RESEARCH PAPER | Asian Journal of Bio Science, Volume 7 | Issue 2 | October, 2012 | 163-168
Received : 05.04.2012; **Revised :** 08.07.2012; **Accepted :** 18.07.2012

Heterosis and inbreeding depression in relation to other genetic parameters in egg plant

KAILASH RAM[1] AND P. SINGH[2]

[1]Government Degree College, Jakhini, VARANASI (U.P.) INDIA
[2]Department of Genetics and Plant Breeding, C.S. Azad University of Agriculture and Technology, KANPUR (U.P.) INDIA
Email : drprm12@rediff.com

Heterosis and inbreeding depression with other genetic parameters were studied with the 60 hybrids involving 15 female lines and 4 male testers evaluated for ten characters in a Randomized Block Design with three replications at Kanpur. Maximum positive heterosis (69.23 per cent) was recorded over economic parent (Type 3), whereas inbreeding depression has score 32.39 per cent. None of the crosses exhibited significant heterosis for most of the characters. However, on the basis of fruit yield per plant supported by other significant traits, crosses KS 233 x T 3, KS 263 x AB 1, ACC 2623 x T 3, ACC 820 6 x T 3, ACC 8204 x T 3, KS 247 x T3 and KS 227 x AB 1 for days to flowering, days to marketable maturity, plant height (only for KS 233 x T 3), number of branches per plant, number of fruits per plant, width of fruit (only for KS 263 x AB 1), fruit weight (except KS 247 x T 3 and KS 227 x AB 1) and plant spread exhibited maximum heterotic effects alongwith inbreeding depression. All the 60 crosses exhibited additive gene action except KS 247 x DBR 8 and KS 227 x ABR 8 for plant height, ACC 2623 x KS 224 and ACC 2623 x DBR 8 for width of fruit, ACC 8206 x T 3 for fruit weight and KS 250 x AB 1 for yield per plant which showed non-additive gene effects in relation to heterosis and inbreeding depression. High heritability coupled with high genetic advance was recorded by days to flowering, days to marketable maturity, plant height and fruit weight. Rest of the characters showed high heritability with medium or low genetic advance.

Key words : Egg plant, Heterosis, Inbreeding depression, sca effects, Degree of dominance, Heritability, Genetic advance

How to cite this paper : Ram, Kailash and Singh, P. (2012). Heterosis and inbreeding depression in relation to other genetic parameters in egg plant. *Asian J. Bio. Sci.*, **7** (2) : 163-168.

INTRODUCTION

The feasibility of utilizing hybrid vigour in egg plant depends on magnitude of per cent superiority of hybrids over economic parent/variety and hybrid seed production at cheaper rate for commercial cultivation. Efforts are underway for commercial exploitation of heterosis in egg plant using natural out-crossing coupled with discovery of stable male sterility system, and the development of technology for hybrid seed production. The heterotic effect is largely dependent on diverse parents with high degree of specific combining ability (sca) as well as good general combining ability (gca). The magnitude of heterosis particularly for yield is of paramount importance and if the heterosis is practically and economically feasible it can help to achieve high yield levels and thereby high productivity in egg plant. Studies on other genetic parameters and *per se* performance in relation to heterosis would also supplement in achieving the desired goal. A knowledge of expression and flexibility of most important characters is, therefore, essential in this respect.

RESEARCH METHODOLOGY

The materials consisted of 15 female lines (KS 219, KS 247, KS 253, KS 262, KS 228, KS 233, KS 250, KS 263, KS 235, KS 227, ACC 5114, ACC 8204, ACC 8206, ACC 8207 and ACC 2623) and 4 mole testers (T 3, AB 1, KS 224 and DBR 8) and their possible 60 F_1 cross combinations. These were grown in Randomized Block Design with three replications at Vegetable Research Station, Kalyanpur, C.S. Azad University of Agriculture and Technology, Kanpur during *Kharif*, 2003-2004. Each entry was grown in 3 m long row at 60cm x 60 cm inter and intra-row spacing. Observations were recorded from five plants from each parents and F_1s and 10 competitive plants in F_2s selected randomly from each replications for days to flowering, days to marketable maturity, plant height (cm) number of branches per plant, number of fruits per plant, length of fruit (cm), width of fruit (cm), fruit weight (g), plant spread (m^2) and yield per plant (kg). Heterosis was calculated over economic parent against check variety (Type 3). The data were also subjected to estimate the genetic advance using the formula suggested of Robinson *et al*. (1949), gene action, average degree of dominance and heritability were calculated according to method suggested by Kempthorne and Curnow (1961).

