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COMBINING ABILITY FOR YIELD AND QUALITY ATTRIBUTES IN BHENDI (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH)

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ABSTRACT

The present experiment on bhendi consisted of 12 parents (9 lines and 3 testers) with their 27 F_1 hybrids developed through line x tester mating design with three replications in randomized block design. Parents and hybrids differed significantly for gca and sca effects, respectively. Among the parents, maximum gca effect was found in EC 169329 and Aruna for fruit length, EC 102605 and Arka Anamika for fruit girth, EC 112241 and Arka Anamika for fruit yield per plant, EC 169335 and Aruna for ascorbic acid content, EC 109454 and Arka Anamika for mucilage content. The crosses EC 169331 x Kashi Kranti, EC 102605 x Arka Anamika and EC 169344 x Arka Anamika were found as good specific combiners for fruit length, fruit girth and yield per plant respectively. The hybrids EC 169335 x Aruna and EC 109454 x Arka Anamika exhibited maximum significant positive sca effects for quality traits like ascorbic acid content and mucilage content respectively.

Keywords: Line x Tester, gca, sca, Bhendi

INTRODUCTION

Bhendi [*Abelmoschus esculentus* (L.) Moench] commonly known as Ladies finger or Okra or Bhindi comes under the family of Malvaceae with chromosome no: 2n=2x=130 and often cross pollinated crop. It is an important vegetable grown in tropical and sub-tropical regions of the world and believed to have originated in Tropical Africa. Bhendi is used for treating genitor-urinary disorder, chronic dysentry and spermatorrhoea. The roots and stems of okra are used for clarification of sugarcane juice before it is converted into jaggery and brown sugar (Fageria *et al.,* 2012). Mature fruits and stems of okra containing crude fibre are used in the paper industry. The mature seeds of bhendi are roasted, ground and used as substitute for coffee in some countries (Dhande *et al.,* 2012).

Okra mucilage is the thick and slimy substance present in fresh as well as dried pods. The mucilage of okra fruit has potential for use as food, non-food products, and medicine. In food applications, mucilage of okra used as a whipping agent for reconstituted egg whites and additive in the formulation of flour based adhesives. In non-food applications, okra mucilage used as brightening agents in electro deposition of metals, fabric production, deflocculant in paper and protectant to reduce friction in pipe flow. This mucilage is used to produce new biodegradble polymeric materials through the polysaccharides are combined with acrylamide. In medicinal applications, this mucilage is used as an extender of serum albumin and tablet binder. Okra fruit mucilage is used as a protective food additive against irritating and inflammatory gastric diseases (Gemede *et al.,* 2015). The fruit of okra is botanically known as capsule and it is having anti-goiter property due to the presence of considerable amount of iodine in its tender edible fruits (Selvakumar, 2014). The concept of combining ability plays an important role in selection of parents and production of superior hybrids. The general combining ability (gca) and specific combining ability (sca) is a foundation for any breeding programme and used for the selection of desirable parents for hybridization programme. Hence, the current study was conducted to identify the general combining ability (gca) of the parents and specific combining ability (sca) of the hybrids on yield and quality attributing characters in bhendi.

MATERIALS AND METHODS

The experimental materials comprised of twelve parents which involved nine lines viz., EC 102605 (L_1), EC 112112 (L_2), EC 112264 (L_3), EC 109454 (L_4), EC 112241 (L_5), EC 169329 (L_6), EC 169344 (L_7), EC 169331 (L_8), EC 169335 (L_9) and three testers Arka Anamika (T_1), Kashi Kranti (T_2) and Aruna (T_3). All the parents and their their twenty seven F_1 hybrids, were raised at spacing of 45 x 30 cm in Randomized Block Design (RBD) with three replications during December to February, 2020 was carried out at Vegetable Unit, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar. Many biometrical procedures were used for studying the combining ability, Line x Tester is one of the efficient method was developed by Kempthorne (1957), which is good method for evaluating the large number of genotypes at a time for combining ability variances and effects. Recommended cultural practices were followed to raise a successful crop. Five plants of each entry in each replication were randomly selected for recording the observations on fruit length, fruit girth, fruit yield per plant, ascorbic acid content and mucilage content of the fruit.

RESULT AND DISCUSSION

The analysis of variance (Table 1.) showed all the lines and testers were significant for all the characters. The variance due to lines x testers interaction was significant for all the characters except fruit girth, there by showing high specific combining ability. The variance due to hybrids was significant for all the characters.

The estimates of gca effects (Table 2) showed the range of gca effects of lines varied from -0.93 to 1.66 whereas in the testers -0.52 to 0.29. Among the lines EC 169329 (1.66) followed by EC 112112 (0.48), EC 169331 (0.28) and EC169344 (0.19) exhibited maximum positive significant gca effect for fruit length whereas, among the testers Aruna (0.29) and Arka Anamika (0.23) exhibited positive gca effect for this character. The results are in conformation with earlier findings of More *et al.,* (2015) and Devi *et al.,* (2017).

