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RESEARCH ARTICLE

Heterosis Studies in Okra (*Abelmoschus esculentus* (L.) Moench)

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ABSTRACT

A set of 45 genotypes including 8 females, 4 males, their 32 resultant hybrids and one commercial check variety (GAO-5) were sown during *kharif* (2012) at Vegetable Research Scheme, Regional Horticultural Research Station, Navsari Agricultural University, Navsari to study the magnitude of heterosis using line x tester analysis for twelve characters. Significant differences were observed among parents and hybrids indicating considerable genetic variation among these genotypes. Significant standard heterosis and high *per se* performance with regards to fruit yield per plant were recorded by the crosses *viz.*, JOL-09-8 x PUSA SAWANI, JOL-10-17 x GJO-3, JOL-09-7 x PUSA SAWANI and AOL-10-18 x VRO-6.

KEYWORDS heterosis, Line x tester, hybrid

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) has captured a prominent position among vegetables and commonly known as bhendi or lady's finger in India, being native of tropical Africa. It is the choicest fruit vegetable grown extensively in the tropical, subtropical and warm areas of the world like India, Africa, Turkey and other neighboring countries. Major areas of cultivation in India are Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh, Gujarat, Karnataka and Assam. Okra is a polyploid, belonging to the family *Malvaceae* with 2n = 8x = 72 or 144 chromosome and a self pollinated crop, occurrence of out crossing to an extent of 4–19% with the maximum of 42.2% is noticed with the insect assisted pollination (Kumar, 2006). Tender green fruits are cooked in curry and soup, while crop has not adapted in India as leafy vegetable as in Far East countries. In India, among fresh vegetables, 60% share of export goes to Okra (Rewale et al., 2003[a]).

Major problems of Okra are lack of location specific varieties, tolerant or resistant to disease, pest and abiotic stresses. An important challenge would be to develop a variety/hybrid which response well to resources and resistant to yellow vein mosaic virus. To exploit the heterosis of potential yield components, knowledge of genetic architecture of fruit yield and its attributes is important in crop improvement. Hybrid vigour provides the means to an increase in the crop yield, disease and insect resistance and to combining ability characters, it is one of the important objectives in the plant breeding. Hence, an attempt has been made to study the 'line × tester' analysis (Kempthorne, 1957) to know the standard heterosis for interested traits in Okra (Solankey et al., 2013). Heterosis for yield and yield components has been reported by several workers, like Joshi et al. (1958), Lal and Srivastava (1973), Elangovan (1979), Singh et al. (1975), Swamy Rao (1977), etc. There is very less total area under F_1 hybrids. Yield is a mere universal breeding objective. The magnitude of heterosis provides a basis for genetic diversity and a guide to the choice of desirable parents for developing superior F_1 hybrids. A clear understanding for heterosis of the traits under consideration will help in deciding the appropriate breeding methods to improve the genetic makeup as well as productivity. Therefore, present investigation was carried out to estimate the magnitude of heterosis for pod yield and its contributing characters in Okra. Several reports on heterosis for fruit yield and its attributes have enhanced the scope for commercial utilisation of heterosis in Okra. The present investigation was undertaken to work out for further exploitation of heterosis for fruit yield in Okra.

MATERIALS AND METHODS

The present investigation entitled "Genetic analysis of yield and yield attributing characters in Okra (*Abelmoschus esculentus* (L) Moench.)" was carried out at Vegetable Research Scheme, Regional Horticulture Research Station (R.H.R.S.), Navsari Agricultural University, Navsari during *kharif*-2012. The experimental material comprised 12 parents which involved 8 females, 4 males and their 32 F_1 hybrids along with one commercial check. The above materials (45) were used for the experiment to study the heterosis. Seeds of male and female parents were sown during *kharif* 2011 for attempting crosses in line x tester fashion. Sowing was done 60 cm apart ridges at spacing of 60 cm between plants for easy movement. All packages of cultivation practices were followed to raise a good crop. The following observations were recorded on all the five plant chosen at random in each genotype and in each replication. Data were recorded on the quantitative

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characters were *viz.,* days to 50% flowering, plant height (cm), number of branches per plant, internodal length (cm), fruit length (cm), fruit diameter (mm), fruit weight (g), number of fruits per plant, fruit yield per plant (g), number of seeds per fruit and 100-seed weight (g).

