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Heterosis for fruit yield and its component traits in ridge gourd (*Luffa acutangula* (Roxb.) L.)

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Abstract

Twenty-one crosses of ridge gourd in a Line x Tester set involving 10 parents were evaluated in RBD design to study heterosis for fruit yield and its components. The hybrids exhibited marked heterosis over better parent and standard check for various characters. Significant estimates of positive heterobeltiosis and standard heterosis were observed in 10 and 9 cross combinations, respectively for fruit yield per vine and its attributing traits. The range of heterobeltiosis was varied from -24.22 to 36.69%, while the standard heterosis ranged from -17.23 to 26.55% for fruit yield per vine. The cross JRG-13-04 x Jaipur Long (26.55%) recorded the highest standard heterosis for fruit yield per vine followed by JRG-13-04 x Arka Sujat (17.23%), JRG-13-04 x Pusa Nasdar (17.11%), JRG-13-02 x Jaipur Long (16.43%) and JRG-13-06 x Jaipur Long (15.93%). These crosses also recorded significant standard heterosis for length of main vine, number of primary branches per vine, length of fruit and girth of fruit. The results thus, showed that the heterosis for fruit yield per vine was associated with heterosis for its component characters.

Keywords: Heterobeltiosis, standard heterosis, fruit yield, ridge gourd

Introduction

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. The magnitude of heterosis provides a basis for genetic diversity of the parents and a guide to the choice of parents in developing superior F_1'S so as to exploit hybrid vigour. In addition, if heterosis is due to epistatic gene action, particularly of additive x additive type, it would be possible to fix alleles at the interacting loci to preserve the heterotic effect. It is, therefore, desirable to identify crosses which exhibit heterosis preferably when one of the parents is of acceptable commercial quality. The heterotic hybrids can also produce desirable transgressive segregants in advanced generations. In this context, the aim of estimation of heterosis in the present study was to know nature and magnitude of heterosis on yield and its components and to identify the best cross combination giving high degree of useful heterosis (Singh 1957) [13].

Materials and Methods

Experimental material consisting of 32 entries, three male lines (used as testers) *viz*., Arka Sujat, Pusa Nasdar, Jaipur Long and seven female lines (used as lines) *viz*., JRG-13-01, JRG-13-02, JRG-13-03, JRG-13-04, JRG-13-05, JRG-13-06, JRG-13-07 and their 21 hybrids developed through line x tester mating design along with standard check (GJRGH-1) were evaluated in a randomized block design with three replications. The 21 crosses made in line x tester mating design during *kharif*-2015 at Vegetable Research Station, Junagadh Agricultural University, Junagadh, which were evaluated during summer-2016 at the 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 per each entry in each replication were randomly selected before flowering and tagged for the purpose of recording the observations of different characters *viz*., 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), rind thickness (mm), flesh thickness (mm), fruit yield per vine (g), number of seeds per fruit and 100-seed weight (g). Heterosis was calculated as percentage of F_1 performance in the favourable direction over better parent, the best parent and commercial check (GJRGH-1).

The analysis of variance for experimental design was performed to test the significance of difference among the genotypes for all the characters model as suggested by Panse and Sukhatme (1985) [8]. Heterobeltiosis was estimated as per the procedure given by Fonseca and Patterson (1968) [3] using mean values for various characters over replications.

Experimental Results and Discussion

Analysis of variance (Table 1) showed highly significant differences among the genotypes for all the characters indicating that the genotypes exhibited significant differences for all the characters studied. Differences among hybrids were found highly significant for all characters except for length of fruits. Differences among parents were found highly significant for all characters except for number of fruits per vine, girth of fruit and rind thickness. Differences due to parents *vs* hybrids were found highly significant for all the characters except for rind thickness and 100-seed weight (Table 1) indicating presence of mean heterosis for the characters under studied.