RESEARCH FINDINGS AND ANALYSIS

Analysis of variance of mean squares for different traits revealed highly significant differences among genotypes, parents and crosses indicating much variability among them. Variances due to parents *vs* hybrids and hybrids *vs* F_2s also differed significantly for all the character except for number of branches per plant and days to marketable maturity, respectively, which indicated significant heterosis in hybrids and inbreeding depression in segregating population.

The crosses with significant desirable economic heterosis and inbreeding depression with sca effects are presented in Table 1. The maximum heterosis over economic parent alongwith high sca effects was observed for number of fruits per plant (103.39 per cent) followed by fruit yield per plant (69.23 per cent). A large number of crosses manifested high heterosis for number of fruits per plant and fruit yield per plant. Crosses KS 235 x T 3 and ACC 8204 x T 3 for number of branches per plant and KS 227 x AB 1 and KS 233 x T 3 for number of fruits per plant and KS 219 x T3, KS 219 x AB 1 and KS 233 x T 3 for fruit yield per plant showed significantly higher heterotic values alongwith high sca effects. Out of these crosses, only KS 219 x T 3 and KS 233 x T 3 for number of fruits per plant and KS 219 x T 3, KS 219 x AB 1 and KS 233 x T 3 for fruit yield per plant exhibited significant inbreeding depression in F_2 generation. High heterosis with significantly positive inbreeding depression and high sca effects was recorded in KS 235 x T 3 and ACC 8204 x T 3 for number of branches per plant and KS 219 x T 3 and KS 233 x T 3 for number of fruits per plant and KS 233 x T 3 and KS 219 x AB 1 for fruit yield per plant, whereas number of branches per plant, number of fruits per plant and yield per plant exhibited also high heritability with over dominance and non-additive gene effect due to dominance and epistasis). These comparative results are indicated to additive gene action, and heterosis breeding may be feasible use for development of improved varieties. High magnitude of hybrid vigour have also been reported by Babu and Thirumurugan (2001) and Das and Barua (2001) in egg plant.

The results have been discussed in the light of recent concept of genetic basis of yield. Whitehouse *et al*. (1958) and Grafius (1959) have suggested that there may not be any gene system for yield *per se* which is largely an artifact. Several worker (Grafius, 1959; Durate and Adams, 1963; Coyne, 1965) have reported that genetic basis of heterosis for a complex character like yield can be explained by multiplicative interaction on the phenotypic level of components of the trait. Hagberg (1952) also suggested that increase in yield in F_1 hybrid was resulted due to increase in yield components. This would mean that the heterosis for yield should reflect through the heterosis in the individual yield components.

While considering the heterosis with related genetic parameters for fruit yield over economic parent (Table 2), it was noted that increase in fruit yield of KS 219 x T 3, KS 247 x T 3, KS 263 x AB 1, KS 227 x AB 1, ACC 2623 x T 3, ACC 8206 x T 3 and ACC 8204 x T 3 was due to number of branches per plant and number of fruits per plant, whereas in crosses KS 233 x T 3 , KS 263 x AB 1, ACC 8206 x T 3 and ACC 8204 x T 3 was due to fruit weight. These hybrids have also superiority for early flowering, early marketable maturity and dwarf plant type. Heterosis in desirable direction with positive inbreeding depression was recorded in KS 233 x T 3, KS 263 x AB 1, KS 227 x AB 1, ACC 2626 x T 3 and KS 262 x DBR 8 for number of fruits per plant, whereas KS 263 x AB 1, ACC 2623 x T 3 and ACC 8204 x T 3 were recorded for number of branches per plant, indicating the change of getting more number of fruits/branches per plant, which have more beneficial for enhancing the fruit yield in the F_1 generations in comparison to F_2 population. Biswas (1964) reported that crosses of with high x low yielding varieties/genotypes gave the most productive hybrids, while low x low combinations yielded slightly more than hybrids between the yielding parents.