RESULTS AND DISCUSSION

The exploitation of heterosis in crop plant is regarded as one of the major breakthrough in the field of plant breeding. The application of heterosis is considered to be an outstanding application of principles of genetics to agriculture. The scope of exploitation of hybrid vigour depends on directions and magnitude of heterosis and type of gene action involved.

The knowledge of heterosis with inbreeding depression would help in the elimination of poor crosses in early stages. The magnitude of heterosis varied from cross to cross for all the characters studied, of these, the character of economic importance for Okra is fruit yield and the heterotic response obtained for this character is of greater importance for the purpose of practical plant breeding.

In case of standard heterosis, many crosses manifested significant shift in desired direction *viz.*, for days to 50% flowering nine crosses, plant height 6 crosses, intermodal length 1 cross, number of branches per plant 5 crosses, number of fruit per plant 21 crosses, fruit length 8 crosses, fruit weight 15 crosses, fruit diameter 32 crosses, fruit yield per plant 17 crosses, 100-seed weight 15 crosses and number of seeds per fruit 15 crosses.

The parents showed significant difference for most of characters studied, which indicated the sufficient variability among parents. The variances due to females were significant for all traits except number of branch per plant and fruit diameter indicating the existence of enormous amount of genetic variability among the female parents. Similarly, the male parents showed significant difference for plant height, fruit weight, fruit diameter, number of seeds per plant and 100-seed weight revealing the presence of sufficient genetic variability among them for these characters.

The interaction between females × males was significant for the characters *viz.,* days to 50% flowering, plant height (cm), internodal length, number of fruits per plant and rest of characters *viz.,* number of branches per plant, fruit length, fruit weight, fruit diameter, yield per plant, number of seeds per fruit and 100-seed weight were found non-significant. The hybrid showed highly significant difference for all the characters except number of branch per plant. Parents vs. crosses showed highly significant differences for internodal length (cm), fruit weight (g), number of seeds per fruit, and rest of the characters were non-significant (Table 1).

Earliness is an important trait in vegetables like Okra. Earliness is required in such crops for realising the potential economic yield in as less time as possible, which is an important consideration for a vegetable grower. With regards to days to 50% flowering, nine crosses showed significant negative standard heterosis in desired direction. Among them, six crosses showed highly significant standard heterosis. The earliest crosses

Table 1: Analysis of variance for parents and crosses in respect of 11 characters in Okra.

Source of variation	d.f.	Days to 50% flowering (cm)	Plant height (cm)	Internodal length (cm)	Number of branches per plant	Number of fruits per plant	Fruit length (cm)	Fruit weight (g)	Fruit diameter (mm)	Fruit yield per plant (g)	Number of seeds per plant	100-seed weight (g)
Replications	2	3.28	83	1.93	0.014	0.76	0.55	1.09	2.30	592.86	1.93	0.68
Parents	11	7.18**	536.78**	3.64**	0.13	2.27**	4.98**	7.28**	3.10*	474.65**	175.29**	2.71**
Females	7	9.8**	526.71**	3.88**	0.06	2.62**	7.32**	4.75**	2.06	613.18**	141.86**	2.87**
Males	3	1.00	330.26**	0.78	0.08	1.18	0.76	14.98**	5.19*	308.82	302.60**	1.52**
Females vs. males	1	7.34*	1226.77**	14.64**	0.72	3.12*	1.28	1.93	4.19	2.37	27.38	0.58
Hybrids	31	6.07**	293.17**	1.03**	0.094	2.91**	5.24**	4.92**	2.63*	603.06**	698.14**	1.82**
Parents vs. hybrids	1	2.70	45.29	14.64**	0.019	0.10	0.24	42.33**	2.27	73.47	4683.68**	0.58
Error	86	1.50	61.60	0.43	3.15	0.71	0.87	0.71	1.37	174.01	21.69	0.20

**: Significant at 1%, *: Significant at 5%.

Table 2: Magnitude of heterosis for various characters in Okra.

