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Combining Ability Studies in Bhendi (*Abelmoschus esculentus* (L.) Moench) for Yield and Its Important Component Characters

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ABSTRACT

The present study was undertaken to evaluate five lines crossed with four testers and twenty hybrids through line x tester mating system, to study the *gca* and *sca* effects and genetic analysis for various yield and yield contributing traits. The results of the present study indicated that existence of significant differences among the lines, testers and hybrids. Among the parents, Krishnagiri local, Karimangalam local, Arka Anamika and Arka Abhay were adjudged as good general combiners. Among the hybrids, the hybrid Krishnagiri local x Arka Abhay was the best hybrid based on *sca* effects, since it had desirable performance for all the characters and the hybrid Karimangalam local x Arka Anamika was also best hybrid since, it possessed desirable *sca* effects for most of the yield contributing characters.

Key words: Line x Tester, GCA, SCA, *Abelmoschus esculentus* (L.) Moench

Bhendi is one of the outstanding vegetables due its wide popularity and high nutritive value and is the only vegetable crop of family Malvaceae under the order Malvales with chromosome number of cultivated species $2n = 82 - 130$ and is regarded as an amphidiploid. It is predominantly a crop of tropics and sub-tropics. It is a self -pollinated crop. Bhendi is native of Ethiopia [1]. Bhendi is known by many local names in different parts of the world. In India it is known by various names such as vendai (Tamil), Bendakayi (Kannada), ventayakka (Malayalam), Bhendi (Hindi) and Asra-Patraka (Sanskrit). It is a multipurpose crop due to its various uses of the fresh leaves, buds, flowers, pods, stems and seeds. Okra mucilage has medicinal applications when used as a plasma replacement or blood volume expander. The mucilage of okra binds cholesterol and bile acid carrying toxins dumped into it by the liver. Okra has been called “a perfect villager’s vegetable” because of its robust nature, dietary fibre, and distinct seed protein balance of both lysine and tryptophan amino acids (unlike the proteins of cereals and pulses) [2-3]. The high quantity of folic acid within okra performs a huge role within the neural tube formation of the fetus through the fourth to the 12th week of pregnancy [4]. The line x tester analysis developed by Kempthorne has been used in this present study to estimate the genetic potentialities of the parents in hybrid combination [5]. Combining ability helps in the evaluation of inbred in terms of their genetic value and identification of

superior cross combinations. Keeping in view of the above facts, the objective of present study was to evaluate the general combining ability of parents and specific combining ability of hybrids for yield and its component traits.

MATERIALS AND METHODS

The present investigation consists of five genotypes viz., Annamalai local (L₁), Krishnagiri local (L₂), Karimangalam local (L₃), Chidambaram local (L₄), Cuddalore local (L₅) were used as lines and four genotypes viz., Varsha Uphar (T₁), Arka Anamika (T₂), Arka Abhay (T₃), MDU-1 (T₄) were used as testers were crossed in a line x tester mating design resulting 20 F₁ hybrids. All the 20 F₁ hybrids and their 9 parents were laid out in a randomized block design in three replications during two seasons February to April 2019 and December to February 2020 at the Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar (Tamil Nadu), India. Inter and Intra row spacing of 60 and 30 cm was provided and normal cultural and agronomical practices were followed as per the recommendation and need based plant protection measures were taken up to maintain healthy crop stand. The observations were recorded on ten randomly selected plants in each replication. The characters namely days to 50 per cent flowering, plant height at maturity, number of branches per plant, fruit length, fruit girth, average fruit weight, number of fruits per plant, number of seeds per fruit, 100 seed weight and fruit yield per plant were studied. The combining ability analysis was carried out by Kempthorne [6] method.

RESULTS AND DISCUSSION

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The analysis of variance indicated that existence of significant differences among the lines, testers and hybrids. The mean sum of squares due to lines and testers were significant for all the characters studied (Table 1). The variance due to line

× testers and hybrids were also significant for all traits. The combining ability of parents give useful information on the choice of parents in terms of expected performance of their progenies [7].