The magnitude of heterobeltiosis and standard heterosis in 21 hybrids are presented in Table 2. 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 -24.22 to 36.69 percent and -17.23 to 26.55 percent over better parent and standard check, respectively (Table 2). In general, it can be concluded that the magnitude of heterosis was higher for number of fruits per vine, fruit weight, fruit yield per vine; moderate for length of main vine, number of primary branches per vine, girth of fruit, flesh thickness and low for length of fruit, rind thickness, number of seeds per fruit and 100-seed weight (Table 2). In the present study, out of 21 hybrids, ten and nine hybrids showed significant and positive heterobeltiosis and standard heterosis for fruit yield per vine (g) respectively. The cross JRG-13-04 x Jaipur Long showed highest significant and positive standard heterosis (26.55%) for fruit yield per vine followed by cross JRG-13-04 x Arka Sujat (17.23%), JRG-13-04 x Pusa Nasdar (17.11%), JRG-13-02 x Jaipur Long (16.43%) and JRG-13-06 x Jaipur Long (15.93%). In such cases, expressions of heterotic response over better and standard parent indicated the real superiority of hybrids from the commercial point of view. Niyaria and Bhalala (2001) [7], Shaha and Kale (2003) [12], Acharya *et al*. (2005) [1], Purohit *et al*. (2005) [10], Deshpande (2010) [2] have also reported high heterosis for fruit yield per vine in ridge gourd.

For length of main vine one and seven F_1's expressed significant desirable heterobeltiosis and standard heterosis respectively, of which cross JRG-13-05 x Jaipur Long had highest value for former and cross JRG-13-01 x Arka Sujat had highest value for later. For number of primary branches per vine, seven and six F_1's expressed significant desirable heterobeltiosis and standard heterosis respectively, of which cross JRG-13-01 x Pusa Nasdar highest value for both the cases. With regard to number of fruits per vine appeared, nine F_1's exhibited positive and significant heterobeltiosis and standard heterosis respectively, of which cross JRG-13-04 x Jaipur Long highest value for both the cases. For fruit weight 11 and nine F_1's expressed significant desirable heterobeltiosis and standard heterosis respectively, of which cross JRG-13-07 x Pusa Nasdar had highest value for former and cross JRG-13-04 x Jaipur Long had highest value for later. For length of fruit, four and one hybrids expressed significant desirable heterobeltiosis and standard heterosis respectively, of which cross JRG-13-02 x Pusa Nasdar had highest value for former and cross JRG-13-07 x Pusa Nasdar had highest value for later. For girth of fruit 12 and four F_1's showed positive and significant heterosis over better parent and heterosis over standard parent respectively, of which cross JRG-13-04 x Arka Sujat had highest value for both the cases. In case of flesh thickness eight hybrids showed positive and significant heterosis over better parent and three hybrids exhibited positive and significant heterosis over standard parent, of which cross JRG-13-06 x Pusa Nasdar had highest value for former and cross JRG-13-04 x Jaipur Long had highest value for later.

In the present study, many hybrids showed the existence of considerable heterosis for fruit yield as well as component traits over better parent and over standard check, (GJRGH-1). The degree and magnitude of heterosis varied from cross to cross for all the characters.

The crosses which showed high heterosis for fruit yield per vine also had high heterosis for node number of first female flower, length of main vine, number of fruits per vine, fruit weight, length of fruit and girth of fruit. The results thus, revealed that the heterosis for fruit yield per plant was associated with the heterosis expressed by its component characters (Table 3). In the present study, top most nine high yielding hybrids JRG-13-04 x Jaipur Long, JRG-13-04 x Arka Sujat, JRG-13-04 x Pusa Nasdar, JRG-13-02 x Jaipur Long, JRG-13-06 x Jaipur Long, JRG-13-07 x Jaipur Long, JRG-13-05 x Jaipur Long, JRG-13-07 x Pusa Nasdar and JRG-13-06 x Arka Sujat can be exploited in practical plant breeding for selection of better transgressive segregants (Table 3). Significant and desirable heterobeltiosis and standard heterosis along with high *per se* fruit yield per vine as well as significant and positive sca effects was observed in the present study in three cross combinations *viz*., JRG-13-04 x Jaipur Long, JRG-13-04 x Arka Sujat and JRG-13-04 x Pusa Nasdar (Table 3), they might be exploited as commercial hybrids, after testing on large scale as well as for its reaction to major diseases and pests.