Crosses	Days to 50% flowering	Plant height (cm)	Internodal length (cm)	Number of branches per plant	Number of fruits per plant	Fruit length (cm)	Fruit weight (g)	Fruit diameter (mm)	Fruit yield per plant (gm)	Number of seeds per plant	100-seed weight (gm)
AOL-10-3 × GO – 2	-3.28	1.77	19.51**	14.78**	35.33**	26.65**	6.43	40.97**	28.26**	22.30**	1.61
AOL-10-3 × P.SAWANI	-3.28	-14.77	-2.44	0.87	11.33	-9.09	27.36**	34.92**	23.91*	-30.74**	18.5*
AOL-10-3 × GJO-3	-2.46	-9.08	4.07	9.57*	0.67	0.31	20.97**	21.85**	11.28	38.51**	25.40**
AOL-10-3 × VRO-6	0.00	-6.31	-16.26*	-0.87	-0.67	10.97	15.15*	21.61**	14.92	-23.99**	34.27**
AOL-10-18 × GO-2	-0.84	6.77	0.00	1.74	6.67	0.31	15.73*	22.50**	27.32**	8.78	15.73
AOL-10-18 × P.SAWANI	-4.92*	1.62	10.57	3.48	19.63**	-8.46	10.50	37.80**	28.90**	-17.91**	28.63**
AOL-10-18 × GJO-3	-4.92*	10.62	13.82*	1.74	22.33**	2.82	9.28	19.68*	10.07	-20.27**	49.19**
AOL-10-18 × VRO-6	-0.01	-5.31	-1.63	1.74	22.00**	-5.96	21.55**	17.10*	37.94**	-3.04	29.03**
JOL-09-5 × GO-2	2.46	11.31	7.32	0.00	16.67*	-1.57	8.17	20.94**	21.49*	6.42	-4.84
JOL-09-5 × P.SAWANI	-2.46	-10.31	-3.25	-3.48	12.67	14.73	3.52	27.66**	-5.45	-23.99**	13.71
JOL-09-5 × GJO-3	-2.46	-6.46	1.63	1.74	24.00**	9.72	-9.28	40.97**	10.11	-40.20**	0.00
JOL-09-5 × VRO-6	-4.10	-3.23	1.63	-1.74	11.33	10.97	10.50	18.52*	14.22	-25.23**	-2.42
JOL-09-7 × GO-2	-2.46	5.15	-3.25	-1.74	22.83**	5.96	-3.46	28.33**	22.68	-22.07**	-12.90
JOL-09-7 × P.SAWANI	-5.74*	7.54	-7.25	0.00	23.33**	-10.34	4.10	24.84**	41.72**	-14.19*	34.27**
JOL-09-7 × GJO-3	-9.01**	0.54	5.69	-1.74	18.00*	-19.75**	2.94	44.44**	6.39	-4.73	9.68
JOL-09-7 × VRO-6	-6.55**	4.46	2.44	0.00	28.00**	-0.31	-4.04	34.33**	16.44	22.52**	12.10
JOL-09-8 × GO-2	-9.01**	22.62**	-3.25	10.43*	26.00*	5.33	5.26	25.97**	14.74	-4.73	18.15*
JOL-09-8 × P.SAWANI	-9.83**	-1.92	8.13	1.74	35.33**	7.84	6.43	28.04**	57.29**	23.99**	43.95**

(Continued)

Table 2: (Continued)