Comparative evaluation of the results through other genetic parameters (Table 1) further revealed that the important role in the inheritance of days to flowering, days to marketable maturity, number of branches per plant and yield per plant had shown the preponderance of non-additive gene action with over dominance and high heritability in both generation. These results are in accordance with those reported by Das and Barua (2001). The presence of predominantly large amount of non-additive gene action due to dominance or epistasis (additive x dominance and dominance x dominance) would necessitate the maintenance of heterozygosity in the population. These type of gene action are non-fixable. Therefore, one should emphasize the development of hybrids in this crop. Breeding methods such as biparental mating followed by recurrent selection may be another strategy to hasten the rate of genetic improvement for these characters.

In the present study, heritability was high for all the characters in both the generations except length of fruit and width of fruit showed medium or low heritability in F_2 generations, indicating that these characters were largely influenced by additive gene action. High heritability coupled with high genetic advance was exherted by days to flowering, days to marketable maturity, plant height and fruit weight and thus these fruits are under the control of additive gene action and improved through simple selection. These findings were also reported by Patil *et al*. (1999) and Singh and Gopalakrishnan (1999).

Table 1: Estimates of heterosis and inbreeding depression (in percentage) with related genetic parameters in egg plant

Characters	Cross	F_1	F_2			Inbreeding depression	
D F (sig)	KS 253 x KS 224	43.00	50.67	KS 253 x KS 224	36.14**	KS 253 x KS 224	17.84**
	KS 228 x KS 224	48.67	47.33	KS 247 x DBR 8	32.67**	KS 263 x DBR 8	16.77**
	ACC 2623 x KS 224	48.67	48.67	KS 247 x KS 224	27.71**	KS 263 x KS 224	15.12**
D M M (sig)	KS 247 x AB 1	61.67	65.67	KS 247 x AB 1	29.38**	KS 263 x KS 224	15.36**
	KS 247 x DBR 8	61.67	69.00	KS 247 x DBR 8	29.38**	KS 235 x KS 224	13.60**
	KS 253 x KS 224	62.00	68.00	KS 253 x KS 224	29.00**	KS 247 x DBR 8	11.89**
P H (sig)	KS 262 x 113	62.53	61.53	KS 262 x 113	18.51**	KS 227 x DBR 8	10.76**
	KS 219 x 113	62.87	59.40	KS 219 x 113	18.06**	KS 247 x DBR 8	10.56**
	KS 247 x KS 224	64.13	64.10	KS 247 x KS 224	16.42**	KS 235 x AB 1	NS
B/P (sig)	KS 247 x 113	11.87	9.47	KS 247 x 113	37.89**	KS 263 x AB1	28.24**
	ACC 8204 x 113	11.73	8.73	KS 235 x 113	33.30**	KS 227 x KS 224	27.32**
	KS 235 x 113	11.73	8.60	ACC 8204 x 113	33.30**	KS 235 x 113	26.68**
F/P	KS 227 x AB 1	33.60	27.95	KS 227 x AB 1	103.39**	ACC 2623 x 113	25.06**
	KS 233 x 113	30.61	23.04	KS 233 x 113	85.29**	KS 262 x DBR 8	24.80**
	KS 228 x AB 1	29.43	25.80	KS 219 x 113	81.84**	KS 233 x 113	24.73**
L F (sig)	KS 262 x AB 1	7.68	9.17	KS 262 x AB 1	NS	KS 263 x AB 1	NS
	KS 233 x DBR 8	7.87	8.87	KS 233 x DBR 8	NS	KS 250 x 113	NS
	KS 262 x DBR 8	8.31	8.60	KS 262 x DBR 8	NS	KS 263 x 113	NS
W F (sig)	ACC 2623 x DBR 8	6.38	8.70	KS 233 x DBR 8	23.23**	ACC 2623 x KS 224	33.46**
	KS 233 x DBR 8	6.62	7.99	ACC 8207 x AB 1	20.51**	ACC 2623 x DBR 8	33.36**
	ACC 8207 x AB 1	6.86	8.35	ACC 2623 x DBR 8	20.07**	KS 227 x 113	NS
F W	ACC 8204 x 113	125.00	113.93	ACC 2623 x DBR 8	17.93**	ACC 8204 x 113	8.86**
	KS 263 x AB 1	124.40	115.53	ACC 8204 x 113	10.23*	ACC 8204 x KS 224	8.53**
	KS 219 x AB 1	123.40	113.73	ACC 8204 x AB 1	9.76*	ACC 8206 x 113	8.41**
P S (sig)	KS 263 x AB 1	0.43	0.39	KS 235 x AB 1	50.00**	KS 262 x 113	NS
	KS 262 x AB 1	0.45	0.46	KS 235 x KS 234	46.88**	KS 262 x AB 1	NS
	KS 262 x KS 224	0.45	0.46	KS 253 x KS 224	43.75**		
Y/P	KS 219 x 113	3.30	2.28	KS 219 x 113	69.23**	KS 250 x AB 1	32.39**
	KS 219 x AB 1	3.29	2.42	KS 219 x AB 1	68.72**	KS 235 x 113	32.05**
	KS 233 x 113	3.24	2.26	KS 233 x 113	66.15**	ACC 2623 x 113	31.95**

