STUDY ON HETEROSIS AND INBREEDING DEPRESSION FOR FRUIT YIELD AND ITS RELATED TRAITS IN RIDGE GOURD (*Luffa acutangula* (ROXB.) L.)

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ABSTRACT

The present investigation on ridge gourd (Luffa acutangula (Roxb.) L.) was carried out with a view to know extent of heterosis and inbreeding depression for fruit yield and its attributes through generation mean analysis. Heterosis and inbreeding depression were varied in degree and direction from cross to cross. Ample amount of heterosis over mid parent and better parent was observed for all the traits studied. The relative heterosis and heterobeltiosis were found significantly negative in cross GRGL-2 x GRGL-13 for earliness. The significant and positive mid-parent heterosis and better parent heterosis for fruit length, number of fruits per vine and fruit yield per vine observed in crosses GRGL-2 x GRGL-13, CHRG-1 x CHRG-2 and Pusa Nasdhar x Jaipur Long. Moderate to high amount of inbreeding depression was observed for all the traits.

KEY WORDS: Ridge gourd, heterobeltiosis, inbreeding depression.

INTRODUCTION

The ridge gourd **(***Luff aacutangula* (Roxb.) L**.)** is a vegetable of commercial importance and green immature fruits are cooked as vegetable and used in preparation of chutney and curries. Fruits are 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 and does not suffer much due to inbreeding depression resulting in natural variability in the population. Thus, provides ample scope for utilization of hybrid vigour on commercial scale to increase the production and productivity. In spite of availability of wider range of genetic variability in plant and fruit characters and also large number hybrid seed at reasonable cost, very little work has been done to exploit the hybrid vigour and inbreeding depression in this crop. One of the methods to achieve quantum jump in yield and quality is heterosis breeding. Hence, an attempt was made to study the heterosis and inbreeding in different crosses to develop and identify the suitable best performing hybrids over better and mid-parent.

MATERIALS AND METHODS

The experiment materials consisting P_1, P_2, F_1 and F_2 generations of six cross involving ten promising genotype of ridge gourd evaluated in a randomized block design with three replications. Six F_1 hybrids and their F_2 generation and ten parents were grown in *kharif* 2016 season at Vegetable Research Station, Jungadh Agricultural University, Junagadh. Each replication was divided in to four compact blocks and each block had a single cross of P_1, P_2, F_1 and F_2 generations. Each block comprised seven rows consisting of single row each of P_1, P_2 and F_1 and four of F_2. Each row was spaced at 2.0 m x 1.0 m. The observations were recorded on eleven traits from 5 randomly selected plants each in P_1, P_2 and F_1 and 40 plants in F_2 generation in each replication. The data were subjected to statistical analysis for estimation of heterosis and inbreeding depression.

RESULTS AND DISCUSSION

The estimate of heterosis, heterobeltiosis and inbreeding depression for eleven traits in ridge gourd are presented in Table- 1. Significant negative value were considered desirable for days to open first female flower, number of node at which first female flower appeared, days to first picking and days to last picking in ridge gourd.

The relative heterosis for days open first female flower ranged from -8.98 (GRGL-2 x GRGL-13) to 19.94 per cent (IIHR-6 x IIHR-7). Out of six crosses, GRGL-2 x GRGL-13 and CHRG-1 x CHRG-2 expressed the significant and negative relative heterosis suggesting the presence of dominant gene effect. The heterobeltiosis for days to open first female flower was ranged from-17.63 (CO-1 x Jaipur Long) to 21.49 per cent (IIHR-6 x IIHR-7). Out of six crosses, only one cross GRGL-2 x GRGL-13 noted significant negative heterobeltiosis. Negative estimation of heterosis for the trait has been reported by Shaha and Kale (2003) and Naliyadhara *et al*. (2011). Inbreeding depression for days to open first female flower varied from -14.65 (KRG-5 x Pusa Nasdhar) to -2.76 per cent (CHRG -1 x CHRG-2). Significant and negative inbreeding depression was found in two crosses *viz*., GRGL-2 x GRGL-13 and KRG-5 x Pusa Nasdhar.

Extent of heterosis over mid parent for number of node at which first female flower appeared was ranged from -17.33 (KRG-5 x PusaNasdhar) to 29.43 per cent (CO-1 x Jaipur Long). The significant and negative relative heterosis expressed by GRGL-2 x GRGL-13, CHRG-1 x CHRG-2 and KRG-5 x Pusa Nasdhar. The heterobeltiosis was ranged from -6.37 (Pusa Nasdhar x Jaipur Long) to 51.23 per cent (Co-1 x Jaipur Long). The negative and significant heterobeltiosis was expressed in KRG-5 x Pusa Nasdhar and Pusa Nsadhar x Jaipur Long. Inbreeding depression for this trait ranged from -26.68 (KRG-5 x Pusa Nasdhar) to 7.16 per cent (Co-1 x Jaipur Long). Most of the crosses exhibited significant and negative inbreeding depression.