Crosses	Days to 50% flowering	Plant height (cm)	Internodal length (cm)	Number of branches per plant	Number of fruits per plant	Fruit length (cm)	Fruit weight (g)	Fruit diameter (mm)	Fruit yield per plant (gm)	Number of seeds per plant	100-seed weight (gm)
JOL-09-8 × GJO-3	-7.38**	14.62	-3.25	0.00	22.00**	16.61*	12.24*	27.12**	25.01*	-19.59**	47.18**
JOL-09-8 × VRO-6	-4.09	10.00	-8.94	3.48	16.67*	9.09	11.08	25.22**	16.21	-41.89**	-4.44
JOL-08-8 × GO-2	-4.10	0.54	4.88	-3.48	28.67**	-0.94	23.87**	29.95**	21.50*	-10.47	26.61**
JOL-08-8 × P.SAWANI	-2.46	18.31*	2.44	8.70*	22.00**	6.58	26.20**	30.56**	29.42**	-19.26**	12.10
JOL-08-8 × GJO-3	-0.01	5.15	6.50	3.48	11.33	14.11	11.08	28.68**	24.70*	-22.30**	0.81
JOL-08-8 × VRO-6	-0.01	0.00	1.63	-1.74	20.00	-4.70	24.45**	25.35**	14.85	-11.49	15.73
JOL-55-3 × GO-2	-6.56**	-4.23	-12.20	8.70	11.33	15.36*	11.08	21.83**	21.56*	-35.47**	26.61**
JOL-55-3 × P.SAWANI	-1.65	-5.00	-2.44	10.43*	-1.33	34.80**	32.60**	27.53**	26.65**	-30.41**	-8.06
JOL-55-3 × GJO-3	1.63	-6.15	-4.07	6.96	4.67	26.65**	25.04**	34.68**	23.06*	75.66**	15.73
JOL-55-3 × VRO-6	0.82	4.00	0.00	3.48	32.67**	19.75**	-2.30	25.78**	31.38**	15.77*	-2.02
JOL-10-17 × GO – 2	1.64	19.62*	4.07	-3.48	25.33**	19.12**	19.80**	46.34**	33.43	9.46	-2.42
JOL-10-17 × P.SAWANI	-2.96	27.69**	2.44	3.48	16.00*	0.31	26.20**	34.17**	1.04	23.31**	38.71**
JOL-10-17 × GJO-3	1.11	29.62**	6.50	6.96	16.00*	28.53**	20.97**	25.62**	41.72**	15.54*	25.00**
JOL-10-17 × VRO-6	4.09	22.69**	-1.63	3.48	30.67**	6.58	19.80**	21.32**	18.33	6.08	53.23**

**: Significant at 1%, *: Significant at 5%.

JOL-09-08 x PUSA SAWANI showed negative heterosis of the extent of -9.83% for this character. Similar results have been observed by Solankey and Singh (2011), Medagam et al. (2012), Himani Patel et al. (2015) and Kumar et al. (2015) for days to 50% flowering (Table 2).

Plant height at fully matured stages is one of the important ideotype in bhendi for higher yield. The results for plant height testified that six crosses highlighted highly significant heterosis over standard check in desired direction. The hybrid JOL-10-17 x GJO-3 demonstrated the highest standard heterosis. The present findings are in close association with results reported by Solankey and Singh (2011), Kumar (2011), Medagam et al. (2012), Lyngdoh et al. (2013), Paul (2013), Jethava (2014), Himani Patel et al. (2015) and Kumar et al. (2015), for plant height (Table 2).

The branches are an important growth parameter contributing to productivity. For number of branches per plant, five crosses gave significant results for standard heterosis. The cross showing highest percentage of standard heterosis was AOL-10-3 x GO-2. Kumar (2011), Medagam et al. (2012), Paul (2013), Jethava (2014), Himani Patel et al. (2015) and Kumar et al. (2015) also reported similar results in Okra (Table 2).

In case of internodal length, only one cross AOL-10-3 x VRO-6 tracked most eminent negative economic heterosis. The results are in agreement with the previous findings of Solankey and Singh (2011), Medagam et al. (2012), Jethava (2014), Himani Patel et al. (2015) and Kumar et al. (2015). As Okra bears pod at each node, shorter distance between the node, will ultimately lead to higher production. Joshi et al. (1958) have stressed the importance of shorter internodes for increased yield in Okra (Table 2).

With respect to fruit length, nine crosses were found to be significant for standard heterosis, in which eight crosses found in positive direction. The present findings are in close association with the results reported by Kumar (2011), Medagam et al. (2012), Paul (2013), Jethava (2014) Himani Patel et al. (2015) and Kumar et al. (2015), for fruit length (Table 2).

For fruit diameter, all crosses were found to be significant for standard heterosis and all are in positive direction. The present findings are in close association with the results reported by Kumar (2011), Medagam et al. (2012), Paul (2013), Jethava (2014) Himani Patel et al. (2015) and Kumar et al. (2015), for fruit diameter (Table 2).

With regard to fruit weight, 15 crosses were found to be significant for standard heterosis in positive direction. The present findings are in close association with the results reported by Kumar (2011), Medagam et al. (2012), Jethava (2014), Nagesh et al. (2014), Himani Patel et al. (2015) and Kumar et al. (2015) for fruit weight (Table 2).

