 %)
		-	COHB-3 × Pusa Nasdar (17.26 %)	COHB-4 × Pusa Nutan (-4.29 %)	COHB-3 × Pusa Nutan (-2.78 %)	COHB-7 × Pusa Nutan (-28.89 %)	-	COHB-5 × Deepthi (11.07 %)	-	COHB-4 × Arka Sumeet (-69.53 %)
		-	COHB-1 × Deepthi (12.39 %)	-	-	COHB-7 × Pusa Nasdar (-25.93 %)	-	COHB-4 × Pusa Nutan (5.09 %)	-	COHB-7 × Pusa Nasdar (-68.32 %)

BP-Better Parent, SP-Standard Parent, COHB-College of Horticulture Bagalkot

The best performing hybrids over the standard parent for different characters included COHB-1 × Deepthi for fruit yield per vine, COHB-5 × Pusa Nasdar for number of branches, COHB-5 × Pusa Nutan for days to first male flowering, COHB-5 × Pusa Nutan days to first female flowering, COHB-3 × Pusa Nutan for days to first harvest and COHB-1 × Deepthi for per cent disease index for downy mildew.

The hybrid COHB-1 × Deepthi was selected as the best hybrid for yield per vine and its total yield was 4.95 kg per vine as compared to 3.93 kg per vine of the commercial check (Naga) with 25.95 per cent standard heterosis.

Performance of this hybrid with respect to total yield is attributed to its significant heterosis observed over the commercial check in the desirable direction for number of branches, nodes up to first female flowering, fruit yield per vine and per cent disease index for downy mildew disease.

The hybrid COHB-1 × Deepthi also exhibited desirable significant sca effects for fruit yield per vine, days to first initiation of downy mildew symptoms and per cent disease index for downy mildew.

The parent COHB-1 involved in the development of this hybrid was found to be a good general combiner for number of branches, days to first male and female flowering, nodes up to first female flowering, days to first harvesting and per cent disease index for downy mildew. The other parent Deepthi exhibited significant gca effects in the desirable direction for vine length, number of branches per vine, days to first harvesting fruit yield per vine and per cent disease index for downy mildew. The hybrid COHB-1 × Deepthi recorded the lowest downy mildew disease intensity and took more days to initiation of downy mildew symptoms.

The next hybrid was COHB-5 × Deepthi exhibited 11.07 per cent standard heterosis for yield per plant which had yielding ability of 4.37 kg per vine as compared to 3.93kg per vine yield of commercial check. Performance of hybrids with respect to total yield is attributed to significant standard heterosis was observed in the desirable directions for fruit yield per vine and per cent disease for downy mildew disease. The hybrid COHB-5 × Deepthi also exhibited desirable significant sca effects for nodes up to first female flowering, days to first harvest, fruit yield per vine and per cent disease index for downy mildew.

The parent COHB-5 involved in the development of this hybrid was found to be a good general combiner for vine length, days to first male and female flowering, days to first harvest and fruit yield per vine.

The other parent Deepthi exhibited significant gca effects in the desirable direction for vine length, number of branches per vine, days to first harvesting, fruit yield per vine and per cent disease index for downy mildew. The hybrid COHB-5 × Deepthi recorded the low downy mildew disease intensity.

Higher magnitude of heterosis over commercial check observed for fruit yield in the present investigation is low as compared to earlier reports in ridge gourd where in up to 99.71 per cent standard heterosis for yield per vine was reported by Mole *et al.*, (2001), 93 per cent was reported by Hedau and Sirohi (2004), 33.1 per cent was reported by Ahmed *et al.*, (2006) and 80.51 per cent was reported Poshiya *et al.*, (2015).

Many of these studies involved open pollinated varieties as commercial check, whereas in the present investigation commercially popular F_1 hybrid (Naga) is used as the check and hence the magnitude of 25.95 per cent standard heterosis assumes significance over previous reports.

The present study suggest that it is useful to select parental lines having one or more important characters like early maturity, minimum days to anthesis of first female flower, more branches and resistance to downy mildew disease in a plant to achieve higher

gains in the F_1 hybrids through heterosis breeding. On the basis of the above results, the best performing hybrids *Viz.*, COHB-1 × Deepthi and COHB-5 × Deepthi can be further tested and recommended for commercial cultivation to boost the fruit yield per unit area of ridge gourd as these hybrids recorded 25.95 and 11.07 per cent higher yield as well as low downy mildew intensity over the commercial growing hybrid "Naga."

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