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HETEROSIS, COMBINING ABILITY AND GENE ACTION STUDIES IN OKRA [*ABELMOSCHUS ESCULENTUS* (L.) MOENCH]

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Summary

Heterosis and combining ability effects were estimated for yield and contributing traits in Line x Tester programme involving six lines (VRO-5, VRO-6, HRB-9-2, Pusa Sawani, Prabhani Kranti and HRB-55) and four testers (Arka Anamika, Arka Abhey, IIVR-11 and P-7). Among twenty four hybrids, the high sca were recorded in cross combinations namely Pusa Sawani x A. Anamika, HRB-9-2 x P-7, HRB-55 x A.Anamika, VRO-5 x A. Anamika, VRO-5 x IIVR-11 and VRO-5 x A. Abhey. Among parents, Parbhani Kranti, VRO-6, VRO-5 and IIVR-11 were found good general combiner. Hence, these parents may be used as one of the parent in okra hybrid programme. The gene action studies indicated that there was preponderance of non-additive (dominance) gene action for all the traits under study.

सारांश

भिण्डी के छः मादा जनको (वी.आर.ओ.–5, वी.आर.ओ.–6, एच.आर.बी.–9–2, पूसा सावनी, परभनी क्रान्ति एवं एच.आर.बी.–55) व चार नर जनको (अर्का अनामिका, अर्का अभय, आई.आई.बी.आर.–11 एवं पी–7) के उपज हेतु लाइनx टेस्टर संयोजी विधि द्वारा ओज व संयोजी क्षमता का अध्ययन किया गया। सभी 24 संकरो में पूसा सावनीx अर्का अनामिका, एच.आर.बी.–9 x पी–7, एच.आर.बी.–55 x अर्का अनामिका, वी.आर.ओ.–5 x अर्का अनामिका, वी.आर.ओ.–5 x आई.आई.बी.आर.–11 व वी.आर.ओ.–5 x अर्का अभय के संयोजी संकरो में विशिष्ट संयोजी क्षमता अधिक पायी गई। सभी पित्तको में परभनी क्रान्ति, वी.आर.ओ.–6, वी.आर.ओ.–5 एवं आई.आई.बी.आर.–11 सामान्य संयोजकता हेतु उपयुक्त पाये गये। अतः ये पित्तक भिण्डी के संकर प्रजातियों के विकास हेतु उपयोग किये जा सकते हैं। जीन क्रियान्वयन के अध्ययन से यह प्रदर्शित होता है कि सभी लक्षणों में प्रभाविता का गुण पाया गया।

Introduction

Okra is one of the most important vegetable in the tropical and subtropical parts of the world. A line x tester mating design as given by (Kampthrone, 1957) provides information about general and specific combining abilities of parents and at the same time it is helpful in estimating various types of gene effects, hence keeping the importance of this design, the present investigation was carried out to know the extent of heterosis, combining abilities and nature of gene action which may be useful in selection of parents for hybridization, cross combinations for advancement and also in choosing the appropriate breeding procedure for improvement of yield and quality of Okra.

Materials and Methods

Ten genetically diverse parents were crossed in line x tester crossing programme involving six as lines (VRO-5, VRO-6, HRB-9-2, Pusa Sawani, Prabhani Kranti (PK) and HRB-55) and four as testers (Arka Anamika, Arka Abhey, IIVR-11 and P-7) in 2007-08 at experimental area of Indian Institute of Vegetable Research, Varanasi. Twenty four F_1s along with their parents were raised in randomized block design having three replications during 2008-09. Each treatment was sown in six meter long double rows keeping 60 cm distance between rows and 30 cm between plants. Data were recorded on fifteen randomly competitive plants in each replication in parent and F_1s. Observations were recorded on plant height (cm), number of primary branches/plant, internodal length (cm), days to first flowering, first flowering node, fruit length (cm), fruit diameter (cm), average fruit weight (g), number of fruits/plant and fruit yield/plant (g). The mean data was further subjected for statistical analysis for estimating extent of heterosis over better parent (BP), combining abilities and gene action (Kempthrone, 1957).

