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RESEARCH ARTICLE

Estimation of heterosis for earliness and yield component traits in ridge gourd [*Luffa acutangula* (L.) Roxb.]

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Abstract

The present study aimed to evaluate heterosis for earliness and yield component traits in ridge gourd (*Luffa acutangula* (L.) Roxb.) using line × tester mating design. About 24 hybrids were developed by crossing eight lines with three testers and evaluated along with their 11 parents in a randomized block design with three replications during the *Kharif* 2025 season at Junagadh Agricultural University. Analysis of variance revealed significant differences among genotypes, indicating the presence of substantial genetic variability for the traits studied. For fruit yield per vine, standard heterosis over the check variety Pusa Nasdar ranged from -16.24 to 17.83%, with the hybrid JRG-16-6 × GRG-2 exhibiting the highest positive standard heterosis (17.83%). Among the earliness traits, JRG-16-5 × Pusa Nasdar recorded the highest desirable standard heterosis for days to 50% flowering (-12.20%), days to appearance first female flower (-12.38%), and days to first picking (-16.98%). The hybrid JRG-20-5 × GRG-2 showed superior performance for days to first male flower appearance (-9.56%) and main vine length (31.67%). The results identified promising hybrid combinations with desirable heterosis for earliness and yield-related traits, which may be utilized in ridge gourd breeding programmes for the development of high-yielding and early-maturing hybrids.

Keywords: Ridge gourd, heterosis, line × tester, earliness, fruit yield, hybrid vigor

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Introduction

Ridge gourd (*Luffa acutangula* (L.) Roxb.) is a member of the family Cucurbitaceae. It is widely cultivated across tropical agro-ecological zones worldwide. In India, ridge gourd cultivation mainly occurs during the summer and *Kharif* seasons. The species is a diploid (2n = 2x = 26). It is also known as ''ribbed gourd'', ''angular loofah'' and ''fluted loofah'' as its fruits have about ten prominent longitudinal ridges. Monoecism is most common sex form; however, a feral form with hermaphrodite sex known as ''Satputia'' is predominantly found in Eastern parts of Uttar Pradesh, Bihar, Jharkhand and West Bengal (Karmakar et al., 2013). Despite its wide adaptability, the productivity of ridge gourd remains relatively low the reason behind this is the absence of early-maturing and high-yielding hybrids. Earliness is a crucial trait in vegetable crops, as it ensures early market availability and higher economic returns. Along with earliness, yield and yield component traits, such as fruit weight, length of main vine and fruit girth, are the major determinants of overall productivity. Therefore, both earliness and yield component traits need improvement in ridge gourd breeding programs. Heterosis has been widely exploited to improve yield component traits in cucurbitaceous crops. The line × tester mating design is an effective tool for evaluating heterosis and combining ability. This method allows breeders to identify superior parental lines and cross combinations and understand the genetic mechanisms controlling these traits. Keeping these aspects in mind, the investigation aimed to estimate heterosis for earliness and yield component traits, which identified promising hybrids for improving productivity in ridge gourd.

Materials and Methods

The experimental material comprised 35 entries, including three testers (Pusa Nasdar, GRG-2 and GARG-1) and eight lines (JRG-16-5, JRG-16-6, JRG-17-3, JRG-17-5, JRG-17-9, JRG-17-10, JRG-19-5 and JRG-20-5). During *Zaid*-2025, 24 hybrid combinations were developed by crossing eight lines and three testers using a line × tester mating design. The experimental setup included 35 entries, comprising 11 parental lines and 24 hybrids. The experiment was evaluated with three replications using a randomized block design at the Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, during the *Kharif*-2025 season. Each entry was planted at a spacing of 2.0 × 1.0 m (row-to-row × plant-to-plant) and accommodated 10 plants per plot. Observations were recorded on five randomly selected competitive plants from each plot in each replication, and the mean values were used for statistical analysis. The study involved analyzing 14 traits, viz., days to 50% flowering, days to appearance of first male flower, days to appearance of first female flower, node number of first male flower, node number of first female flower, days to first picking, length of main vine (m), number of primary branches per vine, number of fruits per vine, fruit weight (g), length of fruit (cm), girth of fruit (cm), fruit yield per vine (kg) and total soluble solids (°Brix). The observations were recorded following the standard procedures for evaluation of cucurbitaceous vegetable crops. The amount of heterosis was estimated as the percentage increase or decrease in F_1 over the better parent (heterobeltiosis) and the standard check (Pusa Nasdar). ANOVA was performed following the method of Panse & Sukhatme (1995) to test the significance of differences among genotypes. Heterobeltiosis was calculated as described by Fonseca and Patterson (1968); Heterobeltiosis (%) = [(F1 – Better Parent)/Better Parent] × 100. Standard heterosis (%) = [(F1 – Standard Check)/Standard Check] × 100. The significance of heterosis was tested using the standard error and t-test procedure described for heterosis studies.

