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Identification of best hybrid combination for fruit yield and its component traits in Okra (*Abelmoschus esculentus* (L). Moench.)

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Abstract
Present investigation was carried out with thirty lines and three testers with two replications at Main Agriculture Research Station, College of Agricultural College, University of Agricultural Science, Dharwad during 2015-2016 in order to determine the extent to which the heterosis is manifested for fruit yield and its component traits. The results revealed highly significant differences for all the characters among the parent and genotypes studied indicating the diversity among the parents and individuals. Among all the crosses evaluated, the cross combination DOIL40 × DOIL 19 exhibited highest heterosis for most of the characters under study.

Keywords: *Abelmoschus esculentus*, line x tester, better parent, heterosis, yield

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench.] is fast growing annual which has captured a prominent position among the vegetables and is commonly known as bhendi or lady's finger in India. Being a native of Tropical Africa it is grown for its tender fruits in tropics, sub-tropics and warmer seasons of the temperate areas in the world. India is the largest producer of okra in the world with an annual production of 63.46 mt with an area of 0.53 mha with a productivity of 11.90 t/ha (Anonymous 2014) [1]. Okra is belongs to the family *Malvaceae* under the order *Malvales*, having a more common somatic chromosome number of 2n = 72 to 144 and is considered to be an amphidiploid with n=12. For the higher production, productivity and pest and disease free we have to rely on hybrids to meet the required production for the growing population. And hybrids in other words consider heterosis and hence the present study carried out to look into the per cent heterosis is given by the particular hybrid over mid, better and commercial checks.

Materials and Methods

Experimental material comprised of 30 lines and 3 testers. The testers were crossed with each line and thus 90 F1s were produced. The 33 parents along with 90 F1s were grown in a randomized block design with two replications at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, during 2015. Each entry was sown in one row and 15 plants in each replication. Each row of 5 m length was spaced at 60 cm and plants were spaced at a distance of 30 cm in the rows. All the observations were recorded on days to 50 per cent flowering, number of branches per plant, plant height, number of fruits per plant, fruit length, fruit diameter, fruit weight, number of seeds per fruit, test weight, number of fruits per plant, fruit yield per plant and yield per hectare. The analysis of general and specific combining abilities for the above characters was calculated as per the model suggested by Kempthorne (1957) [4].

Results and Discussion

In the present investigation, 90 F1 hybrids derived from thirty Lines and three testers were evaluated using Line × Tester analysis with three commercial checks (Arka Anamika, Mahyco-10 and Pusa Sawani). The analysis of variance showed significant variation for treatments for all the characters. The interaction like females v/s males and parents v/s hybrids showed significant differences for most of the characters indicated that the selected material was appropriate for the study at arriving in identifying good general and specific combiners and gene effects involved in inheritance of various traits in okra (Table 1). The mean performance of hybrids for different traits studied were compared with the corresponding mid parent (MP), better parent (BP) and standard checks (Arka Anamika, Mahyco 10 and Pusa

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Sawani) and the differences are being expressed as per cent heterosis for fruit yield and its components (Table 2). The results are presented character wise as under.

Several workers conducted experiments with an objective of identification of best hybrid combination for fruit yield and its component traits, but in any study no single hybrid performed better for all the characters under study. The present study aimed at identifying best hybrid combination as much as possible number of characters for fruit yield and its component characters. And those hybrids with early maturing and high fruit yielding can be considered as best hybrid combination as fruit yield is considered as ultimate aim of any breeding progrrame. After identification evaluation of those hybrids showing good performance for number of characters under study with low heterosis reduction in the segregating generations with additive gene action can be successfully used in varietal development programme by individual plant selection basis.