The wide ranges of heterosis usually indicated the higher amount of variability for heterosis. Most of the characters expressed either high or moderate range of heterosis (Table 2). Comparatively moderate estimates of heterotic effects for various traits were mainly due to inclusion of well adapted parental lines of different states. It is imperative to know the causes of heterosis for fruit yield. Grafius (1959) [4] suggested that there may not be any gene system for fruit yield *per se* as fruit yield is an end product of the multiplicative interaction between the fruit yield components. This would indicate that the heterosis for fruit yield should be through heterosis for the multiplicative effects of partial dominance of component characters. William and Gilbert (1960) reported that even simple dominance in respect of fruit yield components may lead to expression of heterosis for fruit yield. Hagberg (1952) observed similar effects and termed it "Combinational Heterosis". Heterosis of fruit yield per vine mostly due to number of fruits per vine and other components. These results are akin with the results of Kadam *et al*. (1995), Rao *et al*. (2000), Niyaria and Bhalala (2001) [7], Purohit *et al*. (2005) [10], Deshpande (2010) [2].

Table 1: Analysis of variance for experimental design (mean squares) for different characters in ridge gourd

Source of variations	Df	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)
Replications	2	0.01	0.07	0.91**	43.58	12.85*	3.49
Genotypes	30	0.6**	0.56**	1.30**	1571.48**	10.68**	9.33**
Parents	9	0.12**	0.61**	0.08	1084.93**	13.59**	2.38
Hybrids	20	0.05**	0.27**	1.73**	1287.39**	4.07	6.63**
P. Vs H.	1	0.21**	6.03**	3.66**	11632.37**	116.67**	125.91**
Error	60	0.06	0.06	0.05	34.74	3.39	1.17

Source of variations	Df	Rind thickness (mm)	Flesh thickness (mm)	Fruit yield per vine (g)	No. of seeds per fruit	100- seed weight (g)
Replications	2	0.22**	32.78	549.80*	14.85	0.50*
Genotypes	30	0.06**	269.68**	19401.89**	256.82**	0.65**
Parents	9	0.02	242.07**	12857.87**	86.54**	0.43**
Hybrids	20	0.07**	165.47**	20452.22**	333.57**	0.78**
P. Vs H.	1	0.06	2602.28**	57291.47**	254.33**	0.07
Error	60	0.02	19.51	153.94	5.87	0.11

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

Table 2: Range of heterobeltiosis (H_1) and standard heterosis (H_2) as well as number of crosses with specific heterotic effects for various traits in ridge gourd

Sr. No.	Characters	Range of heterosis (%)						Number of crosses with significant heterosis			
		Heterobeltiosis (H_1) (%)			Standard heterosis (H_2) (%)			H_1 (%)		H_2 (%)	
								+Ve	-Ve	+Ve	-Ve
1	Length of main vine (m)	-24.77	to	14.19	-13.86	To	16.63	1	13	7	2
2	Number of primary branches per vine	-20.00	to	60.00	-1.33	To	38.67	7	2	6	0
3	Number of fruits per vine	-22.75	to	31.14	-18.35	To	38.61	9	2	9	2
4	Fruit weight (g)	-23.52	to	23.09	-17.23	To	27.05	11	5	9	5
5	Length of fruit (cm)	-6.67	to	27.80	-8.03	To	12.17	4	0	1	0
6	Girth of fruit (cm)	4.65	to	48.15	-5.03	To	52.17	12	0	4	0
7	Rind thickness (mm)	-25.00	to	19.04	-25.97	To	20.82	1	1	1	1
8	Flesh thickness (mm)	-4.68	to	27.71	-13.10	To	9.69	8	0	3	4
9	Fruit yield per vine (g)	-24.22	to	36.69	-17.23	To	26.55	10	7	9	8
10	Number of seeds per fruit	-4.63	to	47.49	-5.98	To	45.11	7	0	6	0
11	100-seed weight (g)	-2.99	to	12.31	0.78	To	20.93	6	0	9	0

+ve = Positive and -ve = Negative

Table 3: Comparative study of nine most standard heterotic crosses for fruit yield per vine along with *per se* performance and their heterotic effects for component characters in ridge gourd