Table 1 Analysis of variance of Line × Tester analysis for various characters in Bhendi

Source of variance	Replication	Line	Tester	L × T	Error
DF	2	4	3	12	56
Days to 50 per cent flowering	2.1256	39.6279**	6.3056**	5.0347**	0.1516
Plant height at maturity	2.2276	1370.4349**	49.5986**	111.4766**	0.1474
Number of branches per plant	0.3874	0.7791**	0.6192**	0.1233	0.1342
Fruit Length	0.0799	37.6752**	40.7053**	5.0628**	0.2127
Fruit girth	0.1045	3.7398**	9.0323**	0.9103**	0.1434
Average fruit weight	2.1147	30.2065**	94.6360**	8.2803**	0.0753
Number of fruits per plant	1.8664	11.4110**	54.5568**	5.2629**	0.1324
Number of seeds per plant	2.2581	46.8457**	161.7566**	10.3592**	0.0988
100 seed weight	1.1542	7.4959**	1.7297**	0.1447**	0.1566
Fruit yield per plant	2.1978	18615.1667**	30080.0889**	1696.5229**	0.2141

Table 2 General combining ability effect of parents for various characters in Bhendi

Parents	Days to 50% flowering	Plant height at maturity	No. of branches per plant	Fruit length	Fruit girth	Average fruit weight	No. of fruits per plant	No. of seeds per fruit	100 seed weight	Fruit yield per plant
Lines										
L ₁	1.65**	10.92**	-0.16	-2.55**	-0.77**	-2.27**	-0.34**	-0.52**	-0.83**	-51.69**
L ₂	-1.93**	-10.51**	0.39 **	0.45**	0.49**	1.91**	1.30**	2.20**	0.71**	45.39**
L ₃	-0.87**	-7.97**	0.14 **	2.31**	0.56**	1.01**	0.63**	1.66**	0.53**	32.22**
L ₄	2.21**	12.00**	-0.17	-0.61**	-0.31**	-0.47**	-1.26**	-0.62**	-0.89**	-5.94**
L ₅	-1.06**	-4.43**	-0.19	0.41**	0.03	-0.18*	-0.33**	-2.72**	0.49**	-19.99**
SE for line	0.11	0.11	0.11	0.13	0.11	0.08	0.10	0.09	0.09	0.14
Testers										
T ₁	-2.40**	-2.40**	-0.16	-1.06**	-0.63**	-1.12**	-1.30**	-2.40**	0.21 **	-37.85**
T ₂	-0.29**	-0.29**	0.20 **	1.11**	0.49**	2.24**	1.75**	2.89**	-0.04	41.49**
T ₃	0.85**	0.85**	0.15 **	1.68**	0.83**	1.89**	1.52**	2.77**	0.29 **	35.96**
T ₄	1.83**	1.83**	-0.19	-1.73**	-0.69**	-3.01**	-1.96**	-3.26	-0.46**	-39.60**
SE for tester	0.11	0.11	0.10	0.12	0.11	0.07	0.09	0.08	0.09	0.12

Table 3 Specific combining ability effect of hybrids for various characters in Bhendi

