ESTIMATION OF COMBINING ABILITY FOR YIELD AND ITS COMPONENTS THROUGH DIALLEL MATING SYSTEM IN BHENDI [*ABELMOSCHUS ESCULENTUS* L. MOENCH.]

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Abstract

A set of seven parents along with forty two hybrids were evaluated to study the general and specific combining ability effects through diallel mating system. In the population, observations were recorded on single plant basis for various yield and yield attributing traits *viz*., days to first flowering (days), number of fruits per plants, fruit length (cm), fruit girth (cm), individual fruit weight (g), number of immature seeds, plant height at maturity (cm) and fruit yield per plant (g). Diallel analysis exhibited higher significance rate for all the traits indicating the presence of high genetic variability among the parents.

Contemplating the per se performance of parents, Thunder and Basanti promised to be the best parents for traits like number of fruits per plant, individual fruit weight, number of immature seeds and fruit yield per plant, besides Srivilliputhur local recorded high mean values for fruit length, fruit girth and plant height and shakthi for earliness. The *gca* effects of parents concluded that Srivilliputhur local proved to be the best parent for the traits like earliness, fruit length, individual fruit weight and fruit yield per plant. Furthermore the genotypes Srivilliputhur local, Basanti, Shakthi and Arka Anamika were found to be the next best parents and as well as good general combiners for various traits in this study.

Considering the *sca* effects, Srivilliuthur local x Thunder reported high *sca* effects for individual fruit weight, number of immature seeds, plant height and fruit yield per plant and Thunder × Arka Anamika for earliness. Furthermore taking an account on study other traits, the hybrids Srivilliputhur × Basanti and Srivilliputhur local × Arka Anamika displayed high *sca* effects for various traits and hence can be used as best hybrids with good specific combining ability.

Key words : General combining ability (*gca*), Specific combining ability (*sca*), Diallel analysis.

Introduction

Okra [*Abelmoschus esculentus* (L.) Monech] is the only substantial vegetable crop in the family malvaceae. It is an allopolyploid with chromosome number 2n = 72, 124, 130, 144. It's origin has found to be India (Master *et al*., 1875) Ethiopia (Cnadolle, 1883 and Vavilo, 1951) West Africa (Chevalier *et al*., 1940) Tropical Asia (Grubben *et al*., 1977). It is found throughout the tropics and subtropics (Hamon and Van Stolen, 1989). It ensures a potential foreign exchange accounting for about 60 percent of fresh vegetables from India to Middle East countries (Singh *et al*., 2014). Okra is consumed for its green tender fruits which banks up rich nutritional profie.

It is known for its richness of Iodine source. Its popularity in accordance with health concern is due to its contribution of high fibre, vitamin C and folate content. Furthermore, it harbours antioxidants and also serves as a good sources of Calcium and Pottasium. Though researches on various aspects of improvement in vegetable crops are being carried on, there is a need for identifying varieties with high yield which is still at its infancy in Bhendi breeding. Okra being an often cross pollinated crop, it exhibits good amount of variability of growth, earliness and other yield attributes (Manivannan *et al*., 2007; Yadav *et al*., 2007).

High yielding varieties are the target for a basic breeding programme, which is accomplished by the right choice of parents. The genotypes involved in the breeding programme should have good yield contributing traits

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along with the ability to combine well with other genotypes. Thus combining ability analysis serves as a potential to for identifying prospective parents for hybridization and shifting productive hybrids from a set of crosses in F1 generation (Griffing *et al.*, 1956). Additive and non additive gene actions in the parents estimated through combining ability analysis may be useful in determining the possibility for commercial exploitation of heterosis and isolation of purelines among the progenies of the heterotic F_1 and interpretation of the genetic basis of the important traits. Diallel analysis is useful for obtaining rapid overall picture of gene action involved in the inheritance of different quantitative traits. It is extensively used to test the combining ability of the single crosses in okra (Jindal *et al.*, 2007; Singh *et al.*, 2009). With the above mentioned perspective the present study was carries on to generate information on combining ability for yield and its attributing traits in okra.

Materials and Methods

The experimental material consisted of seven genotypes of wide genetic diversity, which were raised in a randomized block design with two replications in a separate crossing block. Ridges and furrows were formed at 45 cm spacing. Two seeds were dibbled per hill with the spacing of 40 × 30 cm. On the 12th day after sowing, thinning was done to ensure only one healthy seedling per hill. Hand emasculation was carried to ensure controlled pollination. Crossing in all possible combinations was done as in diallel system. The seeds obtained from the Forty two hybrids combinations and their seven parents in the crossing block were raised in three replications for evaluation. Cultural and agronomical package of practices were followed as per the standard recommendation and need based plant protection measures were taken up to maintain healthy crop stand. The observations were recorded on five randomly selected plants in each treatment in all three replications for characters *viz.*, like days to first flowering, number of fruits per plant, fruit length, fruit girth, individual fruit weight, plant height at maturity and fruit yield per plant. the diallel analysis as described by Griffing (1956) method I and model I was adopted to work out the combining ability effects with the assumption of the variety and block effects were constant. The mean values of each genotype were sufficient for combining ability analysis by diallel mating design to identify the parents with *gca* effects and cross combinations with high *sca* effects.

