

Research Note

Heterosis study in ridge gourd (*Luffa Acutangula* (Roxb.) L.)

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Abstract

The heterosis study for fruit yield and its attributes was carried out in ridge gourd (*Luffa acutangula* (Roxb.) L.) through 8 x 8 diallel mating design (excluding reciprocal). The magnitude of heterotic effects was high for fruit yield per vine (kg) and number of fruits per vine. No heterosis was observed for fruit length and it was low to moderate for rest of the traits. The highest, positive and significant standard heterosis for fruit yield per vine and some of its component traits were recorded in the crosses, Pusa Nasdar x JRG-05-6, Pusa Nasdar x JRG-05-4, JRG-05-4 x ARGS-05-31, Pusa Nasdar x Jaipur Long and JRG-05-4 x ARGS-07-41. Such crosses could be exploited for practical plant breeding programme in ridge gourd.

Keywords

Ridge gourd, Heterosis, Diallel

Ridge gourd (*Luffa acutangula* (Roxb.) L.) is one of the popular cucurbitaceous vegetable crops. A wide range of variability in fruit and vegetative characters is available in this crop, but the same has not been assessed and utilized. Heterosis breeding is one of the most efficient tools to exploit the genetic diversity in ridge gourd. Being monoecious in sex expression and cross pollinated, it provides ample scope for the utilization of hybrid vigor. Thus diallel analysis is useful for preliminary evaluation of genetic stock for use in hybridization programmes with a view to identify heterotic hybrids, which may be used to build up population with favourable fixable genes for effective yield improvement.

The experimental material comprised of parents and their F₁s derived by crossing eight different genotypes of ridge gourd viz., Pusa Nasdar, Jaipur Long, JRG-05-4, JRG-05-6, HARG-109, HARG-110, ARGS-05-31 and ARGS-17-41 in a diallel fashion excluding reciprocals during *kharif-2009* at Vegetable Research Station, Junagadh Agricultural University, Junagadh. The experiment was laid out in a randomized block design with three replications during Summer-2010 at Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. The plants were spaced at a distance of 2.0 m between rows and 1.0 m within a row. Five plants of each parents and F₁ hybrids were selected randomly for data recording for 12 characters (Table 1). The formula used to estimate heterosis over better parent and standard check were as per Fonseca and Patterson (1968).

The analysis of variance for experimental design (Table 1) revealed highly significant mean squares differences due to genotypes for all the characters indicating sufficient amount of genetic variability for the 12 traits studied. In the present investigation, fruit yield per vine was found to be the most heterotic trait as heterosis for fruit yield per vine ranged from -45.93 to 67.46 per cent and -52.12 to 80.51 percent over better parent and standard check, respectively (Table 2). The magnitude of heterotic effects was high for fruit yield per vine (kg) and number of fruits per vine, while significant heterosis was not observed for fruit length and it was low to moderate

for rest of the traits. Out of 28 hybrids, 13 and 20 crosses manifested significant and positive heterosis over better parent and standard check, respectively. The cross Pusa Nasdar x JRG-05-6 showed highest significant and positive standard heterosis (80.51 %) for fruit yield per vine followed by cross Pusa Nasdar x JRG-05-4 (69.28 %), JRG-05-4 x ARGS-05-31 (66.10 %) and Pusa Nasdar x Jaipur Long (65.25 %) (Table 3). In such cases, expression of heterotic response over better and standard parents indicates the real superiority of hybrids from the commercial point of view. Kadam *et al.* (1995), Mole *et al.* (2001), Niyaria and Bhalala (2001), Shaha and Kale (2003), Acharya *et al.* (2005), Purohit *et al.* (2005) and Deshpande (2010) have also reported high values of heterosis for fruit yield in ridge gourd.

Early male and female flowering, lower nodal position of both male and female flowers, early picking and low fruit fly infestation are desirable features in ridge gourd cultivation. Therefore, significant and negative heterosis for these all characters is desirable. For days to open first female flower, 13 and 26 F₁'s expressed significant and desirable heterobeltiosis and standard heterosis respectively, of which cross JRG-05-4 x ARGS-05-31 had highest value for former and cross JRG-05-4 x HARG-110 had highest value for later. For node number at which first female flower appeared, five and 13 F₁'s expressed significant and desirable heterobeltiosis and standard heterosis respectively, of which cross HARG-109 x HARG-110 had highest value for both the cases. With regards to node number at which first male flower appeared, four and 16 F₁'s expressed significant and desirable heterobeltiosis and standard heterosis respectively, of which cross JRG-05-4 x JRG-05-6 had highest value for former and cross HARG-110 x ARGS-05-31 had highest value for later. For length of main vine, six hybrids showed positive and significant heterosis over better parent and three hybrids exhibited positive and significant heterosis over standard parent. In case of number of primary branches per vine, six and one crosses showed positive and significant heterosis over better and standard parent, respectively. The number of cross combinations, which exceeded the better and standard parent values for number of fruits per vine, was 13 and 23 crosses, respectively. Only two crosses

exhibited positive and significant heterosis over better parent and standard parent for fruit weight. With regard to fruit fly infestation, six hybrids showed significant and negative heterosis over better parent and one hybrid exhibited significant and negative heterosis over standard parent.

