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MAGNITUDE OF HETEROSIS FOR YIELD AND ITS CONTRIBUTING CHARACTERS IN BRINJAL (*SOLANUM MELONGENA* L.)

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ABSTRACT

The main objective of identifying the high yielding parents and F_1 hybrids through Line x Tester mating design to estimate the heterosis of 32 F_1 hybrids from eight lines and four testers during *rabi* 2014-15 at Regional Horticultural Research Station, NAU, Navsari (Gujarat). The genotypes differed significantly for most of the characters studied. The heterosis was recorded for yield and its component characters. As a result, seven F_1 hybrids, AB-7/2 x NSR-1, AB-8/14 x GJB-3, JBL-8/8 x NSR-1, JBL-8/8 x NSRP-1, JBR-12/6 x NSR-1, JBR-12/6 x Punjab Barsati and JBGR-6/8 x NSR-1 showed significant and desirable heterosis for fruit yield per plant over standard check. The results suggest a high degree of variability and heterosis in positive direction among the crosses.

INTRODUCTION

Nowadays, brinjal is most popular vegetable in India. Brinjal or egg plant (*Solanum melongena* L.) belonging to the family Solanaceae is one of the most important vegetable crops grown in India and other parts of the world. It is grown throughout the year under tropical and subtropical conditions and usually finds its place in common men's kitchen. Being a center of origin, Brinjal has a huge genetic divergence in our country which offers much scope for improvement through heterosis breeding. The effort could enhance its quality and productivity without sacrificing the consumers' choice. Exploitation of hybrid vigour has become a potential tool for improvement in eggplant. Nagai and Kada (1926) were the first to observe hybrid vigour in brinjal. The commercial exploitation of this phenomenon has been possible in the brinjal because of the low cost of F_1 seed production and the low seed requirement per unit area. With increasing popularity of F_1 hybrids in Brinjal, it is imperative to obtain such hybrids, having excellent quality coupled with high yields. In crop manifestation of heterotic effect for different economically important characters have been reported by many scientists (Naresh *et al*., 2013; Biswas *et al*., 2013 and Reddy and Patel, 2014). Brinjal being in the preliminary stage of breeding, information on good heterosis is lacking. Therefore, present investigation was carried out to estimate the magnitude of heterosis for yield and its contributing characters in brinjal.

MATERIALS AND METHODS

The present investigation was carried out at Vegetable Research Scheme, Regional Horticultural Research Station (R.H.R.S.), Navsari Agricultural University, Navsari during *rabi* 2014-15. The experimental material comprised of 12 parents which involves eight females, four males and their 32 F_1 hybrids along with one commercial check (Surati Ravaiya). The above materials were used for the experiment to study the heterosis. In each replication, parents and hybrids were planted in single row of 10 plants per entry and row length was kept 6.0 meters in Randomized Block Design with three replications. Row to row & plant to plant distance was 90 and 60 cm, respectively. The recommended agronomic practices and plant protection measures were adopted for raising a good crop. Observations were recorded on plant height (cm), number of branches per plant, days to 50 per cent flowering, number of flowers per inflorescence, fruit length (cm), fruit diameter (cm), fruit weight (g), fruit length : fruit diameter ratio, number of fruits per plant, fruit yield per plant (kg), phenol content (mg / 100 g fresh weight) and total sugar (%). The data was subjected to line x tester analysis suggested by Kempthorne (1957). The magnitude to heterosis as the difference in F_1s performance over standard check in percentage was calculated and presented using the methods of Turner (1953) and Hayes *et al*. (1956).

RESULTS AND DISCUSSION

In the present investigation, 32 F_1 hybrids derived from eight lines and four testers were evaluated using Line x Tester analysis with one commercial check hybrid. Significant variation was observed among treatments for all the characters except number of fruits per plant. The interaction like females *vs.* males and parents *vs.* hybrids showed significant differences for most of the characters indicated that the selected material was appropriate for the study of manifestation of heterosis and gene effects involved in inheritance of different traits.

Heterosis was estimated as per cent increase or decrease of F_1 values over standard check hybrid (Standard heterosis); Surati Ravaiya. The nature and magnitude of heterosis are presented in Table 1.

