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Heterosis, Inbreeding Depression and Residual Heterosis Study in F_2 and F_3 Segregating Generations of Okra (*Abelmoschus esculentus* (L.) *moench*)

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A B S T R A C T

The present investigation was carried out to the heterosis, inbreeding depression and residual heterosis for yield and yield attributing traits in segregating generations of okra (*Abelmoschus esculentus* L.). An experimental material comprised F_2 and F_3 segregation generation, two parents, F_1 and one standard check (Parbhani kranti) were evaluated in a randomized block design with three replications during *kharif* 2017. The perusal of data revealed that the characters for days to first flowering, plant height, internodal length and fruit weight in this cross show significant heterosis in desirable direction over standard check. For traits plant height, internodal length, number of branches per plant, fruit diameter and fruit weight positively high significant heterosis over better parent. Residual heterobeltiosis for the F_3 generation the traits plant height, number of nodes per plant and length of fruit negatively and fruit diameter positively significant over better parent. Whereas days to first flowering, plant height, number of nodes per plant and length of fruit negatively significant over check Parbhani kranti. The inbreeding depression in F_2 generation was highest significant for the character plant height, number of branches per plant, number of nodes per plant and fruit yield per plant. Whereas, F_3 generation number of branches per plant show high and negatively significant.

Introduction

Okra (*Abelmoschus esculentus* L.) belonging to the family Malvaceae is an important vegetable crop in India. The major problem in okra cultivation is lack of high yielding varieties along with location specific pest and disease tolerant hybrids of the various approaches to overcome this problem, exploitation of heterosis is considered as one of the desirable and sustainable approach. The heterosis reveals the type of gene action involved and it helps in the selection of suitable breeding methodology and parameters, which are employed for crop improvement programme.

Heterosis resulting from crosses between strains or between different races or varieties is theoretically known as the reverse of inbreeding depression, and forms an important means of genetic improvements (Falconer, 1989). The required goal of increasing productivity in the quickest possible time can be achieved only through heterosis breeding, which is feasible in this crop. The scope for utilization of heterosis largely depends on the direction and magnitude of heterosis. However, from the practical point of view, standard heterosis is the most important of the three types of heterosis because it is aimed at developing desirable hybrids superior to the existing high yielding commercial varieties (Chaudhary, 1984). Heterosis breeding is an important genetic tool that can facilitate yield enhancement from 30 to 40% and helps enrich many other desirable quantitative and qualitative traits in crops. Through heterosis breeding, it is often possible to combine desired alleles in regular fashion without waiting for longer term as in case of development of open pollinated cultivars.

Materials and Methods

The experiment was conducted in randomized block design with a three replication during *kharif*, 2017 at experimental farm, department of agricultural botany, college of agriculture, Latur. The material comprised of five generations *viz*., P_1, P_2, F_1, F_2, and F_3 of the cross Arka bahar x IC 31032A and check Parbhani kranti were used to study the heterosis and inbreeding depression for ten characters. The experimental material was developed by crossing two genetic diverse genotype viz. Arka Bahar and IC31032A. The F_1's and parents were grown in summer, 2016 to advance the F_2 generation and F_2 was grown and selfed during *Kharif*, 2016 to advance F_3 generation. Thus seed of five generation, P_1, P_2, F_1, F_2 and F_3 were evaluated. The ten observations *viz*., days of first flowering, plant height (cm), intermodal length (cm), number of branches per plant, number of nodes per plant, fruit length (cm), fruit weight (g), fruit diameter (mm), number of fruits per plant fruit yield per plant (g) were recorded on randomly selected uniform five plants in P_1, P_2, F_1 and Parbhani kranti and each plant in F_2 and F_3 generation in each replication.

The mean of F_1 hybrids over replication were utilized for the estimation of heterosis. The magnitude to heterosis was calculated and presented as per Fonesca and Patterson (1968). The residual heterosis and inbreeding depression was worked out in F_2 and F_3 generation as per the formula given below:

Residual heterosis in F_2 : $$\frac{\overline{F_2} - \overline{SC}}{\overline{SC}} \times 100$$

Residual heterosis in F_3 : $$\frac{\overline{F_3} - \overline{SC}}{\overline{SC}} \times 100$$

Inbreeding depression in F_2 : $$\frac{\overline{F_1} - \overline{F_2}}{\overline{F_1}} \times 100$$

Inbreeding depression in F_3 : $$\frac{\overline{F_2} - \overline{F_3}}{\overline{F_2}} \times 100$$

Where,

$\overline{F_1}$ = mean of the F_1 generation, $\overline{F_2}$ = mean of the F_2 generation, $\overline{F_3}$ = mean of the F_3 generation, SC = standard check mean.