A comparison of best performing three crosses in order with first three most heterobeltiotic crosses further revealed that for the characters like days to first picking, number of primary branches per vine, number of fruits per vine, length of fruit, fruit yield per vine and fruit fly infestation, the performance of crosses was not associated with the heterobeltioses. On the other hand, one cross for days to open first female flower, node number at which first male flower appeared and girth of fruit; and two crosses each in case of node number at which first female flower appeared, length of main vine and weight of fruit were common in comparison between best performing three crosses with three most heterobeltiotic crosses. This indicated that the selection of crosses on the basis of either *per se* performance or heterotic response over better parent would be equally important, but the former being more desirable.

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Table 1. Analysis of variance showing mean squares for fruit yield and its contributing characters in ridge gourd.

Source of variation	df	Days to open first female flower	Node number at which first female flower appeared	Node number at which first male flower appeared	Days to first picking	Length of main vine (m)	Number of primary 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)	Fruit fly infestation (%)
Replications	2	1.11	0.51	1.00**	3.01	0.05	0.003	0.641	88.88	2.78	0.12	0.04	4.84
Genotypes	35	42.71**	3.90**	2.50**	51.88**	1.46**	3.71**	55.09**	632.44**	46.66**	0.51*	0.83**	231.56**
Parents	7	27.34**	1.31**	2.04**	24.55**	1.22**	2.36**	50.03**	548.27**	85.33**	0.16	0.77**	338.82**
Hybrids	27	39.75**	4.71**	2.70**	47.85**	1.57**	4.19**	47.38**	663.61**	38.18**	0.61**	0.69**	210.36**
Parents Vs Hybrids	1	230.21**	0.003	0.44	352.0**	0.03	0.20	298.73**	380.20*	4.76	0.05	4.83**	53.26**
Error	70	1.59	0.27	0.15	5.58	0.04	0.10	1.87	55.63	2.40	0.29	0.03	6.51

*, ** significant at 5% and 1% levels, respectively.



Table 2. Magnitude of heterobeltiosis (H) and standard heterosis (SH) in ridge gourd.

Sr. No.	Characters	Range of heterosis (%)						Number of crosses with significant heterosis			
		H (%)			SH (%)			H (%)		SH (%)	
		+Ve	-Ve		+Ve	-Ve		+Ve	-Ve	+Ve	-Ve
1.	Days to open first female flower	-14.29	to	17.08	-21.77	to	7.94	5	13	1	26
2.	Node number at which first female flower appeared	-17.08	to	36.97	-28.42	to	24.10	9	5	5	13
3.	Node number at which first male flower appeared	-16.19	to	52.44	-29.59	to	27.55	7	4	3	16
4.	Days to first picking	-16.67	to	6.95	-18.12	to	5.08	2	10	0	19
5.	Length of main vine(m)	-49.37	to	45.60	-40.15	to	29.72	6	12	3	18
6.	Number of primary branches per vine	-40.63	to	24.44	-51.69	to	13.56	6	12	1	24
7.	Number of fruits per vine	-37.89	to	57.13	-28.81	to	99.60	13	4	23	1
8.	Weight of fruit (g)	-21.83	to	13.57	-32.31	to	13.14	2	8	2	13
9.	Length of fruit (cm)	-23.23	to	6.92	-39.64	to	7.63	0	17	0	17
10.	Girth of fruit (cm)	-9.33	to	12.00	-9.93	to	11.26	1	1	1	1
11.	Fruit yield per vine (kg)	-45.93	to	67.46	-52.12	to	80.51	13	4	20	1
12.	Fruit fly infestation (%)	-38.44	to	92.67	-31.57	to	145.74	15	6	20	1

Table:3 Performance of promising crosses for fruit yield per plant along with *per se* performance and their standard heterosis for component characters in ridge gourd.

Sr. No.	Crosses	Mean fruit yield per vine (kg)	Fruit yield per vine (kg)	Days to open first female flower	Node number at which first female flower appeared	Node number at which first male flower appeared	Days to first picking
1.	Pusa Nasdar x JRG-05-6	2.84	80.51**	-7.55**	-10.79*	-3.06	-2.13
2.	Pusa Nasdar x JRG-05-4	2.66	69.28**	-9.48**	2.52	-6.12	-6.78*
3.	JRG-05-4 x ARGS-05-31	2.61	66.10**	-19.33**	-5.76	-18.37**	-14.47**
4.	Pusa Nasdar x Jaipur Long	2.60	65.25**	-4.14**	2.52	-7.14	-1.43
5.	JRG-05-4 x ARGS-07-41	2.57	63.35**	-18.69**	-9.35*	-20.41**	-17.86**