Results and Discussion

Analysis of variance of the experimental design indicated significant differences between the genotypes for all the traits. The mean square due to parents was highly significant for all traits, indicating the genetic variability among the parents. The mean squares were also found significant

Table 1: Analysis of variance (mean squares) for earliness and yield component traits in ridge gourd

Source	*d.f.*	*Days to 50% Flowering*	*Days to appearance of first male flower*	*Days to appearance of first female flower*	*Node number of first male flower*	*Node number of first female flower*	*Days to first picking*	*Length of main vine (m)*	*Number of fruits per vine*	*Fruit weight (g)*	*Fruit girth (cm)*	*Fruit yield per vine (kg)*
Replication	2	0.77	2.73	0.23	0.07	0.08	1.34	0.13	0.02	334.41	0.09	0.005
Genotypes	34	17.55**	20.10**	17.51**	1.04**	2.18**	22.77**	1.51**	1.03**	57101.5**	2.54**	0.025**
Parents	10	21.10**	22.59**	21.86**	0.79**	1.74**	15.45**	1.06**	1.02**	55392.1**	1.73**	0.028**
Hybrids	23	15.29**	14.17**	11.50**	0.66**	2.23**	18.00**	1.72**	0.97**	56730.2**	2.78**	0.025**
P. vs H.	1	34.10**	131.40**	112.49**	12.16**	5.49**	205.5**	1.26**	2.64**	82736.4**	5.22**	0.017*
Error	68	1.62	1.33	1.53	0.08	0.09	2.19	0.05	0.11	936.93	0.26	0.0023

*, ** significant at 5 and 1% level, respectively when tested against error mean square

for hybrids and parents *vs.* hybrids for all the characters. This indicated that the material was advantageous for studying heterosis and genetic parameters engaged with the inheritance of different traits (Table 1). The significant variation observed among parents, hybrids and parents versus hybrids indicates the presence of substantial genetic diversity among the parental lines. Such diversity is a prerequisite for the expression of heterosis, as genetically divergent parents are more likely to produce superior hybrids through favorable interactions of alleles. The significant performance of several crosses further suggests the involvement of non-additive gene action, including dominance and over-dominance effects, in the inheritance of yield and yield-attributing traits.

In ridge gourd, earliness is an advantage for realizing the possible economic yield within a short time period. The traits include days to 50% flowering, days to appearance of first male and female flower, node number of first female flower and days to first picking which were known as criteria for earliness. For these traits, negative and significant heterosis is desirable. In the current research, the cross JRG-16-5 × Pusa Nasdar demonstrated the most significant negative

Table 2: Per cent heterobeltiosis (HB) and standard heterosis (SH) for days to 50% flowering, days to appearance of first male flower and days to appearance of first female flower in ridge gourd