In the present study, the range of standard heterosis was 1.98 to 80.49 per cent for yield per plant. Among 32 hybrids, seven hybrids (JBGR-6/8 x NSR-1, JBR-12/6 x NSR-1, JBR-12/6 x Punjab Barsati, JBL-8/8 x NSRP-1, AB-8/14 x GJB-3, JBL-8/8 x NSR-1 and AB-7/2 x NSR-1) exhibited significant standard heterosis for yield and its attributing characters. Fruit yield per plant is the ultimate and the most important trait. However, yield of a crop cannot be taken as a single entry; since it is associated with many yield attributing characters. In brinjal, heterosis in yield per plant was positively associated with the heterosis in number of fruits per plant (Singh and Nandpuri, 1974), in some cases it associated with number of branches per plant, plant height and fruit weight (Chadha and Sidhu, 1982). Similar reports were made by Pratibha *et al.* (2004), Singh and Maurya (2005), Suneetha *et al.* (2008), Makani *et al.* (2013) and Nagesh *et al.* (2014).

The longer plant height and more number of branches per plant was the major parameter which acts as source trait to support yield and its component traits. Out of 32 crosses, 17 showed significantly positive standard heterosis for plant height. Similar findings have also been reported by earlier workers, Suneetha *et al.* (2008), Sao and Mehta (2010), Biswas *et al.* (2013), Naresh *et al.* (2013) and Reddy and Patel (2014) in brinjal.

Number of branches per plant is one of the major parameter contributing for total fruit yield per plant. Out of the 32 crosses, five showed significant and positive standard heterosis for the trait indicating predominance of non-additivity. These results are in conformation with the results of earlier workers *viz.*, Nalini Dharwad *et al.* (2011), Biswas *et al.* (2013) and Reddy and Patel (2014).

Days to 50 per cent flowering is generally an indication of early yield and also early hybrids fit well in multiple cropping systems. For these traits, negative heterosis is considered to be desirable. All the crosses exhibited significant negative (desirable) heterosis over the standard check. This indicates the predominant non-additive gene action. Similar results were also reported by Nalini Dharwad *et al.* (2011), Biswas *et al.* (2013) and Reddy and Patel (2014).

For number of flowers per inflorescence, majority of crosses exhibited positive significant standard heterosis suggesting the importance of dominant gene action. The findings are on line with Nalini Dharwad *et al.* (2011) and Reddy and Patel (2014).

Fruit length is an important parameter of fruit deciding consumer preference. In south Gujarat region, high fruit length is not preferred. Therefore, the crosses showing negative heterosis are useful. For fruit length, seven crosses exhibited negative heterosis over the standard check. These are in conformity with the studies of Pratibha *et al.* (2004) and Naresh *et al.* (2013).

Fruit diameter is another important character as that of fruit length. Majority of the crosses showed negative heterosis over standard check for fruit diameter. In earlier studies, Biswas *et al.* (2013) and Reddy and Patel (2014) also found similar results in brinjal.

Fruit length: fruit diameter ratio defines the fruit shape. There is lot of preference for the specific size of fruit in the market. In the south Gujarat region, round to oval fruit shape is preferred. This suggests, negative heterosis for fruit length: diameter ratio is useful.Seven crosses over the standard check showed negative heterosis. Similar reports have been made by Nalini Dharwad *et al.* (2011).

Fruit weight is one of the component characters directly influencing the fruit yield. Out of 32 crosses, thirteen crosses were exhibited positive and significant heterosis over the standard check. Similar views are put forth by Suneetha *et al.* (2008), Nalini Dharwad *et al.* (2011), Biswas *et al.* (2013) and Reddy and Patel (2014).

High number of fruits per plant is commercially important trait to gain high market value through high productivity. Out of 32 crosses, seven crosses were exhibited positive and significant heterosis over the standard check. Similar findings for number of fruits per plant over standard heterosis were also reported to the extent of 210.51 per cent by Biswas *et al.* (2013) and Reddy and Patel (2014).

Phenol content is the one of the most important character to reduce the shoot and fruit borer incidence. If the phenol content is high, borer infestation will be less. Among 32 crosses, nine exhibited significant positive heterosis over standard check. The results are agreement with Suneetha *et al.* (2008).

Sugar content is another important character to reduce the shoot and fruit borer incidence. If the sugar content is low borer infestation will be less. Among 32 crosses, four exhibited significant negative heterosis over standard check.