The range of relative heterosis for days to first picking varied from 9.80 (GRGL-2 x GRGL-13) to 13.72 per cent (IIHR-6 x IIHR-7). Two crosses *viz*., GRGL-2 x GRGL-13 and Co-1 x Pusa Nasdhar expressed significant and positive relative heterosis. The heterobeltiosis ranged from -8.00 (GRGL-2 x GRGL-13) to 10.21 per cent (IIHR-6 x IIHR-7). Only one cross GRGL-2 x GRGL-3 exhibited significant positive heterobeltiosis for days to first picking. Positive heterosis for this trait reported by Shaha and Kale (2003) and Purohit *et al.* (2007). The minimum (-7.89 %) and maximum (3.20 %) value of inbreeding depression was recorded in CO-1 x Jaipur Long and IIHR-6 xIIHR-7 for this character.

The estimate on relative heterosis for days to last picking ranged from 2.72 (GRGL-2 x GRGL-13) to 7.15 per cent (Pusa Nasdhar x Jaipur Long). Only one cross Pusa Nasdhar x Jaipur Long exhibited positive and significant relative heterosis. The heterosis over better parent ranged from 0.72 (CHRG-1 x CHRG-2) 9.86 per cent (KRG-5 x Pusa Nasdhar) for days to last picking. The positive and significant heterobeltiosis expressed in three crosses *viz.*, GRGL-2 x GRGL-13, KRG-5 x Pusa Nasdhar and Pusa Nasdhar x Jaipur Long. The significant heterosis over better parent observed by Mole *et al.* (2001) and Purohit *et al.* (2007). The highest (5.55%) and the lowest (1.97%) value of inbreeding depression were observed in GRGL-2 x GRGL-13 and IIHR-6 x IIHR-7.

For fruit length, heterosis with respect to mid-parent ranged from -6.23 (IIHR-6 x IIHR-7) to 29.83 per cent (CO-1 x Jaipur Long). Three crosses *viz*., GRGL-2 x GRGL-13, CO-1 x Jaipur Long and Pusa Nasdhar x Jaipur Long expressed positive and significant heterosis. The heterobeltiosis ranged from -0.27 (CHRG-1 x CHRG-2) to 14.26 per cent (IIRH-6 x IIHR-7). Out of six crosses, GRGL-2 x GRGL-13, IIHR-6 x IIHR-7 and Pusa Nasdhar x Jaipur Long noted significant and positive heterobeltosis for fruit length. Mole *et al.* (2001) and Purohit *et al.* (2007) reported positive and significant heterobeltiosis for this character. Inbreeding depression varied from -2.88 (CHRG-1 xCHRG-2) to 36.37 per cent (CO-1 x Jaipur Long). Three crosses *viz*., GRGL-2 x GRGL-13, CO-1 x Jaipur Long and Pusa Nasdhar x Jaipur Long noted significant and positive inbreeding depression for this character.

In case of fruit girth, the relative heterosis ranged from 0.77 (IIHR-6 x IIHR -7) to 11.70 per cent (GRGL-2 x GRGL-13). Three crosses *viz*., GRGL-2 x GRGL-13, CO-1 x Jaipur Long and Pusa Nasdhar x Jaipur Long manifested significant and positive heterosis. The range for heterobeltiosis was from -4.45 (KRG-5 x PusaNasdhar) to 7.95 per cent (CO-1 x Jaipur Long). The significant and positive heterobeltiosis was observed in CHRL-1 x CHRL-2, IIHR-6 x IIHR -7, CO-1 x Jaipur Long and Pusa Nasdhar x Jaipur Long for this trait. Significant and positive heterobeltiosis was observed by Rao and Rao (2002) and Purohit *et al.* (2007). Inbreeding depression value varied in between 1.35 (IIHR-6 x IIHR-7) to 17.00 per cent (Pusa Nasdhar x Jaipur Long). Out of six crosses, three crosses *viz*., GRGL-2 x GRGL -13, KRG-5 x Pusa Nasdhar and Pusa Nasdhar x Jaipur Long exhibited positive and significant inbreeding depression.