Contd... Table 1

Table 1... ...Contd

Cross	Sca effect		Gene action		Degree of dominance		Heritability (%)		Genetic advance (%) of mean	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
ACC 5114 x AB 1	4.02*	3.59*	Non add.	Non add.	OD	OD	H	H	H	H
KS 250 x 113	3.66*	3.83*								
ACC 2623 x DBR 8	3.61*	NS								
ACC 2623 x KS 224	7.46**	7.12**	Non add.	Non add.	OD	OD	H	H	H	H
ACC 5114 x AB 1	3.37*	5.12**								
KS 233 x 113	4.11**	NS								
ACC 8204 x AB 1	12.19**	8.00**	Non add.	Add.	OD	PD	H	H	H	H
ACC 2623 x 113	9.82**	5.45**								
KS 219 x 113	7.69**	5.08**								
ACC 2623 x AB 1	2.64**	NS	Non add.	Non add.	OD	OD	H	H	L	L
KS 227 x AB 1	2.37**	1.67*								
KS 219 x AB 1	1.69*	1.49*								
KS 227 x AB 1	10.60**	6.50**	Non add.	Non add.	OD	OD	H	H	M	M
ACC 8206 x 113	7.11**	4.73**								
KS 228 x AB 1	6.18**	4.40**								
KS 263 x 113	1.71**	NS	Non add.	Add.	OD	PD	H	M	L	L
ACC 5114 x KS 224	1.29**	NS								
ACC 8207 x 113	1.17**	NS								
KS 263 x 113	1.83**	NS	Non add.	Add.	OD	PD	H	L	L	L
KS 227 x 113	1.16**	NS								
KS 250 x 113	1.07*	NS								
KS 263 x AB 1	10.50**	NS	Non add.	Non add.	PD	PD	H	H	H	H
KS 219 x AB 1	9.96**	NS								
ACC 8204 x 113	7.56*	NS								
KS 263 x AB 1	0.06**	NS	Non add.	Non add.	PD	PD	H	H	L	L
KS 247 x 113	0.07**	0.09**								
KS 227 x AB 1	0.08**	NS								
KS 219 x AB 1	0.67**	0.41**	Non add.	Non add.	OD	OD	H	H	L	L
KS 263 x AB 1	0.61**	0.29**								
KS 228 x AB 1	0.59**	0.26**								

sig = Negative significant; *, ** indicate significant of values at P=0.05 and P=0.01, respectively; OD- Over dominance; PD = Partial dominance; H- High; M = Medium; L = Low

Table 2: Top nine superior heterotic crosses for yield per plant in relation to other genetic parameters for different traits