Results and Discussion

The highly significant differences were detected between the different generation means i.e. P_1, P_2, F_1, F_2 and F_3 for one cross of okra. Indicated these economic characters under study were genetically controlled. These results are in harmony with those previously obtained by Goswami (2014), Mehta *et al.*, (2006), Singh *et al.*, (2017).

Mean performance was a realized value can be employed for selecting superior plant, parents and hybrids. The mean performance of the Arka Bahar × IC31032A cross revealed the superiority of Arka Bahar for internodal length, number of nodes per plant and length of fruit, whereas IC31032A for fruit diameter, F_1 for plant height and number of branches per plant, F_2 for early flowering, and fruit weight.

Heterobeltiosis studied for this cross was ranged from -16.01 % (length of fruit) to 39.87 % (internodal length). The perusal of data revealed that the range of standard heterosis was -11.53 (length of fruit) to 24.44 per cent (internodal length). The characters for days to first flowering, plant height, internodal length and fruit weight in this cross show significant heterosis in desirable direction over standard check (Parbhani kranti). For plant height, internodal length, number of branches per plant, fruit diameter and fruit weight positively high significant heterosis over better parent. Similar result reported by Sabesan *et al.*, (2016), Tonde *et al.*, (2016), Mahajan *et al.*,(2017), Aware *et al.*,(2014), Paul *et al.*,(2017), Bhatt *et al.*,(2015), Patel and Patel (2016), Tiwari *et al.*,(2015) (Table 1).

Table.1 Heterosis and inbreeding depression for yield and yield component traits in cross Arka Bahar x IC31032A

Character	Heterosis (%) (F_1)		Residual heterosis (%)				Inbreeding depression (%)	
	BP	SH	F_2		F_3		F_2	F_3
			BP	SH	BP	SH		
Days to first flowering	-0.84	-5.75**	-3.05	-7.85**	-2.47	-7.30**	2.23	-0.60
Plant height (cm)	10.92**	17.22**	-10.29	-5.19	-17.87**	-13.20*	19.12**	8.45
Internodal length (cm)	39.87**	24.449*	34.54**	19.69	20.25	6.98	3.82	10.65
No. of branches	30.72**	11.11	-7.19	-21.11**	16.34*	-1.11	29**	-25.35*
No. of nodes per plant	-3.64	8.89	-17.82**	-7.14	-24.14**	-14.28**	14.72**	7.69
Length of fruit (cm)	-16.01*	-11.53	-31.51**	-27.85**	-31.85**	-28.22**	18.45*	0.50
Fruit diameter (mm)	19.41**	-2.73	23.90**	0.93	27.18**	3.60	-3.76	-2.65
No. of fruit per plant	-12.42*	-8.56	-6.29	-2.16	-8.11	-4.06	-6.99	1.94
Fruit weight (g)	13.33*	14.25*	15.82*	16.76*	10.27	11.17	-2.2	4.78
Fruit Yield per plant (g)	4.21	9.98	-11.00	-6.06	-15.19*	-10.49	14.59*	4.72

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

Inbreeding depression among the characters was ranged from -6.99% (no. of fruit per plant) to 19.12% (plant height) in F_2 and -25.35 (no. of branches) to 10.65 (internodal length) in F_3. Generation F_2 was high significant for the character plant height, number of branches per plant, number of nodes per plant and fruit yield per plant.

Whereas in F_3 population number of branches per plant show highly negatively significant inbreeding depression. Similar results reported by Sabesan *et al.*, (2016), Aware *et al.*,(2014), Mahajan *et al.*, (2017), Khanorkar and Kathiria (2010), Neetu (2015). Residual heterobeltiosis for the characters studied for the fruit diameter 23.90% and 27.18% in F_2 and F_3 populations respectively identified positive and high significant. For the F_3 population plant height, number of nodes per plant and length of fruit negatively and fruit diameter positively significant over better parent.

Whereas days to first flowering, plant height, number of nodes per plant and length of fruit negatively significant over check Parbhani kranti. Similar results reported by Reddy *et* *al.*, (2013), Tonde *et al.*, (2016), Sabesan *et al.*, (2016).

The results of heterosis were indicated for almost all characters under study. However, the direction and magnitude of heterosis over two bases varied with characters. On an average, okra displayed heterosis for yield and its component traits studied. Yield components should be considered to increase the yield through selections. In the present study maximum inbreeding depression recorded in F_2 than F_3 generations. Highest and significant heterosis observed in desirable direction for the characters plant height, number of branches per plant and fruit diameter and residual heterosis for the character length of fruit in both generation.

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