Number of fruits per plant, fruit length, fruit weight and fruit diameter are all very closely related productivity parameters. For number of fruit per plant, 21 crosses generated desirable significant standard heterosis. The cross picturing highest percentage of heterosis over standard check was AOL-10-3 x GO-2 (35.33) and JOL-09-8 x PUSA SAWANI (35.33). Number of fruit per plant is most contributing trait to yield, especially in hybrids. These results are in harmony with the earlier findings of Solankey and Singh (2011), Kumar (2011), Medagam et al. (2012), Paul (2013), Jethava (2014), Nagesh et al. (2014), Himani Patel et al. (2015) and Kumar et al. (2015) for number of fruit per plant (Table 2).

Fruit yield per plant is the ultimate and the most important trait. In present study fair amount of standard heterosis was observed for yield per plant. Seventeen crosses depicted significant positive standard heterosis for this character. The best performing cross for this trait was JOL-09-8 x PUSA SAWANI (57.29) followed by JOL-09-7 x PUSA SAWANI (41.72) and JOL-10-17 x GJO-3 (41.72). Similar observations were reported by Solankey and Singh (2011), Medagam et al. (2012), Paul (2013), Jethava (2014), Himani Patel et al. (2015) and Kumar et al. (2015) for yield per plant (Table 2).

With respect to number of seeds per fruit, 23 crosses designated significant, out of 15 crosses meaningful positivistic effects in forms of heterosis over commercial check. JOL-55-3 x GJO-3 (75.66) was top ranking cross showing highly significant positive in standard heterosis for number of seeds per fruit. Similar observation was reported by Jethava (2014), Nagesh et al. (2014), Himani Patel et al. (2015) and Kumar et al. (2015) for number of seeds per fruit (Table 2).

For 100-seed weight, standard heterosis was found to be substantial with the margin of 15 out of 32 crosses. All 15 crosses had shown positive significant heterosis and cross JOL-10-17 X VRO-6 expressed top rated highly significant positive standard heterosis for this trait. Similar observation was reported by Jethava (2014), Himani Patel et al. (2015) and Kumar et al. (2015) for 100-seed weight (Table 2).

Manifestation of heterosis for all the characters in one cross may not be possible but the exploitation of hybrid vigour for yield-attributing traits will significantly improve the crop performance over existing hybrid or variety (Hosamani et al. 2008). Some crosses for fruit yield traits which were non-heterotic, may be ascribed to cancellation of positive and negative effects showed by the parents involved in a cross combination and can also happen when the dominance is not unidirectional (Gardner and Eberhart, 1966; Mather and Jinks, 1982) (Table 2).

In the present study, the magnitude of the heterosis deviated from cross to cross. JOL-09-8 x PUSA SAWANI, JOL-09-7 x PUSA SAWANI, JOL-10-17 x GJO-3 showing heterosis for characters like days to 50% flowering, plant height, number of fruit per plant, fruit length, fruit weight, fruit diameter, fruit yield per plant, number of seed per plant and 100-seed weight. The cross AOL-10-3 x GO-2 registered significant positive heterosis over standard check for trait like internodal length, number of branches per plant, number of fruit per plant and fruit diameter which indicates that the heterosis for fruit yield was due to heterosis for other yield component characters.

It is clear from the above discussion that this hybrid was found to be the most promising for pod yield and other desirable traits. It is also clear that the high degree of non additive gene action for all 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. So, it can be identified as the potential hybrid combination for commercial exploitation in other climate against this hybrid check.

The disparities in interpretation between the present study and previous reports might be due to differences in parental materials used and the environment under which the trial was conducted because estimates of gene effects change with environments and genotypes (Das et al. 2013).