The high heterotic response observed in most of the crosses further supported the predominant role of non-additive component in most of the characters studied. Dispersion of favourable dominant genes coupled with complementary epistasis has been considered to be the major components of heterosis. Similar findings are reported by Sao and Mehta (2010).

Heterosis exploitation is the best method for exploiting total free phenols and total sugar for resistance. Thus, parents producing heterotic crosses for high phenol content and low total sugar may be preferred, while, aiming to produce shoot and fruit borer resistant crosses. For shoot and fruit borer infestation, out of 32 crosses, eight crosses *viz.*, AB-7/2 x NSR-1, AB-7/2 x NSRP-1, AB-7/2 x GJB-3, AB-7/2 x Punjab Barsati, AB-12/10 x Punjab Barsati, JBL-8/8 x Punjab Barsati, GAOB-2 x NSR-1 and GAOB-2 x Punjab Barsati exhibited highly resistant

Table 1 : Estimation of standard heterosis for different characters in brinjal

Crosses	Plant height	Number of branches per plant	Days to 50% flow ering	Number of flowers per inflore scence	Fruit length Fruitlength	Fruit diameter:	Fruit diameter	Average fruit weight	Number of fruits per plant	Fruit yield per plant	Phenol content	Total sugar
AB-7/2 x NSR-1	27.37 **	2.6	-14.59 **	14.04 *	126.30 **	-55.17 **	425.12 **	2.86	50.64 **	54.73 *	22.62 **	-9.38 *
AB-7/2 x NSRP-1	13.43	1.3	-15.68 **	15.79 *	138.28 **	-43.20 **	311.19 **	-5.86	41.86 *	33.84	11.51 **	-6.25
AB-7/2 x GJB-3	17.03	-3.9	-17.30 **	15.79 *	92.33 **	-53.85 **	313.18 **	-10.22	24.42	12.5	11.11 **	-7.72
AB-7/2 x Punjab Barsati	24.93 *	2.6	-18.38 **	10.53	124.34 **	-49.62 **	348.01 **	-7.62	53.26 **	41.16	27.78 **	-11.76 **
AB-8/14 x NSR-1	36.38 **	-19.48 **	-14.05 **	8.77	6.89	2.45	4.23	28.02 **	-5.06	21.8	-8.73 *	12.13 **
AB-8/14 x NSRP-1	41.65 **	-15.58 *	-13.51 **	5.26	-2.54	2.75	-5.22	28.15 **	3.66	33.38	-11.11 **	15.07 **
AB-8/14 x GJB-3	33.21 **	-7.79	-14.59 **	1.75	6.89	7.54	-0.75	23.55 *	42.44 *	76.22 **	-8.33 *	24.26 **
AB-8/14 x Punjab Barsati	38.00 **	-27.27 **	-9.73	-3.51	30.72 **	-0.46	38.81 **	25.36 **	-15.7	6.4	-0.79	49.26 **
AB-12/10 x NSR-1	27.66 **	-7.79	-16.76 **	1.75	25.48 *	-22.92 **	61.94 **	10.61	12.21	27.44	-9.92 *	22.79 **
AB-12/10 x NSRP-1	19.76	-16.88 *	-17.84 **	0	37.81 **	-32.20 **	101.49 **	-10.52	44.19 **	28.96	20.63 **	-2.57
AB-12/10 x GJB-3	27.27 **	-12.99	-7.57	5.26	18.43	-7.69	27.36 *	14.54	14.72	30.95	-11.11 **	24.82 **
AB-12-10 x Punjab Barsati	13.35	7.79	-13.51 **	1.75	64.07 **	-39.99 **	170.15 **	-11.98	23.26	10.37	18.25 **	-9.19 *
JBL-8/8 x NSR-1	19.3	28.57 **	-18.92 **	-12.28	29.39 **	-7.28	39.05 **	31.94 **	20.15	58.54 **	-9.52 *	21.32 **
JBL-8/8 x NSRP-1	24.27 *	-16.88 *	-16.76 **	1.75	27.48 **	-3.46	31.09 *	14.84	39.53 *	62.50 **	3.57	-2.21
JBL-8/8 x GJB-3	14.67	-5.19	-13.51 **	7.02	26.85 **	-8.76	39.55 **	22.18 *	8.37	32.62	2.78	1.65
JBL-8/8 x Punjab Barsati	29.20 **	1.3	-14.59 **	-14.04 *	54.79 **	-33.67 **	129.10 **	4.25	28.68	34.45	15.08 **	-10.11 *