Superior heterotic crosses with Y/P		ID	gca of parents P1	gca of parents P2	sca effects F1	sca effects F2	*Per se* performance F1	*Per se* performance F2	Heterosis and inbreeding depression (ID) for their related traits
KS 233 x T3	(66.15**)	30.25**	0.09	0.43**	0.56**	0.18**	3.24	2.26	DF (15.34**, N.S.); DMM (13.35**, N.S.); PH (15.29**, N.S.); B/P (27.27*, N.S.); F/P (85.29**, 24.73**); FW (8.33*, N.S.); PS (28.13**, N.S.)
KS 247 x T3	(56.41**)	16.72**	0.15**	0.43**	0.31**	0.31**	3.05	2.54	DF (17.32**, N.S.); DMM (16.41**, N.S.); B/P (34.89**, N.S.); F/P (72.34**, N.S.); PS (30.21**, 17.91**)
KS 263 x AB 1	(54.36**)	24.25**	0.21**	0.04	0.61**	0.29**	3.01	2.28	DF (15.83**, N.S.); DMM (14.12**, 7.11*); B/P (28.75*, 28.24**); F/P (76.15**,17.22**), FW(9.70*,7.13**); PS (55.21**, N.S.)
KS 227 x AB 1	(49.23**)	22.68**	0.20**	0.04	0.51**	0.27**	2.91	2.25	DF (20.79**, N.S.); DMM (14.89**,N.S.); B/P (27.27*, N.S.); F/P (10.39**,16.82**); PS (53.13**, N.S.)
ACC 2623 x T3	(36.41**)	31.95**	0.30**	0.43**	0.37**	0.05	2.66	1.81	DF (8.91**,9.78**); DMM (6.48**,5.72*); B/P (25.80**, 25.29**); F/P (47.82**,25.06**); FW (8.82**,5.41**); PS (17.71**, N.S.)
ACC 8206 x T3	(31.28**)	14.06*	0.24**	0.43**	0.21**	0.28**	2.56	2.20	DF (9.40**,7.66*); DMM (5.34*,7.46); B/P (31.82*, N.S.); F/P (73.49**, N.S.); FW (8.29*,8.41**); PS (11.46**, N.S.)
KS 235 x KS 224	(27.67**)	18.88**	0.25**	0.25**	0.32**	0.24**	2.49	2.02	DF (23.26**, N.S.); DMM (27.09*, 13.60**); PH (11.73**, N.S.); F/P (32.51*, N.S.); PS (46.88**,17.65*)
ACC 8204 x T3	(26.63**)	11.74*	0.28**	0.43**	0.16	0.39**	2.47	2.18	DF (9.40*,10.38**); DMM (5.73*,6.07*); B/P (33.30**,25.58**), F/P (56.60**, N.S.); FW (10.23*,8.86*); PS (16.67**, N.S.)
KS 262 x DBR 8	(17.44**)	20.09*	0.10*	0.21**	0.45**	0.16*	2.29	1.83	DF (13.37**, N.S.); DMM (11.45**,9.05**); PH (11.29**, N.S.); F/P (55.15**, 24.80**); PS (51.04**, N.S.)

ID Inbreeding depression; NS Negative non significant; NS Positive non significant; DF Days to flowering; DMM Days to marketable maturity; PH Plant height; B/P Number of branches per plant; F/P Number of fruits per plant; LF Length of fruit; WF Width of fruit; FW Fruit weight; PS Plant spread; Y/P Yield per plant.

LITERATURE CITED

Babu, S. and Thirumurugan, J. (2001). Studies on heterotic effect in brinjal (*Solanum melongena* L.). *J. Ecotoxicol. & Environ. Monitoring*, **11** : 259-262.

Biswas, C.K. (1964). Heterosis and combining ability in brinjal (*Solanum melongena* L.) in West Pakistan. Post Graduate Research Ayub Agriculture Research Institute. *A. restrospect*, pp. 300-302.

Coyne, D.P. (1965). Component interaction in relation to heterosis for plant height in *Phaseolus vulgaris* L. Variety crosses. *Crop Sci*., **5** : 17-18.

Durate, R. and Adoms, H.W. (1963). Component interaction in relation to expression of complex trait in a field bean cross. *Crop Sci*., **3** : 185-186.

Das, G. and Barua, N.S. (2001). Heterosis and combining ability for yield and its components in brinjal. *Annals agric. Res*., **22** : 299-403.

Grafius, J.E. (1959). Heterosis in barley. *Agron. J*., **51** : 551-154.

Hagberg, A. (1952). Heterosis in F_1 combinations in Galiopsis. *Hereditas*, **38** : 33-82.

Kempthorne, O. and Curnow, R.N. (1961). The partial diallel cross. *Biometrics,* **17** : 229-250.

Patil, N.T., Bhalala, M.K., Kathiria, K.B. and Doshi, K.M. (1999). Genetic variability for yield and its components in brinjal (*Solanum melongena* L.). *Gujrat agric. Univ. Res. J.,* **25** : 77-80.

Robinson, H.F., Comstock, R.E. and Harvey, P.H. (1949). Estimates of heritability and the degree of dominance in corn. *Agron. J.,* **41** : 353-359.

Singh, P.K. and Gopalakrishnan, T.R. (1999). Variability and heritability estimates in brinjal. *South Indian J. Hort.,* **47**: 174-178.

Whitehouse, R.N.H., Thompson, J.V. and Reberio, D.V. (1958). Studies on the breeding of self-pollinated cereals. II. The use of diallel crosses analysis in yield production. *Euphytica,* **7** : 147-169.