Table 1 : Analysis of variance for combining ability effects for yield and yield attributes characters.

Sources	Mean Sum of Squares							
	Days to first flowering (days)	Number of fruits per plant	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	No. of immature seeds	Plant height at maturity (cm)	Fruit yield per plant (g)
GCA	8.29**	62.45**	1.70	0.59	96.52**	66.17**	1105.66**	240936.68**
SCA	2.14*	17.26**	8.16**	0.40	62.23**	113.38**	877.40**	121299.46**
RCA	2.89**	15.09**	3.49	0.50	37.74**	28.68**	478.14**	69744.76**
GCA/SCA	3.87	3.61	0.20	1.47	1.55	0.58	1.26	1.98

*Significance at 5 per cent level   **Significance at 1 per cent

Table 2 : General combining ability effects of parents for various characters under study.

	Combining ability effects						
	Days to first flowering (days)	Number of fruits per plant	Fruit length (cm)	Fruit girth (cm)	Individual fruit weight (g)	Plant height (cm)	Fruit yield per pant (g)
Ankur 40	-0.17	-2.32**	0.20**	-0.33**	-4.20**	-11.41**	-219.58**
Srivilliputhur local	-0.71**	0.68**	0.43**	-0.00	3.96**	14.33**	171.55**
Basanti	-0.10	0.12	-0.45**	0.06**	2.05**	9.27**	62.11**
Shakthi	-0.52**	1.31**	-0.41**	0.18**	0.04	-2.03**	40.49**
Villupuram local	-0.30	-3.34**	-0.07**	-0.15**	-0.57**	-3.00**	-108.37**
Thunder	0.20	2.68**	-0.03	-0.04**	0.48**	-1.03	85.71**
Arka Anamika	-1.61**	0.88**	0.33**	0.28**	-1.77**	-6.13**	-31.91**

*Significance at 5 per cent level   **Significance at 1 per cent level.

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Table 3 : Estimates of specific combining ability of crosses for various traits.

S. no.	Hybrids	Days to first flowering (days)	No. of fruits	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	No. of immature seeds	Plant height at maturity (cm)	Fruit yield per plant (g)
1	Ankur 40 × Srivilliputhur local	-0.55	-0.12	-1.18**	-0.26**	-6.42**	-4.57**	-20.09**	-251.75**
2	Ankur 40 × Basanti	1.10**	-0.46	1.32**	-0.15**	3.24**	6.76**	16.60**	106.93**
3	Ankur 40 × Shakthi	-0.24	-0.14	-0.08	-0.43**	1.66**	3.35**	15.41**	49.97**
4	Ankur 40 × Villupuram local	0.37	0.45	0.98**	0.32**	0.66**	3.45**	0.80	28.10*
5	Ankur 40 × Thunder	-0.08	-1.57**	-1.17**	-0.20**	0.72**	3.29*	9.89**	-9.61
6	Ankur 40 × Arka Anamika	-1.41**	2.64**	2.20**	0.59**	2.77**	0.72	1.44	164.22**
7	Srivilliputhur local × Basanti	-0.79	-1.19*	-0.06	-0.64**	6.88**	5.30**	20.91**	220.51**
8	Srivilliputhur local × Shakthi	0.01	0.67	-0.45**	0.15**	4.78**	4.12**	19.80**	208.55**
9	Srivilliputhur local × Villupuram local	0.35	1.94**	-0.91**	-0.07**	3.21**	4.16**	9.57**	167.10**
10	Srivilliputhur local × Thunder	-0.09	-0.58	1.25**	0.47**	7.89**	9.00**	19.52**	299.70**
11	Srivilliputhur local × Arka Anamika	-0.01	2.74**	1.69**	-0.21**	2.53**	4.54**	7.83**	159.11**
12	Basanti × Shakthi	1.67**	0.12	0.08	0.17**	2.06**	1.62	15.63**	93.15**
13	Basanti × Vilupuram local	-0.36	-0.33	-0.35**	0.43**	1.54**	2.27	2.35	32.57*
14	Basanti × Thunder	0.06	-1.86**	-0.57**	-0.23**	-1.37**	3.78**	2.68	-90.75**
15	Basanti × Arka Anamika	-0.34	0.30	1.87**	0.23**	-0.28**	-1.28	-1.86	-7.78
16	Shakthi × Villupuram local	1.21**	2.36**	1.63**	0.42**	0.46**	0.76	-4.74**	58.71**
17	Shakthi × Thunder	-1.17**	0.94	-1.43**	-0.27**	-0.57**	1.21	5.99**	10.12
18	Shakthi × Arka Anamika	-0.75	2.00**	1.73**	-0.05**	2.44**	1.08	-3.39*	137.06**
19	Villupuram local × Thunder	-0.22	1.54**	2.59**	0.68**	1.49**	2.47	14.60**	86.84**
20	Villupuram local × Arka Anamika	-0.52	2.32**	-0.66**	-0.17**	0.96**	2.07	8.01**	83.05**
21	Thunder × Arka Anamika	-0.42**	1.68**	1.53**	0.00	0.24*	-1.36	-9.17**	45.66**