Sr. No.	*Crosses*	*Days to 50% flowering*		*Days to appearance of first male flower*		*Days to appearance of first female flower*	
		HB%	*SH (%)*	*HB (%)*	*SH (%)*	*HB (%)*	*SH (%)*
1	JRG-16-5 × Pusa Nasdar	-11.57**	-12.2**	-9.31**	-9.31**	-12.3**	-12.38**
2	JRG-16-5 × GRG-2	-1.20	-4.95**	-3.45	-6.25**	-0.79	-4.39*
3	JRG-16-5 × GARG-1	-0.18	-6.6**	-0.51	-5.95**	-0.28	-7.24**
4	JRG-16-6 × Pusa Nasdar	-4.96**	-4.96**	-2.08	-2.08	-4.69*	-4.69*
5	JRG-16-6 × GRG-2	0.19	-3.62*	0.79	-2.13	-1.60	-5.18**
6	JRG-16-6 × GARG-1	0.3	-6.15**	1.8	-3.77	0.45	-6.56**
7	JRG-17-3 × Pusa Nasdar	0.01	-6.22**	-7.53**	-7.53**	-3.28	-8.68**
8	JRG-17-3 × GRG-2	-0.28	-6.49**	-5.63**	-8.36**	-2.18	-7.64**
9	JRG-17-3 × GARG-1	3.05	-3.58	-0.77	-6.2**	0.28	-6.71**
10	JRG-17-5 × Pusa Nasdar	-1.23	-2.24	-2.87	-2.87	-5.35**	-5.35**
11	JRG-17-5 × GRG-2	8.10**	4.00*	15.6**	12.25**	6.70**	2.82
12	JRG-17-5 × GARG-1	4.18*	-2.52	4.28*	-1.42	2.78	-4.39*
13	JRG-17-9 × Pusa Nasdar	1.3	0.63	2.87	2.87	-1.55	-1.67
14	JRG-17-9 × GRG-2	1.49	-2.36	-1.57	-4.42*	-0.19	-3.82*
15	JRG-17-9 × GARG-1	4.22*	-2.48	2.91	-2.71	5.31*	-2.04
16	JRG-17-10 × Pusa Nasdar	3.65	-3.19	-3.61	-7.18**	-0.53	-6.47**
17	JRG-17-10 × GRG-2	6.65**	-0.39	1.21	-2.54	3.85	-2.34
18	JRG-17-10 × GARG-1	3.01	-3.78*	-1.42	-6.81**	1.48	-5.61**
19	JRG-19-5 × Pusa Nasdar	1.4	-1.21	-3.4	-3.4	-2.75	-4.81*
20	JRG-19-5 × GRG-2	5.23**	1.23	1.65	-1.3	3.45	-0.31
21	JRG-19-5 × GARG-1	4.64*	-2.09	3.55	-2.11	3.33	-3.88*
22	JRG-20-5 × Pusa Nasdar	-7.83**	-11.2**	-8.73**	-9.56**	-8.73**	-12.1**
23	JRG-20-5 × GRG-2	-5.05**	-8.65**	-4.43*	-7.2**	-6.03**	-9.50**
24	JRG-20-5 × GARG-1	-3.81	-9.99**	-1.98	-7.34**	-4.35*	-11.02**
S.Em ±		1.04	1.04	0.94	0.94	1.01	1.01
Range of heterosis		-11.57 to 8.10	-12.2 to 4.00	-9.31 to 15.6	-9.56to 12.25	-12.38 to 6.7	-12.38 to 2.82
No. of crosses with significant and desirable heterosis		4	12	5	12	6	19

HB = heterobeltiosis and SH = standard heterosis (Pusa Nasdar)

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

standard heterosis for both days to 50% flowering (-12.20%) and days to appearance of first female flower (-12.38%). Meanwhile, JRG-20-5 × Pusa Nasdar recorded the highest negative heterosis for the days to appearance of first male flower (-9.56%). Across these three flowering traits total 12, 12 and 19 hybrids exhibited significant negative standard heterosis, respectively (Table 2). These results are similar to those of Narasannavar et al. (2014), Malve et al. (2020), Viradiya et al. (2023) and Tejashwini et al. (2025). Regarding the node position of the first female flower, six hybrids outperformed both the better parent and the standard check. The hybrid JRG-17-3 × GRG-2 (-21.06 and -26.01%, respectively) outperformed the maximum negative standard heterosis and heterobeltiosis in a desirable direction for this trait. In the case of days to first picking, eight crosses showed significant negative heterosis over the better parent and twenty-two crosses exhibited significant negative heterosis over the standard check. The hybrid JRG-16-5 × Pusa Nasdar (-16.98 and -15.38%, respectively) exhibited maximum negative standard heterosis and heterobeltiosis for days to first picking (Table 3). The results are in conformity to those of Naransannavar et al. (2014), Sarkar et al. (2015), Singh et al. (2017), Chittora et al. (2018), Malve et al. (2020), Bhalerao et al. (2022), Sharma et al. (2024) and Tejashwini et al. (2025)

Table 3: Per cent heterobeltiosis (HB) and standard heterosis (SH) for node number of first male flower, node number of first female flower and days to first picking in ridge gourd