Table 1: Mean sum of square (ANOVA) for fruit yield and its component traits

Characters	d.f	Days to fifty per cent flowering	Plant height (cm)	Number of branches per plant	Inter nodal length (cm)	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Number of seeds per fruit	Test weight (g)	Number of fruits per plant	Fruit yield per plant (g)	Fruit yield per hectare (tones)
Replication	1	1.04	1.51	0.01	0.23	0.25	0.09	3.08	11.88	0.03	1.18	1901.29	6.74
Genotypes	122	2.99**	737.05**	0.87**	17.21**	3.22**	0.02**	5.52**	269.72**	1.97**	43.28**	11512.36**	30.14**
Parents	32	2.41	445.78**	0.60**	20.36***	3.63**	0.02**	4.47**	58.27**	0.60**	30.44**	6218.44**	14.99**
Lines	29	2.50	469.68**	0.65**	20.53**	3.85**	0.02**	4.83**	50.01**	0.46**	33.24**	6622.51**	15.58**
Testers	2	1.16	213.64**	0.04**	7.44*	1.35	0.06	1.12	13.16**	0.76**	0.71	120.22	0.26
Lines *vs*/ testers	58	2.18	216.98**	0.05**	41.40**	1.78*	0.02**	0.71	387.93**	4.46**	21.62*	6696.90**	25.96**
Hybrids	89	0.89	849.00**	0.97**	16.02**	2.70**	0.02**	5.26**	151.82**	0.79**	40.45**	10820.24**	30.69**
Parents *vs*/ crosses	1	208.59**	93.67**	0.46**	21.69**	36.92**	0.05**	61.90**	17535.78**	150.52**	689.59**	242516.37**	466.75**
Error	122	229.95	7.94	0.01	2.00	0.44	0.04	2.11	15.70	0.09	5.29	656.47	2.13

* - 5% probability level

** - 1% probability level

Table 2: Top 3 desirable best hybrids with per se performance and heterosis over mid, better and commercial checks for 12 traits