In respect to single fruit girth, the range of gca effects of lines varied from -0.40 to 0.38 whereas in the testers -0.27 to 0.15. Highest positive significant gca effect was recorded among the lines EC 102605 (0.38) and EC 169335 (0.22) whereas, the testers Arka Anamika (0.15) and Kashi Kranti (0.12) for this character. The results are in agreement with the findings of Gowda *et al.,* (2018) and Sapavadiya *et al.,* (2019).

The gca effects of lines and testers ranged from -31.15 to 40.50 and -50.40 to 43.54 respectively. The lines EC 112241 (40.50) followed by EC 169329 (23.03), EC 169335 (14.04) and EC 169331 (13.92) and the tester Arka Anamika (43.54) and Kashi Kranti (6.86) expressed maximum significant positive gca effect for fruit yield per plant. However, this is the conformity with the findings by Tiwari *et al.,* (2016) and Raju and Selvam (2017).

The range of gca effects of lines varied from -2.56 to 3.10 whereas in the testers -1.23 to 2.23. Among the parents EC169335 (3.10), EC 169331 (2.47), EC 112241 (0.77), EC 169344 (0.10) and Aruna (2.23) exhibited highest significant positive gca effect for ascorbic acid content. This is in consonance with the results of Weerasekara *et al.,* (2008) and Sharma and Singh (2012).

The range of gca effects varied from -0.28 to 0.37 and -0.06 to 0.12 for lines and testers respectively. Highest significant negative gca effect were found among the lines EC 109454 (0.37) followed by EC 169331 (0.18), EC 169344 (0.13) and EC 112241 (0.04) whereas the testers Arka Anamika (0.12) for mucilage content. Similar results observed by Balakrishnan *et al.,* (2009), Reddy and Sridevi (2018) and Punia and Garg (2019).

The estimates of sca effects (Table 3) showed the range of sca effects of crosses varied from -1.70 to 1.58. The hybrids showed maximum positive significant sca effect was observed in EC 169331 x Kashi Kranti (1.58) followed by EC 169329 x Arka Anamika (1.56) and EC 112241 x Aruna (1.41) for fruit length. The results are in conformation with earlier findings of Jagan *et al.,* (2013) and Joshi *et al.,* (2015).

The range of sca effects of hybrids varied from -0.33 to 0.71. The hybrids expressed highest significant negative sca effect was reported on EC 102605 x Arka Anamika (-0.33) for fruit girth. The results are in agreement with More *et al.,* (2017), Satish *et al.,* (2017) and Shwetha *et al.,* (2018).

The range of sca effects of crosses varied from -75.12 to 114.63. The crosses exhibited maximum positive significant sca effect was recorded in EC 169344 x Arka Anamika (114.63) followed by EC 112241 x Aruna (72.97) and EC 169331 x Kashi Kranti (67.33) for fruit yield per plant. Similar results were observed by Gendy *et al.,* (2012) and Hazem *et al.,* (2013).

The range of sca effects of hybrids varied from -3.67 to 5.11. The crosses exhibited maximum positive significant sca effect was noticed in EC 169335 x Aruna (5.11) followed by EC 112241 x Aruna (4.44) and EC 109454

Table 1. Analysis of variance for biometric characters in bhendi

Source	DF	Fruit length (cm)	Fruit girth (cm)	Fruit yield per plant (g)	Ascorbic acid content (mg/100g)	Mucilage content (g/100g)
Replication	2	0.02	0.17	0.09	0.001	0.002
Lines	8	5.66**	0.54**	5523.93 **	31.54**	0.39**
Testers	2	5.57**	1.44**	60529.39**	100.70**	0.27**
Lines x testers	16	2.68**	0.09	10306.53**	34.84**	0.32**
Hybrids	26	3.82**	0.34**	12698.26**	38.89**	0.34**
Error	76	0.01	0.07	0.02	0.005	0.001

*significant at 5% level, **significant at 1% level

Table 2. Estimates of general combining ability effects of parents for yield and quality attributes of okra