Sr. No.	*Crosses*	*Node number of first male flower*		*Node number of first female flower*		*Days to first picking*	
		HB (%)	*SH (%)*	*HB%*	*SH (%)*	*HB (%)*	*SH (%)*
1	JRG-16-5 × Pusa Nasdar	-25.78**	-25.9**	-16.55**	-16.5**	-15.3**	-16.9**
2	JRG-16-5 × GRG-2	-18.21**	-18.3**	-16.37**	-12.5**	-6.59**	-9.51**
3	JRG-16-5 × GARG-1	-9.56	-9.70	-4.83	-6.02	-4.77*	-9.46**
4	JRG-16-6 × Pusa Nasdar	15.97**	15.97**	11.41**	11.41**	-10.7**	-10.79**
5	JRG-16-6 × GRG-2	-0.67	2.22	-4.33	2.07	-6.15**	-9.08**
6	JRG-16-6 × GARG-1	-12.57*	-4.89	4.67	3.37	-6.03**	-10.66**
7	JRG-17-3 × Pusa Nasdar	-26.54**	-32.5**	-14.26**	-14.2**	-3.74	-10.34**
8	JRG-17-3 × GRG-2	-8.32	-15.8**	-26.01**	-21.0**	-4.66*	-11.2**
9	JRG-17-3 × GARG-1	-9.98	-17.3**	-15.86**	-16.9**	-2.05	-8.76**
10	JRG-17-5 × Pusa Nasdar	-5.81	-5.81	-1.97	-1.97	-5.02**	-6.91**
11	JRG-17-5 × GRG-2	4.97	8.02	19.54**	27.54**	3.35	0.12
12	JRG-17-5 × GARG-1	-13.31*	-6.95	3.68	2.39	-3.06	-7.84**
13	JRG-17-9 × Pusa Nasdar	-7.10	-7.10	19.87**	19.87**	-2.22	-3.84*
14	JRG-17-9 × GRG-2	-12.4*	-9.85	6.81	13.95**	-1.15	-4.24*
15	JRG-17-9 × GARG-1	-14.68**	-7.18	-4.67	-5.86	-0.34	-5.26**
16	JRG-17-10 × Pusa Nasdar	-15.36**	-15.3**	-4.29	-5.08	-0.48	-6.71**
17	JRG-17-10 × GRG-2	-5.37	-2.98	20.08**	19.09**	2.76	-3.67*
18	JRG-17-10 × GARG-1	-20.34**	-18.3**	4.62	3.32	1.83	-4.54*
19	JRG-19-5 × Pusa Nasdar	-10.62	-10.62	8.51*	8.51*	-2.17	-5.72**
20	JRG-19-5 × GRG-2	-10.10	-7.49	-1.51	5.08	2.12	-1.58
21	JRG-19-5 × GARG-1	-13.41**	-5.81	10.45*	9.08*	0.6	-4.35*
22	JRG-20-5 × Pusa Nasdar	-23.99**	-23.9**	-10.53**	-10.5**	-2.78	-9.28**
23	JRG-20-5 × GRG-2	-10.99*	-8.40	18.46**	22.82**	-2.4	-8.93**
24	JRG-20-5 × GARG-1	0.59	3.51	10.66**	9.28*	-3.56	-10.01**
S.Em ±		0.24	0.24	0.25	0.25	1.21	1.21
Range of heterosis		-26.54 to 15.97	-32.54 to 15.97	-26.01 to 20.08	-21.06 to 27.54	-15.38 to 2.7	-16.98 to 0.12
No. of crosses with significant and desirable heterosis		12	8	6	6	8	22

HB = heterobeltiosis and SH = standard heterosis (Pusa Nasdar)
*, ** Significant at 5 and 1% levels, respectively

Table 4: Per cent heterobeltiosis (HB) and standard heterosis (SH) for length of main vine (m), number of fruits per vine and fruit weight (g) in ridge gourd

Sr. No.	*Crosses*	*Length of main vine (m)*		*No. of fruits per vine*		*Fruit weight (g)*	
		HB%	*SH (%)*	*HB%*	*SH (%)*	*HB (%)*	*SH (%)*
1	JRG-16-5 × Pusa Nasdar	-41.62**	-41.6**	1.68	1.68	2.82	2.82
2	JRG-16-5 × GRG-2	-36.07**	-18.48**	16.92**	10.72*	-16.77**	-8.14**
3	JRG-16-5 × GARG-1	-41.68**	-43.45**	10.43*	-3.09	-12.14**	-10.64**
4	JRG-16-6 × Pusa Nasdar	0.41	0.41	3.9	3.9	15.66**	15.66**
5	JRG-16-6 × GRG-2	-14.01**	9.64	11.09*	5.2	2.78	13.43**
6	JRG-16-6 × GARG-1	-13.95*	-17.36**	25.03**	2.22	6.14**	7.96**
7	JRG-17-3 × Pusa Nasdar	-12.19*	-0.51	-4.42	-0.54	-1.68	7.48**
8	JRG-17-3 × GRG-2	-3.66	22.84**	-0.68	3.36	-2.89	7.18**
9	JRG-17-3 × GARG-1	7.71	22.03**	-0.1	3.95	-13.96**	-5.95*
10	JRG-17-5 × Pusa Nasdar	-25.6**	-11.47*	9.96*	9.96*	8.16**	8.35**
11	JRG-17-5 × GRG-2	-39.49**	-22.84**	-0.8	-6.06	-31.12**	-23.98**
12	JRG-17-5 × GARG-1	-28.33**	-14.72*	-2.06	-7.31	-15.42**	-13.97**
13	JRG-17-9 × Pusa Nasdar	-34.1**	-33.1**	-4.28	-4.28	-20.38**	-11.96**
14	JRG-17-9 × GRG-2	-23.49**	-2.44	-3.6	-5.68	-4.48*	5.62*
15	JRG-17-9 × GARG-1	19.70**	21.52**	-14**	-15.8**	-30.9**	-23.59**
16	JRG-17-10 × Pusa Nasdar	-23.43**	-16.0**	-7.96	-6.12	-22.93**	-12.92**
17	JRG-17-10 × GRG-2	-24.92**	-4.26	-8.97*	-7.15	-30.96**	-22**
18	JRG-17-10 × GARG-1	3.33	13.3*	-23.5**	-21.9**	-19.76**	-9.34**
19	JRG-19-5 × Pusa Nasdar	-30.44**	-29.2**	1.62	1.62	-3.52	-3.52
20	JRG-19-5 × GRG-2	0.01	27.51**	19.84**	13.48**	-21.21**	-13.04**
21	JRG-19-5 × GARG-1	22.55**	24.67**	-3.55	-10.34*	-28.12**	-26.89**
22	JRG-20-5 × Pusa Nasdar	-31.76**	-17.7**	5.83	12.13**	-4.87*	-4.87*
23	JRG-20-5 × GRG-2	3.26	31.68**	9.81*	16.35**	-4.11*	5.83*
24	JRG-20-5 × GARG-1	5.14	26.7**	-6.03	-0.43	-12.38**	-10.88**
S.Em ±		0.18	0.18	0.27	0.27	24.99	24.99
Range of heterosis		-41.67 to 22.55	-43.45 to 31.68	-23.51 to 25.03	-21.98 to 16.35	-31.12 to 15.65	-26.89 to 15.66
No. of crosses with significant and desirable heterosis		2	8	7	5	3	8