Sr. No.	Crosses	Fruit yield per vine	Length of main vine	Number of primary branches per vine	Number of fruits per vine	Fruit weight	Length of fruit	Girth of fruit	*Per se* fruit yield per vine
1	JRG-13-04 x Jaipur Long	26.55**	16.20**	6.67	38.61**	27.05**	4.41	18.34*	842.00
2	JRG-13-04 x Arka Sujat	17.23**	2.35	-1.33	30.38**	17.23**	-8.03	52.17**	780.00
3	JRG-13-04 x Pusa Nasdar	17.11**	9.59*	6.67	27.85**	16.83**	0.33	25.41**	779.16
4	JRG-13-02 x Jaipur Long	16.43**	3.20	17.33	7.59	16.43**	1.78	14.54	774.66
5	JRG-13-06 x Jaipur Long	15.93**	-10.66*	6.67	27.22**	15.93**	8.62	6.79	771.33
6	JRG-13-07 x Jaipur Long	15.23**	-13.86**	28.00**	24.68**	15.23**	0.39	8.56	766.66
7	JRG-13-05 x Jaipur Long	14.83**	8.10	12.00	5.70	14.83**	5.07	8.29	764.00
8	JRG-13-07 x Pusa Nasdar	14.23**	7.89	4.00	20.25**	14.23**	12.17*	8.70	760.00
9	JRG-13-06 x Arka Sujat	8.82**	12.15**	6.67	18.35**	7.82*	6.58	7.88	724.00

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

References

1. Acharya RR, Patel AD, Patel JA, Patel SB, Patel BR. Heterobeltiosis and standard heterosis in ridge gourd. National seminar on cucurbits, GBPUAT, Pantnagar, 2005, 22-23, (Abst. 2).
2. Deshpande MR. Genetic studies of fruit yield and its components by line x tester analysis in ridge gourd (*Luffa acutangula* (Roxb) L.). Unpublished M.Sc. (Agri.) thesis submitted to Anand Agriculture University, Anand, 2010
3. Fonesca S, Patterson FL. Hybrid vigour in a seven parent's diallel cross in common winter wheat (*T. aestivum* L.). Crop Sci. 1968; 8:85-88.
4. Grafius JE. Heterosis in barely. Agron. J. 1959; 40:58-83.
5. Hagberg A. Heterosis in F_1 combinations in Galeopsis-I and II. Heriditas Land, (Fide: Indian J Genet.). 1952; 29:53-61, 1: 221-225
6. Kadam PY, Desai UT, Kale PN. Heterosis studies in ridge gourd. J Mah. agric. Univ. 1995; 20:119-120.
7. Niyaria R, Bhalala MK. Heterosis and combining ability in ridge gourd (*Luffa acutangula* (Roxb.) L.). Indian J Plant Genet. Resour. 2001; 14:101-102.
8. Panse VG, Sukhatme PV. Statistical methods for

Agricultural Workers, Second methods for Agricultural Workers, (Second edition). ICAR, New Delhi, 1985.

9. Poshiya SC, Dhaduk LK, Lata Raval, Mehta DR. Heterosis study in ridge gourd (*Luffa acutangula* (Roxb) L.). Elec. J Pl. Breed., 2015; 6(2):581-585.
10. Purohit VL, Dhaduk LK, Mehta DR, Gajipara NN. Heterosis studied in ridge gourd (*Luffa acutangula* (Roxb.) L.). National seminar on cucurbits, GBPUAT, Pantnagar, 2005, 22-23, (Abst. 17).
11. Rao BN, Rao VP, Muralimohan Reddy B. Heterosis in ridge gourd (*Luffa acutangula* (Roxb.) L.). Haryana J Hort. Sci. 2000; 29:96-98.
12. Shaha SR, Kale PN. Heterosis studies in ridge gourd. J Mah. Agric. Univ., 2003; 28:334-336.
13. Singh SN. Studies in the floral biology of Luffa. Horti. Advan. 1957; 1:86.
14. Williams W, Gilbert N. Heterosis and the inheritance of yield in tomato. Heredity. 1960; 14:133-145.