Parents	Fruit length (cm)	Fruit girth (cm)	Fruit yield per plant (g)	Ascorbic acid content (mg/100g)	Mucilage content (g/100g)
Lines					
Ec 102605	-0.12**	0.38**	-8.61**	-0.90**	-0.22**
Ec 112112	0.48**	-0.09	-30.27**	-0.90**	-0.28**
Ec 112264	-0.93**	0.18	-19.60**	-1.86**	-0.17**
Ec 109454	-0.46**	-0.12	-31.15**	-2.56**	0.37**
Ec 112241	-0.20**	0.15	40.50**	0.77**	0.04**
Ec 169329	1.66**	-0.14	23.03**	-0.23*	0.02
Ec 169344	0.19**	-0.4**	-1.87**	0.10**	0.13**
Ec 169331	0.28**	-0.15	13.92**	2.47**	0.18**
Ec 169335	-0.89**	0.22*	14.04**	3.10**	-0.08**
SE for lines	**0.05**	**0.10**	**0.04**	**0.10**	**0.009**
Testers					
Arka Anamika	0.23**	0.15**	43.54**	-1.00**	0.12**
Kashi Kranti	-0.52**	0.12**	6.86**	-1.23**	-0.06**
Aruna	0.29**	-0.27**	-50.41**	2.23**	-0.06**
SE for testers	**0.03**	**0.10**	**0.02**	**0.06**	**0.017**

*significant at 5% level, **significant at 1% level.

Table 3. Estimates of specific combining ability effects of hybrids for yield and quality attributes of okra

Hybrids	Fruit length (cm)	Fruit girth (cm)	Fruit yield per plant (g)	Ascorbic acid content (mg/100g)	Mucilage content (g/100g)
Ec 102605 x AA	-0.46**	-0.33*	-69.98**	-1.67**	-0.05**
Ec 102605 x KK	-0.03	0.17	62.83**	2.56**	0.01
Ec 102605 x A	0.49**	0.15	7.16**	-0.89**	0.04
Ec 112112 x AA	-0.50**	-0.13	-6.95**	3.33**	-0.12**
Ec 112112 x KK	-0.28**	-0.08	-19.55**	1.56**	0.06**
Ec 112112 x A	0.78**	0.20	26.51**	-4.89**	0.06**
Ec 112264 x AA	0.18*	0.20	-9.99**	1.30**	-0.22**
Ec 112264 x KK	0.29**	-0.07	-29.14**	-1.47**	-0.03
Ec 112264 x A	-0.48**	-0.13	39.12**	0.17**	0.25**
Ec 109454 x AA	-0.26**	0.01	-23.21**	4.00**	0.73**
Ec 109454 x KK	0.17*	0.01	3.68**	-1.77**	-0.45**
Ec 109454 x A	0.09	-0.02	19.54**	-2.23**	-0.28**
Ec 112241 x AA	-0.54**	0.06	-53.32**	-1.34**	-0.22**
Ec 112241 x KK	-0.87**	-0.16	-19.65**	-3.10**	0.15**
Ec 112241 x A	1.41**	0.10	72.97**	4.44**	0.07**
Ec 169329 x AA	1.56**	0.13	43.02**	0.66**	0.39**

continued...

Ec 169329 x KK	-0.79**	-0.12	1.03**	1.90**	-0.20**
Ec 169329 x A	-0.77**	0.00	-44.05**	-2.56**	-0.19**
Ec 169344 x AA	0.28**	0.00	114.63**	-2.67**	-0.22**
Ec 169344 x KK	-0.16*	0.04	-39.51**	3.56**	0.07**
Ec 169344 x A	-0.12	-0.05	-75.12**	-0.89**	0.15**
Ec 169331 x AA	0.12	0.07	-12.53**	0.06*	-0.06**
Ec 169331 x KK	1.58**	0.24	67.33**	-1.80**	0.40**
Ec 169331 x A	-1.70**	-0.31	-54.80**	1.74**	-0.34**
Ec 169335 x AA	-0.38**	-0.01	18.34**	-3.67**	-0.24**
Ec 169335 x KK	0.09	-0.03	-27.02**	-1.44**	-0.01
Ec 169335 x A	0.29**	0.04	8.68**	5.11**	0.25**
SE for crosses	**0.10**	**0.20**	**0.10**	**0.18**	**0.017**

AA – Arka Anamika, KK – Kashi Kranti, A – Aruna. *significant at 5% level, **significant at 1% level.

x Arka Anamika (4.00) for ascorbic acid content. This is in consonance with the results of Jindal *et al.,* (2010) and Kayande *et al.,* (2018).

The range of sca effects of crosses varied from -0.45 to 0.73. The cross combination exhibited highest significant positive sca effect was found in EC 109454 x Arka Anamika (0.73) followed by EC 169331 x Kashi Kranti (0.40) and EC 169329 x Arka Anamika (0.39) for mucilage content. The results are in agreement with the findings of Kishore *et al.,* (2013) and Lokeshwari *et al.,* (2018).

CONCLUSION

From the above discussion that could be concluded with the first top ranking hybrids had either one of the parents as good general combiner for all the characters. Hence, these cross combinations will be used in future hybridization programme for further improvement.

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