HB = heterobeltiosis and SH = standard heterosis (Pusa Nasdar)
*, ** Significant at 5 and 1% levels, respectively

The superior performance of JRG-16-5 × Pusa Nasdar for flowering and picking-related traits may be attributed to favorable gene complementation between the parents and the accumulation of dominant alleles governing earliness. The expression of significant negative heterosis for these traits suggests that genes promoting early flowering and early harvest were dominant in nature. Such hybrids could therefore be useful for developing early maturing cultivars capable of providing quicker economic returns to farmers.

Current research involving 24 crosses, standard heterosis for the length of main vine varied from -43.45% (JRG-16-5 × GARG-1) to 31.68% (JRG-20-5 × GRG-2). Hybrid JRG-20-5 × GRG-2 (31.68%) exhibited the highest heterosis over the standard check (Pusa Nasdar) (Table 1). Regarding the number of fruits per vine, seven hybrids exceeded their better parent and five hybrids outperformed the standard check (Table 4). The highest standard heterosis and heterobeltiosis for the number of fruits per vine were recorded in JRG-20-5 × GRG-2 (16.35%) and JRG-16-6 × GARG-1 (25.03%), respectively. Similar findings align with previous research by Niyaria and Bhalala (2001), Sarkar *et al.* (2015) and Tejashwini *et al.* (2025). Fruit weight also showed improvement, with three crosses over the better parent and eight crosses over the standard check. The maximum positive standard heterosis for this trait was observed in hybrid JRG-16-6 × Pusa Nasdar (15.66%), followed by JRG-16-6 × GRG-2 (13.43%) (Table 4). For fruit girth, 12 hybrids exhibited significant standard heterosis in the positive direction, while significant heterobeltiosis in the positive direction for fruit weight was depicted by six hybrids, with a range varying from 0.15% (JRG-19-5 × GRG-2) to 32.32% (JRG-17-9 × GARG-1). Cross JRG-17-9 × GARG-1 showed the highest and significant value (32.32%) of standard heterosis in the desirable direction, followed by JRG-20-5 × GRG-2 (Table 5). These results are in conformity with the findings of Karmakar *et al.* (2014), Naransannavar *et al.* (2014), Poshiya *et al.* (2015), Srikanth *et al.* (2020), Nagadevi *et al.* (2022) and Sharma *et al.* (2024) The enhanced performance of hybrids such as JRG-20-5 × GRG-2 and JRG-16-6 × Pusa Nasdar for important yield components may be attributed to greater genetic divergence and favorable combining ability of the parental lines involved. The manifestation of positive heterosis for

Table 5: Percent heterobeltiosis (HB) and standard heterosis (SH) for fruit girth (g) and fruit yield per vine (kg) in ridge gourd