JBR-12/6 x NSR-1	29.07 **	-32.47 **	-8.11	-10.53	-13.62	-8.1	-5.72	26.13 **	41.66 *	79.27 **	-24.21 **	65.44 **
JBR-12/6 x NSRP-1	18.27	16.88 *	-18.38 **	-5.26	6.97	6.47	0.75	23.80 *	11.05	36.89	-10.71 **	27.21 **
JBR-12/6 x GJB-3	24.11 *	16.88 *	-13.51 **	12.28	13.31	1.02	12.44	15.71	-1.34	13.72	-21.03 **	20.40 **
JBR-12/6 x Punjab Barsati	27.01 **	-9.09	-11.89 *	-12.28	58.16 **	-21.85 **	100.25 **	21.17 *	45.35 **	75.00 **	-0.79	-1.29
JBGR-6/8 x NSR-1	22.66 *	-5.19	-17.30 **	-3.51	-7.51	-6.11	-1.24	25.90 **	42.05 *	80.49 **	-22.22 **	57.17 **
JBGR-6/8 x NSRP-1	20.13 *	-9.09	-11.89 *	-7.02	13.89	5.2	7.96	23.52 *	2.33	27.44	-3.57	36.58 **
JBGR-6/8 x GJB-3	0.86	-9.09	-8.11	8.77	-2.94	-5.86	3.23	28.39 **	4.53	34.3	-15.48 **	26.47 **
JBGR-6/8 x Punjab Barsati	28.85 **	11.69	-14.05 **	10.53	33.74 **	-23.03 **	73.63 **	7.88	24.78	30.18	-11.11 **	43.75 **
GAOB-2 x NSR-1	22.51 *	1.3	-4.32	-14.04 *	-4.27	1.38	-5.47	-2.63	30.03	26.98	15.08 **	-6.8
GAOB-2 x NSRP-1	13.16	-7.79	-15.14 **	-7.02	-6.73	-10.7	4.23	-0.51	2.33	1.98	-11.11 **	23.16 **
GAOB-2 x GJB-3	17.16	20.78 **	-4.32	15.79 *	-1.1	1.32	-1.99	24.23 *	3.49	28.35	-13.89 **	20.77 **
GAOB-2 x Punjab Barsati	13.58	11.69	-17.30 **	10.53	58.59 **	-16.76 *	88.56 **	11.41	22.73	35.52	9.92 *	-8.46 *
GJB-2 x NSR-1	13.27	12.99	-8.65	0	12.56	-6.21	19.9	-0.33	29.94	30.95	-10.32 **	15.44 **
GJB-2 x NSRP-1	14.43	-6.49	-14.05 **	14.04 *	6.3	-3.82	10.2	6.21	23.95	31.55	-15.48 **	25.55 **
GJB-2 x GJB-3	1.6	20.78 **	-7.57	3.51	19.61	-15.28 *	40.30 **	3.7	26.98	33.08	-7.54	29.60 **
GJB-2 x Punjab Barsati	18.21	-19.48 **	-6.49	-3.51	54.40 **	-31.28 **	122.14 **	11.03	-3.49	6.55	13.10 **	1.29
CD (1%)	20.11	1	8.01	0.63	2.22	1.15	0.48	23.96	9.95	1.23	0.09	0.2
CD (5%)	15.12	0.75	6.02	0.48	1.67	0.87	0.36	18.02	7.49	0.93	0.06	0.15

* - Significant at 5% and **- Significant at 1%

to shoot and fruit borer infestation.

It is clear from the above discussion that these hybrids were found to be the most promising for yield and other desirable traits. It is also clear that the high degree of non additive gene action for most of the component traits observed in the present study favours breeding methodology such as biparental mating, recurrent selection and diallel selective mating (Jensen, 1970) may be resorted to, than conventional pedigree or backcross techniques which would leave the unfixable components of genetic variances unexploited for yield and its components.

In this way, the superior crosses attempted through line x tester mating design utilizing these germplasms of brinjal on the basis of significant heterosis over standard parent that can be further exploited for commercial, cultivation after multilocation testing. These crosses were recognized as the best heterotic crosses for fruit yield and these crosses can be further evaluated and used in hybrid breeding programme to boost up the fruit yield.

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