Characters	Desirable cross	Female	male	F1	Mid parent	Better parent	Arka Anamika	Mahyco 10	Pusa Sawani
Days to fifty per cent flowering.	DOIL 7× DOIL 11	47.50	47.50	43.50	-8.42**	-8.42**	-3.33	-4.40	-6.45*
	DOIL 7× DOIL 19	47.50	48.00	44.50	-6.81**	-7.29*	-1.11	-2.20	-4.30
	DOIL 40× DOIL 19	48.00	48.00	43.50	-9.38**	-9.38**	-3.33	-4.40	-6.45*
Plant height.	DOIL 32× DOIL 11	147.50	170.10	228.50	43.89 **	34.33 **	26.73 **	38.32 **	30.20 **
	DOIL 39× DOIL 19	177.80	163.80	227.50	33.20**	27.95**	26.18**	37.71**	29.63**
	DOIL 63× DOIL 8	178.50	184.00	221.30	22.10**	20.27**	22.74**	33.96**	26.10**
Number of branches per plant.	DOIL 27× DOIL 11	2.00	0.40	3.00	150.00 **	50.00 **	114.29 **	114.29 **	150.00 **
	DOIL 35× DOIL 8	1.50	0.20	3.00	252.94 **	100.00 **	114.29 **	114.29 **	150.00 **
	DOIL 76× DOIL 11	0.40	0.40	2.65	56.50**	56.50**	89.29**	89.29**	120.83**
Inter nodal length.	DOIL 14× DOIL 19	12.30	9.50	9.15	-16.06	-25.61*	-14.49	-43.52**	-40.00**
	DOIL 15× DOIL 8	14.90	13.10	9.40	-32.86**	-36.91**	-12.15	-41.98**	-38.36**
	DOIL 15× DOIL 11	14.90	10.10	9.90	-20.80*	-33.56**	-7.48	-38.89**	-35.08**
Fruit length.	DOIL 7× DOIL 11	13.23	10.15	14.45	23.61 **	9.22	6.96	9.39	10.14 *
	DOIL 3× DOIL 8	11.10	10.12	14.40	35.72 **	29.73 **	6.59	9.01	9.76
	DOIL 70× DOIL 8	9.42	10.12	13.93	42.58 **	37.65 **	3.11	5.45	6.17
Fruit diameter.	DOIL 27× DOIL 19	1.17	1.39	1.26	-1.17	-8.99	-26.88**	-17.86**	-8.33
	DOIL 38× DOIL 11	1.32	1.38	1.30	-3.70	-5.80	-24.86**	-15.58**	-5.80
	DOIL 38× DOIL 19	1.32	1.39	1.26	-7.01	-9.35*	-27.17**	-18.18**	-8.70
Fruit weight.	DOIL 40× DOIL 19	9.5	10.95	18.30	78.97 **	67.12 **	49.14 **	31.42 **	49.02 **
	DOIL 70× DOIL 11	11.2	10.20	15.10	41.12 **	34.82 **	23.06	8.44	22.96
	DOIL 17× DOIL 11	11.05	10.20	15.10	42.12 **	36.65 **	23.06	8.44	22.96
Number of seeds per fruit.	DOIL 12× DOIL 19	58.5	71.50	102.50	57.69 **	43.36 **	60.16 **	58.91 **	62.70 **
	DOIL 78× DOIL 11	64.00	70.00	112.00	67.16 **	60.00 **	75.00 **	73.64 **	77.78 **
	DOIL 76× DOIL 19	64.00	71.50	105.00	54.98 **	46.85 **	64.06 **	62.79 **	66.67 **
Test weight.	DOIL 25× DOIL 19	7.40	8.50	10.00	25.79 **	17.65 **	16.28 **	12.99 **	9.29 **
	DOIL 25× DOIL 11	7.40	7.65	9.75	29.57 **	27.45 **	13.37 **	10.17 **	6.56
	DOIL 48× DOIL 19	7.30	8.50	9.75	23.42 **	14.71 **	13.37 **	10.17 **	6.56
Number of fruits per plant.	DOIL 39× DOIL 8	19.00	19.30	38.00	98.43 **	96.89 **	122.03 **	90.14 **	102.24 **
	DOIL 7× DOIL 19	23.04	19.16	35.70	69.17 **	54.95 **	108.59 **	78.63 **	89.99 **
	DOIL 39× DOIL 11	19.00	18.20	35.40	90.32 **	86.32 **	106.84 **	77.13 **	88.40 **
Fruit yield per plant.	DOIL 40× DOIL 19	220.32	195.78	586.85	182.07 **	166.36 **	180.35 **	101.37 **	113.98 **
	DOIL 17× DOIL 11	220.45	192.50	489.80	137.22 **	122.18 **	133.98 **	68.06 **	78.60 **
	DOIL 7× DOIL 19	318.62	195.78	466.54	81.39 **	46.43 **	122.87 **	60.08 **	70.11 **
Fruit yield per hectare.	DOIL 40× DOIL 19	15.11	11.43	31.33	136.01 **	107.24 **	180.82 **	101.77 **	115.29 **
	DOIL 17× DOIL 11	12.72	11.33	26.50	120.37 **	108.33 **	137.56 **	70.69 **	82.13 **
	DOIL 7× DOIL 19	18.13	11.43	24.45	65.43 **	34.86 **	119.18 **	57.49 **	68.04 **

* - 5% probability level

** - 1% probability level

And the hybrids DOIL 40 x DOIL 19 (inter nodal length, fruit diameter, fruit weight, fruit yield per plant and per ha), DOIL 20 x DOIL 19 (days to fifty percent flowering and number of seeds per fruit) and DOIL 17 x DOIL 11 (for fruit yield per plant and per ha) are considered as a best hybrid combination for fruit yield and its component characters.

Identification of best hybrid combination was also reported by, Rai *et al.* (2011), Khatikh *et al.* (2012) [5] and Ashwani *et al.* (2013) [2], Himani *et al.* (2015) [3] and Neetu *et al.* (2015) [6].

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