Sr. No.	*Crosses*	*Fruit girth (cm)*		*Fruit yield per vine (kg)*	
		HB%	*SH (%)*	*HB (%)*	*SH (%)*
1	JRG-16-5 × Pusa Nasdar	-0.85	6.6	9.55*	9.55*
2	JRG-16-5 × GRG-2	-8.67*	4.13	5.31	7.32
3	JRG-16-5 × GARG-1	-4.18	5.54	7.28*	8.96*
4	JRG-16-6 × Pusa Nasdar	5.25	17.54**	11.15**	11.15**
5	JRG-16-6 × GRG-2	1.75	16.01**	15.62**	17.83**
6	JRG-16-6 × GARG-1	1.13	12.93**	0.32	0.96
7	JRG-17-3 × Pusa Nasdar	1.49	13.55**	-13.6**	-2.87
8	JRG-17-3 × GRG-2	-1.72	12.05**	-7.37*	4.1
9	JRG-17-3 × GARG-1	2.86	15.07**	-12.75**	-1.91
10	JRG-17-5 × Pusa Nasdar	23.46**	23.46**	-7.95*	3.18
11	JRG-17-5 × GRG-2	-7.07*	5.95	-6.82*	4.46
12	JRG-17-5 × GARG-1	11.45**	22.76**	-14.2**	-3.82
13	JRG-17-9 × Pusa Nasdar	10.22**	13.87**	1.74	11.78**
14	JRG-17-9 × GRG-2	-5.76	7.45	-9.28**	-0.32
15	JRG-17-9 × GARG-1	20.13**	32.32**	-23.77**	-16.24**
16	JRG-17-10 × Pusa Nasdar	0.02	21.14**	-7.55*	-2.55
17	JRG-17-10 × GRG-2	-12.01**	6.57	-16.31**	-11.78**
18	JRG-17-10 × GARG-1	-11.69**	6.95	-12.99**	-8.28*
19	JRG-19-5 × Pusa Nasdar	-4.27	2.64	-12.07**	-9.55*
20	JRG-19-5 × GRG-2	-12.17**	0.15	-11.46**	-8.92*
21	JRG-19-5 × GARG-1	-7.11*	2.32	-15.79**	-13.38**
22	JRG-20-5 × Pusa Nasdar	9.88**	20.03**	-11.71**	-1.59
23	JRG-20-5 × GRG-2	11.06**	26.63**	10.14**	12.74**
24	JRG-20-5 × GARG-1	-1.14	8.89*	-10**	0.32
S.Em ±		0.43	0.43	0.04	0.04
Range of heterosis		-12.17 to 23.46	0.15 to 32.32	-23.77 to 15.62	-16.24 to 17.83
No. of crosses with significant and desirable heterosis		6	12	5	6

HB = heterobeltiosis and SH = standard heterosis (Pusa Nasdar)
*, ** Significant at 5 and 1% levels, respectively

fruit number, fruit weight and fruit girth suggests the operation of dominance and possible over-dominance gene action. The superior expression of these traits in the F_1 generation indicates the presence of complementary alleles contributing to improved productivity. Grafius (1959) suggested that the heterosis for fruit yield was affected by heterosis for the individual yield components or due to the multiplicative effects of partial dominance of yield component traits. *Accordingly, the high heterotic response observed in hybrids JRG-16-6 × GRG-2 and JRG-20-5 × GRG-2 may be attributed to the cumulative improvement of several component traits such as fruit number, fruit size and vine vigor. The simultaneous enhancement of these traits indicates favorable gene interactions and efficient expression of heterotic effects in these hybrids.* In this study, six hybrids showed statistically significant positive standard heterosis for fruit yield per vine relative to the check "Pusa Nasdar", including JRG-16-6 × GRG-2 (17.83%) and JRG-20-5 × GRG-2 (12.74%).

When evaluated against the better parent, five hybrids displayed significant positive heterosis ranging from –23.77% to 15.62% (JRG-16-6 × GRG-2) (Table 4). A significant amount of heterosis for fruit yield was also studied by Reddy et al. (2013), Karmakar et al. (2014), Naransannavar et al. (2014a), Poshiya et al. (2015), Bairwa et al. (2017), Wakale et al. (2018), Malve et al. (2020), Nagadevi et al. (2022) and Bhumika et al. (2025). The promising performance of these hybrids suggests their potential utility in future hybrid breeding programmes and warrants further investigation through combining ability and gene action studies. In this study, six hybrids showed statistically significant positive standard heterosis for fruit yield per vine relative to the check "Pusa Nasdar", including JRG-16-6 × GRG-2 (17.83%) and JRG-20-5 × GRG-2 (12.74%). When evaluated against the better parent, five hybrids displayed significant positive heterosis ranging from –23.77% to 15.62% (JRG-16-6 × GRG-2) (Table 4). A significant amount of heterosis for fruit yield was also studied by Reddy et al. (2013), Karmakar et al. (2014), Naransannavar et al. (2014a), Poshiya et al. (2015), Bairwa et al. (2017), Wakale et al. (2018), Malve et al. (2020), Nagadevi et al. (2022) and Bhumika et al. (2025). For most yield component traits positive relative heterosis, indicates that the genes with positive effects were dominant. For most yield component traits, positive relative heterosis indicated the predominance of dominant genes with favorable effects on yield expression. Conversely, the negative heterosis observed for earliness traits suggested the action of dominant alleles promoting earlier flowering and harvesting. These findings collectively indicate the importance of non-additive gene action in the inheritance of both yield and earliness traits and support the exploitation of heterosis breeding for the development of superior ridge gourd hybrids.