Length of vine with respect to mid-parent value varied from 5.30 (HIIHR-6 x IIHR-7) to 23.94 per cent (CO-1 Jaipur Long). All the six crosses studied expressed positive and significant heterosis over mid parent indicates partial dominance. Heterobeltiosis for this trait ranged from 5.07 (IIHR-6 x IIHR-7) to 24.69 per cent (Pusa Nasdhar x Jaipur Long. Allthe six crosses noted significant and positive heterobeltiosis for this trait. Shaha and Kale (2003) and Purohit *et al.* (2007) reported significant and positive heterobeltosis for this trait. Inbreeding depression ranged from 2.79 (IIHR-6 x IIHR-7) to 32.26 per cent (KRG-5 x Pusa Nasdhar). All the six crosses exhibited positive and significant inbreeding depression.

The percentage of relative heterosis ranged from -8.79 (KRG-5 x PusaNasdhar) to 8.33 per cent (CHRG-1 x CHRG-2) for number of branches per vine. The cross, Pusa Nasdhar x Jaipur Long showed positive and significant heterosis. The heterobeltiosis ranged from -22.54 (GRGL –2 x GRGL-13) to 6.40 per cent (KRG-5 x Pusa Nasdhar). Only one cross out of six crosses, Pusa Nasdhar x Jaipur Long expressed positive and significant heterobeltiosis suggested the presence of dominance gene effects for this trait. Minimum inbreeding depression was noted in IIHR-6 x IIHR-7 (0.85 %) and the maximum in KRG-5 x Pusa Nasdhar (36.75%) All the six crosses, except IIHR-6 x IIHR-7 manifested positive and significant inbreeding depression, which indicated that effective number of branches per vine reduced in F_2 generation over F_1 and better parent.

Heterosis over mid-parent value ranged from -6.33 (CHRG-1 x CHRG-2) to 31.98 per cent (CO-1 x Jaipur Long) for weigh of fruit. Out of six crosses, GRGL-2 x GRGL-13, IIHR-6 x IIHR-7 and Pusa Nasdhar x Jaipur Long exhibited positive and significant relative heterosis. Significant and positive heterosis over better parent also reported by Mole *et al.* (2001), Rao and Rao (2002) and Purohit *et al.* (2007). The heterobeltiosis for weight of fruit ranged from -10.10 (CHRG-1 x CHRG-2) to 18.68 per cent (IIHR-6 x IIHR-7). IIHR-6 x IIHR-7, Pusa Nasdhar x Jaipur Long and CO-1 x Jaipur Long exhibited positive and significant heterobeltiosis. With respect to average fruit weight, significant and positive heterobeltiosis was reported by Singh *et al.* (2000) in bitter gourd. The maximum and minimum values of inbreeding depression were noted in CO-1 x Jaipur Long (15.88%) and CHRG-1 x CHRG-2 (-4.32%). Singh et *al.* (2000) reported significant and positive inbreeding depression in bitter gourd.

The relative heterosis ranged from -3.85 (CHRG-1 x CHRG-2) to 42.74 (CO-1 x Pusa Nasdhar) for number of fruit per vine. Out of six crosses, GRGL-2 x GRGL-13, KRG-5 x PusaNasdhar, CO-1 x Jaipur Long and Pusa Nasdhar x Jaipur Long expressed positive and significant heterosis. The maximum heterobeltiosis was noted in cross Pusa Nasdhar x Jaipur Long (36.30%) and the minimum in cross IIHR-6 x IIHR-7 (-21.82%). Out of six crosses, three crosses GRGL-2 x GRGL-13, Co-1 x Pusa Nasdhar and Pusa Nasdhar x Jaipur Long expressed positive heterobeltiosis. Kadam *et al*. (1995) and Purohit *et al*. (2007) reported significant and positive heterobeltiosis for this trait. Inbreeding depression varied from 4.70 (IIHR-6 x IIHR-7) to 27.14 per cent (Pusa Nasdhar x Jaipur Long). All the crosses except two crosses, CHRG-1 x CHRG-2 and IIHR-6 x IIHR-7 exhibited significant positive inbreeding depression. Positive and significant inbreeding depression has been reported by Singh *et al*. (2000) in bitter gourd.

The maximum relative heterosis of 84.87 per cent was observed in CO-1 x Jaipur Long, whereas the minimum (-10.40%) was found in CHRG-2 x CHRG-3 for fruit yield per vine. All the crosses except CHRG-1 xCHRG-2 and IIHR-6 x IIHR-7 manifested positive and significant relative heterosis. Heterobeltiosis ranged from -25.60 (CHRG-1 xCHRG-2) to 58.02 per cent (Pusa Nasdhar x Jaipur Long). Three crosses *viz*., GRGL-2 x GRGL-13, CO-1 x Jaipur Long and Pusa Nasdhar x Jaipur Long exhibited significant and positive heterobeltiosis for yield per vine. The maximum inbreeding depression was observed in Pusa Nasdhar x Jaipur Long (58.02%) and the minimum in CHRG-1 x CHRG-2 (-8.87 %). The results might be due to the dominance interaction effects in F_1 hybrids dissipate in F_2 segregating generation due to reduction in heterozygosity. Thus, selection would be effective in F_2 and subsequent generation for this trait. Pandey *et al*. (2004) and Neeraja (2008) observed positive inbreeding depression for this trait.