Table 3 Contd

Sr. No.	Crosses	Length of main vine (m)	Number of primary branches per vine	Number of fruits per vine	Weight of fruit (g)	Length of fruit (cm)	Girth of fruit (cm)	Fruit fly infestation (%)
1.	Pusa Nasdar x JRG-05-6	2.48	-13.56**	61.82**	13.14**	1.37	-1.66	63.72**
2.	Pusa Nasdar x JRG-05-4	29.72**	-5.08	53.45**	10.88*	-4.33	0.33	78.83**
3.	JRG-05-4 x ARGS-05-31	-12.25**	-27.97**	79.67**	-7.40	-7.18	-3.64	59.16**
4.	Pusa Nasdar x Jaipur Long	4.30	5.93	51.33**	9.50	7.63	-1.32	59.02**
5.	JRG-05-4 x ARGS-07-41	-16.97**	-43.22**	69.74**	-3.59	-16.17**	11.26**	24.74**



Table 4. Three best crosses selected on the basis of best performing parents, heterobeltiosis and best performing crosses for different characters in ridge gourd.

Characters	Best performing parents	Best performing crosses	Heterobeltiosis
Days to open first female flower	ARGS-07-41	JRG-05-4 x HARG-110	JRG-05-4 x ARGS-05-31
	HARG-110	JRG-05-6 x ARGS-05-31	JRG-05-6 x ARGS-05-31
	JRG-05-6	HARG-109 x ARGS-07-41	Jaipur Long x ARGS-05-31
Node number at which first female flower appeared	HARG-109	HARG-109 x HARG-110	HARG-109 x HARG-110
	HARG-110	HARG-110 x ARGS-05-31	HARG-110 x ARGS-05-31
	ARGS-07-41	Pusa Nasdar x ARGS-07-41	JRG-05-6 x ARGS-05-31
Node number at which first male flower appeared	ARGS-05-31	HARG-110 x ARGS-05-31	JRG-05-4 x JRG-05-6
	HARG-110	Jaipur Long x ARGS-07-41	Jaipur Long x ARGS-07-41
	ARGS-07-41	JRG-05-6 x ARGS-05-31	Pusa Nasdar x JRG-05-4
Days to first picking	ARGS-07-41	HARG-110 x ARGS-05-31	JRG-05-4 x JRG-05-6
	HARG-110	JRG-05-6 x ARGS-05-31	Jaipur Long x ARGS-07-41
	JRG-05-6	JRG-05-4 x ARGS-07-41	Pusa Nasdar x JRG-05-4
Length of main vine(m)	ARGS-07-41	Pusa Nasdar x JRG-05-4	Jaipur Long x HARG-109
	Pusa Nasdar	Jaipur Long x HARG-109	Pusa Nasdar x JRG-05-4
	JRG-05-4	Pusa Nasdar x HARG-109	Jaipur Long x JRG-05-4
Number of primary branches per vine	Pusa Nasdar	Pusa Nasdar x ARGS-07-41	HARG-110 x ARGS-05-31
	Jaipur Long	Pusa Nasdar x Jaipur Long	Jaipur Long x JRG-05-4
	ARGS-07-41	Pusa Nasdar x JRG-05-4	Jaipur Long x HARG-110
Number of fruits per Vine	JRG-05-4	Jaipur Long x ARGS-05-31	Pusa Nasdar x JRG-05-6
	Jaipur Long	JRG-05-6 x ARGS-05-31	Pusa Nasdar x ARGS-07-41
	ARGS-05-31	Jaipur Long x JRG-05-6	Jaipur Long x ARGS-05-31
Weight of fruit (g)	Pusa Nasdar	Pusa Nasdar x JRG-05-6	Pusa Nasdar x JRG-05-6
	Jaipur Long	Pusa Nasdar x JRG-05-4	Pusa Nasdar x JRG-05-4
	JRG-05-6	Pusa Nasdar x Jaipur Long	-
Length of fruit (cm)	Jaipur Long	Pusa Nasdar x Jaipur Long	-
	Pusa Nasdar	Pusa Nasdar x JRG-05-6	-
	JRG-05-6	JRG-05-6 x HARG-110	-
Girth of fruit (cm)	JRG-05-4	JRG-05-4 x ARGS-07-41	JRG-05-4 x ARGS-07-41
	Pusa Nasdar	Pusa Nasdar x HARG-109	-
	HARG-109	Jaipur Long x HARG-110	-
Fruit yield per vine (kg)	Jaipur Long	Pusa Nasdar x JRG-05-6	JRG-05-6 x ARGS-07-41
	JRG-05-4	Pusa Nasdar x JRG-05-4	HARG-109 x HARG-110
	ARGS-07-41	JRG-05-4 x ARGS-05-31	JRG-05-6 x HARG-109
Fruit fly infestation (%)	ARGS-05-31	ARGS-05-31 x ARGS-07-41	JRG-05-6 x HARG-110
	Pusa Nasdar	HARG-109 x ARGS-07-41	Jaipur Long x ARGS-07-41
	HARG-109	Pusa Nasdar x HARG-110	HARG-110 x ARGS-07-41