Conclusion

The crosses JRG-16-6 × GRG-2 and JRG-20-5 × GRG-2 recorded the highest significant standard heterosis for fruit yield and also exhibited consistently positive heterosis for several desirable yield-contributing traits. For early maturity, the hybrids JRG-16-5 × Pusa Nasdar and JRG-20-5 × GRG-2 performed best for one or more earliness-related traits. Among all the hybrids, JRG-20-5 × GRG-2 emerged as a superior all-round performer by combining earliness with enhanced yield and yield-attributing characters. These results indicate the potential of these hybrids for improving ridge gourd productivity; however, the findings are based on evaluation during a single season and at a single location. Therefore, the promising hybrids identified in the present study should be further evaluated through multi-location and multi-season trials to confirm their stability and adaptability before commercial exploitation. In addition, these hybrids may serve as valuable genetic material for future hybrid development and breeding programmes aimed at improving yield and earliness in ridge gourd.

References

Bhalerao, R. V., Waskar, D. P. & Khandare, V. S. (2022). Heterosis studies for yield and yield contributing traits in ridge gourd (*Luffa acutangula* (L.) Roxb.). The Pharma Innovation Journal, 11(3), 987-992.

Bhumika, A. M., Yashavant, K. H., Kishor G. K., Priyanka B., Gowdru K. & Pushpa M. V. (2025). Heterosis for growth, yield and quality traits in ridge gourd. International Journal of Advanced Biochemistry Research, 9(12): 1451-1457.

Chittora, A., Kaushik, R. A., Ameta, K. D., Dubey, R. B., & Dhakar, R. (2018). Heterosis in ridge gourd (*Luffa acutangula* (L.) Roxb.) for fruit yield and quality traits. Electronic Journal of Plant Breeding, 9(4), 1428-1435.

Fonseca, S. & Patterson, F. L. (1968). Hybrid vigour in seven parent diallel cross in common winter wheat (*Triticum aestivum* L.). Crop Science, 8, 85-95.

Grafius, J. E. (1959). Heterosis in barely. Agronomy Journal, 40, 58-83.

Kandoliya, U. K., Marviya, G. V., Bodar, N. P., Bhadja, N. V. & Golakiya, B. A. (2016). Nutritional and antioxidant components of ridge gourd (*Luffa acutangula* L. Roxb.) fruits of promising genotypes and varieties. Scholar Journal of Agriculture and Veterinary Sciences, 3(5), 397-401.

Karmakar, P., Munshi, A. D., Behera, T. K. & Sureja, A. K. (2014). Heterosis in ridge gourd (*Luffa acutangula* Roxb.) using hermaphrodite lines. Indian Journal of Horticulture, 71(1), 61-66.

Karmakar, P., Munshi, A.D., Behera, T.K., Kumar, R., Kaur, C. & Singh, B.K. (2013). Hermaphrodite inbreds with better combining ability improve antioxidant properties in ridge gourd [*Luffa acutangula* (Roxb.) L.]. Euphytica, 191(1), 75-84.

Malve, G. M., Bhalekar, M. N. & Kshirsagar, D. B. (2020). Studies on Heterosis in ridge gourd (*Luffa acutangula* (L.) Roxb.) in summer season. International Journal of Chemical Studies, 8(6), 315-320.

Nagadevi Sri A, M Ravindra Babu, D Aparna, M Paratpara Rao & K Umakrishna (2022). Studies on heterosis in ridge gourd (*Luffa acutangula* (L.) Roxb.). The Pharma Innovation Journal, 11(8), 1305-1311.

Narasannavar, A. R., Gasti, V. D., Shantappa, T., Mulge, R., Allolli, T. B. & Thammaiah, N. (2014). Heterosis studied in ridge gourd (*Luffa acutangula* (L.) Roxb.). Karnataka Journal of Agriculture Science, 27(1), 47-51.