Results and Discussion

The analysis of variance of mean performance showed significant differences among genotypes indicating high genetic variability among the parents studied. The analysis of variance for combining ability indicated the importance of both additive and dominance gene effects on the inheritance of the different characters. Based on the *per se* performance of parents, the parent Shakthi was found to be earliest in flowering and best for number of immature seeds. Similarly the parent Srivilliputhur local shows high mean values for the traits like fruit length, fruit girth and plant height. The parents Thunder and Basanti proved to be the best parents for traits like number of fruits per plant, individual fruit weight and fruit yield per plant. Therefore, it is evident that the parents Thunder, Basanti, Srivilliputhur local and Shakthi were adjudged as best parents. Among the crosses, the best crosses based on per se performance was Srivilliputhur local × Thunder proved to be the best hybrids for traits like fruit length, individual fruit weight, plant height and fruit yield per plant and the cross Srivilliputhur local × Basanti with high performance for individual fruit weight and fruit yield per plant. Thunder × Arka Anamika proved to be the parent of earliness as it recorded the minimum mean values for days to first flowering and high performance for number of fruits per plant and fruit length. This is in accordance with the study carried by Amarantha (Reddy *et al*., 2013 and Jagan *et al*., 2013).

gca effects

The ability of an inbred to transmit desirable performance to its hybrid progenies is referred to as combining ability. (Sprague and Tatum, 1942). Considering the *gca* effects of seven parents, Srivilliputhur local proved to be the best parent for the characters like earliness, number of fruits per plant, fruit length, individual fruit weight, number of immature seeds plant height and fruit yield per plant and the parent Thunder proved to be the best parent for characters like earliness, number of fruits per plant, number of immature seeds and fruit yield per plant. Hence, it can be obvious that the parents Srivilliputhur local, Thunder and Shakthi are found to be the best parent and as well as good general combiner for various traits in this study. Similar results were reported by Singh and Sanwal (2001), Jagan *et al*. (2013).

sca effects

Based on the *sca* effects of hybrids Thunder × Arka Anamika recorded high performance for earliness. The crosses Srivilliputhur local × Thunder, Srivilliputhur local × Arka Anamika recorded high positive *sca* effects for fruit girth, individual fruit weight fruit length, plant height, number of immature seeds and fruit yield per plant. Thus the hybrids Srivilliputhur local × Thunder, Srivilliputhur local × Basanti and Thunder × Arka Anamika and Srivilliputhur local × Arka Anamika are found to be good specific combiners and were adjudged as the best hybrid and suitable for exploitation of heterosis. Similar results were reported by Jagan *et al*. (2013), Pal and Sabesan (2009).

Table 4 : Best parents, good general combining and best specific cross combinations for various traits under study.

S. no.	Characters	Best parents per se	Best general combiners	Best specific cross combinations
1.	Days to first flowering (days)	Shakthi (34.77)	Srivilliputhur local (-0.71**)	Thunder x Arka Anamika (-0.42**)
2.	Number of fruits per plant	Thunder (42.55**)	Thunder (2.68**)	Srivilliputhur local x Arka Anamika (2.74**)
3.	Fruit length (cm)	Srivilliputhur local (19.19**)	Srivilliputhur local (0.43**)	Srivilliputhur local x Arka Anamika (1.69**)
4.	Fruit girth (cm)	Srivilliputhur local (8.25**)	Arka Anamika (0.28**)	Ankur 40 x Arka Anamika (0.59**)
5.	Individual fruit weight (g)	Thunder (22.55)	Srivilliputhur local (3.96**)	Srivilliputhur local x Thunder (7.89**)
6.	Plant height (cm)	Arka Anamika (106.37)	Srivilliputhur local (14.33**)	Srivilliputhur local x Thunder (19.52**)
7.	Fruit yield per pant (g)	Thunder (960.00)	Srivilliputhur local (171.55**)	Srivilliputhur local x Thunder (299.70**)

*Significance at 5 per cent level   **Significance at 1 per cent level.

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