Crosses	Days to 50% flowering	Plant height at maturity	No. of branches per plant	Fruit length	Fruit girth	Average fruit weight	No. of fruits per plant	No. of seeds per fruit	100 seed weight	Fruit yield per plant
L ₁ × T ₁	1.52**	2.23**	0.06	1.13**	0.42	1.54**	0.88**	1.04**	0.07	-3.97**
L ₁ × T ₂	-1.73**	0.34	-0.05	-1.06**	-0.11	-1.12**	-0.56**	0.73**	0.01	-10.45**
L ₁ × T ₃	0.33	-0.56*	-0.02	-1.69**	-0.39	-2.27**	-0.29	-0.73**	0.01	-8.72**
L ₁ × T ₄	-0.12	-2.01**	0.00	1.62**	0.08	1.85**	-0.04	-1.04**	-0.08	23.13**
L ₂ × T ₁	-1.65**	-5.69**	-0.28**	-1.38**	-0.38	-2.22**	-2.62**	-1.47**	-0.26 **	-6.04**
L ₂ × T ₂	2.05**	4.82**	0.18 **	1.04**	0.61 **	1.82**	1.52**	1.06**	0.22 **	- 6.60**
L ₂ × T ₃	-1.38**	3.72**	0.28 **	1.68**	0.50*	2.24**	1.61 **	2.10**	0.31 **	23.07 **
L ₂ × T ₄	0.98**	-2.85**	-0.17	-1.34**	-0.73**	-1.84**	-0.52*	-1.69**	0.28 **	-10.43**
L ₃ × T ₁	0.38	1.64**	0.12	-0.76**	-0.12	-0.33*	0.43*	0.49**	-0.03	-22.61**
L ₃ × T ₂	-0.84**	0.18	0.22 **	1.08**	0.04	1.14**	0.44*	-0.84**	0.32 **	16.68 **
L ₃ × T ₃	0.85**	-0.89**	-0.32 **	-0.79**	0.11	0.45**	0.16	0.28	-0.14	15.06 **
L ₃ × T ₄	-0.38	-0.92**	-0.02	0.47	-0.03	-0.78**	-1.03**	0.08	-0.14	41.13**
L ₄ × T ₁	1.33**	3.58**	0.10	-0.81**	0.40	0.66**	0.36	2.06**	0.31 **	15.63**
L ₄ × T ₂	-0.99**	3.13**	-0.25 **	0.90**	-0.91 **	-0.91**	-1.39**	0.14	-0.37 **	-3.46 **
L ₄ × T ₃	-0.14	1.08**	0.03	0.41	-0.30	-0.37*	-0.42*	-3.23**	0.09	9.60**
L ₄ × T ₄	-0.20	-7.79**	0.11	-0.50	0.80**	0.13	1.45**	1.03**	-0.09	-41.81**
L ₅ × T ₁	-0.37	-1.75**	-0.00	-0.03	-0.32	-0.13	0.94**	-2.12**	-0.09	16.99 **
L ₅ × T ₂	0.30	-8.47**	-0.10	-0.12	0.38	-0.44**	-0.02	-1.09**	0.09	3.93**
L ₅ × T ₃	0.34	-3.35**	0.03	0.39	0.07	-0.06	-1.07**	1.58**	-0.10	-8.88**
L ₅ × T ₄	0.27	13.57**	0.08	-0.25	-0.13	0.64**	0.14	1.63**	0.08	-12.03**

Estimation of combining ability revealed that the line Krishnagiri local exhibited significant and *gca* effects for days

to 50 per cent flowering, plant height at maturity, number of branches per plant, fruit length, fruit girth, average fruit weight,

number of fruits per plant, number of seeds per fruit, 100 seed weight and fruit yield per plant. The line Karimangalam local also exhibited significant and *gca* effects for number of branches per plant, fruit length, fruit girth, average fruit weight, number of fruits per plant, number of seeds per fruit, 100 seed weight and fruit yield per plant. Among the testers, Arka Anamika exhibited significant and *gca* effects for days to 50 per cent flowering, plant height at maturity, number of branches per plant, fruit length, fruit girth, average fruit weight, number of fruits per plant, number of seeds per fruit and fruit yield per plant. Arka Abhay also exhibited significant and *gca* effects for number of branches per plant, fruit length, fruit girth, average fruit weight, number of fruits per plant, number of seeds per fruit, 100 seed weight and fruit yield per plant [8-12]. Among the hybrids, the hybrid Krishnagiri local \times Arka Abhay was the best hybrid based on *sca* effects, since it exhibited significant *sca* effects for days to 50 per cent flowering, plant height at maturity, number of branches per plant, fruit length, fruit girth, average fruit weight, number of fruits per plant, number of seeds per fruit, 100 seed weight and fruit yield per plant. The hybrid Krishnagiri local \times Arka Abhay was promising among all the hybrids studied. The cross combination Karimangalam

local \times Arka Anamika exhibited significant *sca* effects for days to 50 per cent flowering, number of branches per plant, fruit length, average fruit weight, number of fruits per plant, 100 seed weight and fruit yield per plant [13-17].

CONCLUSION

Based on *Sca* effects of hybrids Krishnagiri local \times Arka Abhay was the best hybrid based on *sca* effects, since it exhibited significant *sca* effects for days to 50 per cent flowering, plant height at maturity, number of branches per plant, fruit length, fruit girth, average fruit weight, number of fruits per plant, number of seeds per fruit, 100 seed weight and fruit yield per plant. The hybrid Krishnagiri local \times Arka Abhay was promising among all the hybrids studied. The cross combination Karimangalam local \times Arka Anamika exhibited significant *sca* effects for days to 50 per cent flowering, number of branches per plant, fruit length, average fruit weight, number of fruits per plant, 100 seed weight and fruit yield per plant. These hybrids Krishnagiri local \times Arka Abhay and Karimangalam local \times Arka Anamika was adjusted as the best hybrids and suitable for exploitation of heterosis.

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