Niyaria R. & Bhalala M. K. (2001). Heterosis and combining ability in ridge gourd (*Luffa acutangula* (Roxb.) L.). Indian Journal of Plant Genetic Resources, 14, 101-102.

Panse, V. G. and Sukhatme, P. V. (1995). Statistical methods for agricultural workers. ICAR, New Delhi.

Poshiya, S. C., Dhaduk, L. K., Raval, L. & Mehta, D. R. (2015). Heterosis study in ridge gourd (*Luffa acutangula* (L.) Roxb.). Electronic Journal of Plant Breeding, 6(2), 581-585.

Reddy, K. P., Reddy, V. S. K., Vijaya, S. S. & Padma, S. S. (2013). Performance of parents and hybrids for yield and yield attributing characters in ridge gourd [*Luffa acutangula* (Roxb.) L.]. An International Quarterly Journal of Life Sciences or The Bioscan, 8(4), 1373-1377.

Sarkar, K. S., Shanwad, T. & Rao, M. R. (2015). Studies on heterosis, combining ability, genetic advance and character association in ridge gourd. South Indian Horticulture, 32, 97-100.

Sharma, D. and Soni, A. K. (2024). Study of heterosis for yield attributes in ridge gourd (*Luffa acutangula* (L.) Roxb.) in the semi-arid region in Rajasthan. Plant Archives, 25(1), 1343-1347.

Singh, J., Munshi, A. D., Behera, T. K., Sureja, A. K., Srivastava, A. & Tomar, B. S. (2017). Heterosis for quantitative traits and mineral contents in ridge gourd (*Luffa acutangula* L.). Indian Journal of Agricultural Sciences, 87(3), 379-84.

Srikanth, D., Ramana, C. V., Rekha, G. K., Babu, D. R., Umakrishna, K. & Naidu, L. N. (2020). Studies on combining ability for fruit yield and quality attributing characters in ridge gourd (*Luffa acutangula* (L.) Roxb.). Journal of Pharmacognosy and Phytochemistry, 9(2), 1218-1221.

Tejashwini, Kandpal, K., Sood, M., Veena, S. A. & Murthy, P. V. (2025). Heterosis for yield and yield attributing traits in ridge gourd (*Luffa acutangula* (L.) Roxb.). Plant Science Today, 12(4), 1-11.

Viradiya, B. R., Niyaria, R., Vanapariya, S., Gorasiya, K., & Goswami, R. (2023a). Estimation of heterosis in ridge gourd (*Luffa acutangula* (L.) Roxb.). The Pharma Innovation Journal, 12(12), 1840-1843.

Wakale, D. G., Jagtap, V. S. & Sogam, O. A. (2018). Studies on heterosis for yield and yield contributing characters in ridge gourd (*Luffa acutangula* L.). International Journal of Bio-Resource & Stress Management, 9(4), 552-555.

सारांश

वर्तमान अध्ययन का उद्देश्य तुरई (Luffa acutangula (L.) Roxb.) में अग्रता (earliness) तथा उपज घटक लक्षणों के लिए संकर शक्ति का अध्ययन करना था। आठ लाइनों एवं तीन टेस्टर्स को लाइन × टेस्टर विधि द्वारा पार कर 24 संकर (hybrids) विकसित किए गए। इन संकरों एवं उनके 11 अभिभावकों का मूल्यांकन खरीफ-2025 के दौरान जूनागढ़ कृषि विश्वविद्यालय में यादृच्छिक ब्लॉक डिजाइन (RBD) में तीन पुनरावृत्तियों के साथ किया गया। विविधता के विश्लेषण से जीनोटाइप्स के बीच महत्वपूर्ण अंतर पाए गए, जो आनुवंशिक विविधता को दर्शाते हैं। फल उपज प्रति बेल के लिए, मानक संकर शक्ति -16.24% से 17.83% तक (चेक किस्म पुसा नसदार की तुलना में) पाई गई, जिसमें JRG-16-6 × GRG-2 (17.83%) संकर ने सर्वाधिक मानक संकर शक्ति प्रदर्शित किया। अग्रता लक्षणों के लिए, JRG-16-5 × पुसा नसदार संकर सर्वश्रेष्ठ पाया गया, जिसमें 50% फूल आने के दिन (-12.20%), प्रथम मादा फूल आने के दिन (-12.38%) तथा प्रथम तुड़ाई के दिन (-16.98%) में उल्लेखनीय कमी दर्ज की गई। अंततः, JRG-20-5 × GRG-2 संकर अग्रता एवं उपज घटकों के लिए श्रेष्ठ पाया गया, जिसमें प्रथम नर फूल आने के दिन (-9.56%) तथा मुख्य बेल की लंबाई (31.67%) में सुधार देखा गया।