CONCLUSION

Fruit yield and its components had both additive and non-additive gene effects were predominant resulting in high heterosis in GRGL-2 x GRGL-13, CHRG-1 x CHRG-2 and Pusa Nasdhar x Jaipur Long cross combinations., Production of F_1 hybrids on commercial scale in ridge gourd is possible because it is highly cross-pollinated crop which resulted in to large variation in shape and size of fruits, male and female flower originated separately on same plant (monoecious plant). The fruits, being large in size having greater number of seeds per fruit.

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Table 1: Relative hetrosis (H_1), heterobeltiosis (H_2) and inbreeding depression (ID) for different characters in ridge gourd

Heterosis and Inbreeding Depression	GRGL-2 x GRGL-13	CHRG-1 x CHRG-2	IIHR- 6 x IIHR- 7	KRG-5 x Jaipur Long	CO-1 x Pusa Nasdhar	Pusa Nasdhar x Jaipur Long
Days to open first female flower						
H_1	-8.98**	-3.83*	14.94**	5.88**	-7.62**	-6.95**
H_2	-7.55**	1.08	21.49**	-0.49	-17.63	-1.94
ID	-4.79**	2.76	2.90	-14.85**	-6.64	-5.76
Number of node at which first female flower appeared						
H_1	-13.62**	-4.53*	12.70**	-17.33**	29.43**	-7.00
H_2	2.99*	11.60**	35.16**	-4.62**	51.33**	-6.37*
ID	-10.06**	8.08**	-10.54**	-26.48**	7.16**	-2.00
Days to first picking						
H_1	9.80**	-0.26	13.72**	-5.42	8.30**	-7.16**
H_2	-8.00	4.33**	10.21**	2.20	2.20	-4.89
ID	0.83	1.23	3.20	-5.74	-7.89	5.07
Days to last picking						
H_1	-2.72	4.15	5.17	3.44	3.87	7.15*
H_2	6.79*	0.72	8.82	9.86**	3.95	7.86**
ID	5.55	0.34	1.97	5.07	1.84	4.43
Fruit length (cm)						
H_1	10.16**	-5.64**	-6.23**	2.73	29.83**	14.89**
H_2	2.90	-0.27	14.26**	-0.77	9.19**	5.71**
ID	21.50**	-2.88	11.57**	7.94*	36.37**	12.00**
Fruit girth (cm)						
H_1	11.70**	4.52**	0.77	0.95	4.45**	7.07**
H_2	1.98	4.11**	3.88**	-4.95**	7.95**	7.20**
ID	11.38**	2.16	1.35	5.73**	1.86	17.00**
Number of branches per vine						
H_1	-5.28**	-0.45	1.27	-8.79**	-3.65	8.22**
H_2	-22.54**	-15.39**	-3.31	6.40**	-15.39**	5.93**
ID	6.47**	9.69**	0.85	36.75**	8.90**	15.80**
Length of vine (cm)						
H_1	15.97**	11.19**	5.30**	16.21**	23.94**	21.16**
H_2	2.80**	2.28**	5.07**	5.17**	14.13**	24.69**
ID	11.13**	7.28**	2.79**	32.26**	22.67**	22.47**
Weight of fruit (g)						
H_1	10.50**	-6.33*	8.91**	-6.15	31.98**	12.49**
H_2	3.93	-10.10**	18.68**	-3.63	14.19**	11.59**
ID	6.60	-4.32	8.85	4.35	15.88	11.35**
Number of fruits per vine						
H_1	35.34**	-3.85*	16.09**	23.31**	42.74**	38.91**
H_2	25.66**	-17.35**	-21.82**	0.00	27.37**	36.30**
ID	20.07**	-4.00	-4.70**	17.78**	16.26**	27.14**
Fruit yield per vine (kg)						
H_1	50.07**	-10.40**	-3.28	16.43**	84.87**	56.32**
H_2	47.57**	-25.60**	-21.20	-3.68**	45.41**	58.02**
ID	32.90**	-8.87**	9.60	23.54**	26.87**	35.40**

****, ** Significant at 5per cent and 1per cent probability levels, respectively***

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