REFERENCES

1. Das, S., Chattopadhyay, A., Dutta, S., Chattopadhyay, S. B. and Hazra, P. (2013). Breeding Okra for higher productivity and yellow vein mosaic tolerance. *Int J Veg Sci* 19:58–77.
2. Elangovan, M. (1979). Line x tester analysis in bhedi (*Abelmoschus esculentus* (L.) Moench) for some economic traits. Thesis, University of Agricultural Sciences, Tamil Nadu, Coimbatore.
3. Gardner, C.O. and Eberhart, S.S. (1966). Analysis and interpretation of variety cross diallel and related population. *Biometrics* 22:439–52.
4. Himani Patel, Bhanderi, D.R., Patel, A.I. and Tank, R.V. (2015). Magnitude of heterosis for pod yield and its contributing characters in okra (*Abelmoschus esculentus* (L.) Moench). *The Bioscan* 10(2):939–42.
5. Hosamani, R.M., Aajjappalavara, P.S., Patil, B.C., Smitha, R.P. and Ukkund, K.C. (2008). Heterosis for yield and yield components in okra. *Karnataka J Agric Sci* 21(3):473–5.
6. Jethava, B.A. (2014). Heterosis and combining ability in okra (*Abelmoschus esculentus* (L.) Moench). M.Sc., Thesis, Navsari Agricultural University, Navsari.
7. Jensen, F. (1970). A diallel selective mating system for cereal breeding. *Crop Sci* 10:629–33.
8. Joshi, B.S., Singh, H.B. and Gupta, P.S. (1958). Studied in hybrid vigour -3 bhendi. *Indian Journal Genetics* 18(1):57–68.
9. Kempthorne, O. (1957). *An Introduction to Genetic Statistics.* New York: John Wiley and Sons, pp 408–711.
10. Kumar, N. (2006). *Breeding of Horticultural crops.* New Delhi: New India Publishing Agency, pp 173–7.
11. Kumar, N.S. (2011). Heterosis in okra. *Plant Archives* 11(2):683–5.
12. Kumar, N., Saravaiya, S.N., Patel, A.I. and Nazaneen, N.S. (2015). Heterosis studies in Okra (*Abelmoschus esculentus* (L.) Moench). *Trends Biosci* 8(1):236–41.
13. Lal, S. and Srivastava, J.P. (1973). Hybrid vigour in bhendi. *Indian J Horti* 30:542–5.
14. Lyngdoh, Y.A., Mulge, R. and Shadap, A. (2013). Heterosis andcombining ability studies in near homozygous lines of okra [*Abelmoschus esculentus* (L.) Moench] for growth parameters. *The Bioscan* 8(4):1275–279.
15. Mather, K. and Jinks, J.L. (1982). *Biometrical Genetics*, 3rd ed. London: Chapman and Hall Ltd.
16. Thirupathi Reddy, M., Haribabu, K., Ganesh, M. and Begum, H. (2012). Heterosis for yield and yield components in okra. *Chilean Journal of Agricultural Research* 72(3):316–25.
17. Nagesh, G.C., Mulge, R., Rathod, V., Basavaraj, L.B. and Mahaveer, S.M. (2014). Heterosis and combining ability studies in okra [*Abelmoschus esculentus*(L.) Moench] for yield and quality parameters. *The Bioscan* 9(4):1717–23.
18. Paul, T. (2013). Genetic architecture and fruit yield analysis in Okra (*Abelmoschus esculentus* (L.) Moench). Unpublished M.Sc. thesis, NAU, Navsari, Gujarat.
19. Rewale, V.S., Bendale, V.W., Bhave, S.G., Madav, R.R. and Jadhav, B.B. (2003a). Heterosis for yield and yield components in okra. *J Maharashtra Agric Univ* 28(3):247–9.
20. Singh, S.P., Srivastava, J.P. and Singh, H.N. (1975). Heterosis in bhendi (*Abelmoschus esculentus* (L.) Moench) for some economic traits. Thesis, University of Agricultural Sciences, Tamil Nadu, Coimbatore.
21. Solankey, S. and Singh, A. (2011). Manifestation of heterosis in relation to seasonal variation in Okra. *Veg Sci* 38(1):107–10.
22. Solankey, S.S., Singh, A.K. and Singh, R.K. (2013).Genetic expression of heterosis for yield and quality traits during different growing seasons in okra (*Abelmoschus esculentus* L.). Indian J Agri Sci 83(8):815–9.
23. Swamy Rao, T. (1977). Line x Tester analysis of heterosis and combining ability of bhendi. *Agri Res J Kerala* 15(2):112–8.

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