Results and Discussion

Data on heterosis for yield and contributing traits are presented in Table 1. For plant height, the cross combinations *viz* VRO-5 x A. Anamika (100.52%), VRO-5 x IIVR-11 (90.67%) and VRO-5x A. Abhey (87.05%) exhibited high and positive heterosis over better parents. As regard number of primary branches, the positive and high heterosis over better parent was in VRO-6 x IIVR-11 (31.25 %), HRB-9-2 x P-7 (24.72 %) and Pusa Sawani x P-7 (24.44%). These results are in conformity with the findings of Elangovan *et al*. (1981) who also reported heterosis more than 30% for this trait. For first flowering node, days to first flowering and internodal length, lower values of negative heterosis was considered to be better. In the present investigation for internodal length, the cross combinations VRO-5 x A. Anamika (-41.51%), VRO-5 x A. Abhey (-40.76%) and VRO-5 x IIVR-11 (-36%) exhibited negative and high heterosis. For days to first flowering the negative and significant heterosis was recorded from crosses VRO-6 x A. Anamika (-10.26%) and Pusa Sawami x Arka Anamika (-9.52%). Ravishankar *et al*. (2002) also reported maximum standard heterosis for plant height, days to flowering and internodal length. The cross combinations VRO-5 x P-7, HRB-9-2 x A. Abhey and VRO-6 x A. Anamika exhibited high and negative heterosis over better parent for first flowering node.

High and positive heterosis was recorded form crosses Pusa Sawami x A. Anamika (42.05%), VRO-6 x A. Anamika (37.63%) and PK x IIVR-11 (27.47%) for fruit length while for fruit diameter the high and positive heterosis was exhibited by VRO-6 x IIVR-11 (41.18%), VRO-6 x A. Anamika (26.32%) and HRB-9-2 x P-7 (23.53%). Pawar *et al*. (1999) observed moderate heterosis for fruit length and diameter.

For number of fruits per plant the highest positive heterosis for better parent was recorded from the cross combinations HRB-55 x P-7 (41.11%) followed by Pusa Sawani x A. Anamika (34.62%) and HRB-9-2 x P-7(33.33%). The crosses Pusa Sawani x IIVR-11, Pusa Sawani x P-7 and Pusa Sawani x A. Abhey exhibited high and positive heterosis for average fruit weight. The high and positive heterosis for fruit yield/plant was observed in cross combinations Pusa Sawani x A. Anamika (77.6%), HRB -9-2 x P-7(74.81%) and HRB-55 x A. Anamika (70.12%). The observed high heterosis for fruit yield may be due to genetic diversity

Table 1. Heterosis over better parent and their specific combing ability.

Characters	Three better crosses	Heterosis over better parent (%)	Specific combining ability (SCA)	Best three general combiner
Plant height (cm)	VRO-5 x A. Anamika	100.52**	4.39	Parbhani Kranti
	VRO-5 x IIVR-11	90.67**	3.06	Arka Anamika
	VRO-5 x A. Abhey	87.05**	2.17	VRO-6
Number of primary branches	VRO-6 x IIVR-11	31.25	0.24**	VRO-5
	HRB-9-2 x P-7	24.72	0.08	Arka Abhey
	Pusa Sawani x P-7	24.44	-0.01	Arka Anamika
Internodal length (cm)	VRO-5 x A. Anamika	-41.51**	0.23**	VRO-5
	VRO-5 x A. Abhey	-40.76**	0.16	IIVR-11
	VRO-5 x IIVR-11	-36.0**	-0.28**	Arka Anamika
Days to first flowering	VRO-6 x A. Anamika	-10.26**	-2.92**	IIVR-11
	Pusa Sawani x A.Anamika	-9.52**	-2.51**	VRO-6
				VRO-5
First Flowering node	VRO-5 x P-7	-28.33	-0.4	IIVR-11
	HRB-9-2 x A.Abhey	-16.67	-0.95*	HRB-9-2
	VRO-6 x A.Anamika	-12.35	-2.92**	VRO-5
Fruit length (cm)	Pusa Sawani x A.Anamika	42.05**	0.96**	IIVR-11
	VRO-6 x A.Anamika	37.63**	1.88**	Parbhani Kranti
	PK x IIVR-11	27.47**	0.39**	VRO-6
Fruit diameter (cm)	VRO-6 x IIVR-11	41.18**	0.16**	VRO-5
	VRO-6 x A.Anamika	26.32**	0.11*	Parbhani Kranti
	HRB-9-2 x P-7	23.53**	0.04	VRO-6
Number of fruits/plant	HRB-55 x P-7	41.11**	0.33	VRO-6
	Pusa Sawani x A.Anamika	34.62**	2.92**	IIVR-11
	HRB-9-2 x P-7	33.33**	1.98**	HRB-9-2
Average fruit weight (g)	Pusa Sawani x IIVR-11	34.5**	0.06	VRO-6
	Pusa Sawani x P-7	34.36**	-0.01	HRB-55
	Pusa Sawani x A. Abhey	34.11**	0.04	VRO-5
Fruit yield/plant (g)	Pusa Sawani x A. Anamika	77.6**	35.33**	VRO-6
	HRB-9-2 x P-7	74.81**	31.27**	IIVR-11
	HRB-55 x A.Anamika	70.12**	30.71**	HRB-9-2

*Significant at 5%, **significant at 1%

Table 2. Estimate of GCA and SCA variances and A (additive) and D (dominance) component of genetic variance in okra

Parameters	Days to first flowering	First flowering node	Plant height (cm)	Internodal length (cm)	Number of primary branches/ plant	Number of fruits/ plant	Single fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield/ plant (g)
σ^2 GCA for male	6.97	0.06	0.53	0.05	0.0	4.84	-0.02	1.41	0.0	715.46
σ^2 GCA for female	1.98	0.1	37.24	1.62	0.14	17.63	0.01	4.04	0.03	2545.14
σ^2 SCA	21.73	1.07	54.66	2.48	2.34	33.50	1.02	13.2	0.06	3678.60
σ^2 A	9.95	0.15	30.43	1.36	0.12	19.88	-0.01	4.92	0.02	2894.66
σ^2 D	11.73	0.27	44.66	2.14	1.02	23.17	0.13	11.1	0.04	3473.58

of the parents used in hybrid combinations, increase and average fruit weight and number of fruits/plant. Singh and Sood (1999) and Pitchaimuthu and Dutta (2002) observed high and positive heterosis for fruit yield.

General combining ability studies indicating that VRO-6, VRO-5 and IIVR-11 were good combiners for yield and contributing characters (Table 1). The present study showed that the parents who were the best combiner for high yield, exhibited the best combiner for more number of fruits/plant or fruit length or diameter. This suggests that parent showing high sca and yield may be due to their high gca for fruit length or fruit diameter. Yadav *et al*. (2002) and Vishwakarma *et al*. (2002) were also reported high gca for fruit yield due to high gca for number of fruits/plant.

Specific combining ability studies (Table 1) also revealed that the cross combinations Pusa Sawani x A. Anamika, HRB-9-2 x P-7 and HRB-55 x A. Anamika had high positive sca effect as well as high degree of heterosis for fruit yield/plant while the best crosses VRO-5 x A. Anamika, VRO-5 x IIVR-11, VRO-5 x A. Abhey, VRO-6 x IIVR-11, HRB-9-2 x P-7, Pusa Sawani x P-7, HRB-55 x P-7, Pusa Sawani x A.Anamika, HRB-9-2 x P-7, Pusa Sawani x IIVR-11, Pusa Sawani x A. Abhey, VRO-5 x P-7, HRB-9-2 x A.Abhey, VRO-6 x A. Anamika for plant height, number of primary branches, internodal length, days to first flowering, first flowering node, fruit length, fruit diameter, average fruit weight and number of fruits/ plant.

Data presented in Table 2 revealed that plant height, number of primary branches, internodal length, days to first flowering, first flowering node, fruit length, fruit diameter, average fruit weight and number of fruits/ plant and fruit yield/plant showed non-additive gene action as estimated dominance variance (ó^2 D) was higher than that of additive variance (ó^2 A). In the present finding involvement of non-additive (dominance) gene action seems to be more important for expression of these traits. Similar results were reported by Weerasekara *et al*. (2008) and Singh *et al*. (2009).

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