Indian J. Hort. 70(4), December 2013: 595-598

Short communication

Estimation of heterosis in okra for fruit yield and its components through diallel mating system

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ABSTRACT

Forty five F_1 hybrids developed from ten okra parents, *i.e.*, P-7, BO-2, KS-305, Arka Anamika KS-439, KS-419, KS-446 and Azad Bhindi-2 in a diallel fashion were evaluated along with a commercial variety (Pusa Sawani). Analysis of variance with respect to eight characters in parents and hybrids were highly significant. This indicated the existence of high variation in parents and hybrids for different characters studied. Out of 45 cross combinations, 14 crosses revealed the significant and positive heterosis over better parent. While 18 crosses showed positive and significant heterosis over economic parent. It is pertinent to mention that the crop has potential to produce the heterotic cross combinations and such crosses can be use for further improvement of this crop. Four crosses, namely, KS-450 × KS-419, KS-442 × Azad Bhindi-2, Arka Anamika × Azad Bhindi-2 and Arka Anamika × KS-442 were found potential for fruit yield and other desired characters. The high heterosis and *per se* performance was found in hybrid Arka Anamika × Azad Bhindi-2 over both better parents and standard check for fruit yield per plant. This indicates that the cross can be exploited commercially.

Key words: Heterosis, heterobeltiosis, diallel analysis, okra.

Okra is an important fruit vegetable grown for its tender pods in India. It is a power house of variable nutrients and a good source of vitamin A, B and C, protein and mineral elements. Singh *et al.* (6) analyzed fruit and reported 6.60 to 10.40% crude fibres, and about 84.60 to 90.50% edible protein. To start an effective breeding programme, it would be essential to have information on various genetic parameters mentioned above. This will help the breeder to design a suitable breeding programme, characters for selection and relative importance of various yield components to make the selection for final product to be more effective. The yield potential of okra is low. The productivity of this crop should be increased by improving the genetic architecture through hybridization and recombination. Indeed knowledge of heterosis of yield and its component characters should be placed greater emphasis for its.

Present investigation was carried out at Research Farm of DAV Post Graduate College, Muzaffarnagar. Forty five F_1 hybrids developed from ten parents, *i.e.* P-7, BO-2, KS-305, Arka Anamika, KS-442, KS-450, KS-439, KS-419, KS-446 and Azad Bhindi-2 in a diallel fashion excluding the reciprocals were evaluated. The parents were selected based on based on better adaptation and desirable agronomic characters. Parents and F_1s were evaluated along with a commercial variety (Pusa Sawani) in randomized block design (RBD) with three replications. Plants were raised at a spacing of 60 cm × 30 cm and recommended package of practices were followed to raise a good crop. Observations were made on five randomly selected plants in parents, F_1s and check in each replication for eight characters, *viz.*, days to flowering, plant height, No. of branches /plant, No. of nodes /plant, fruit length, width fruit, No. of fruits/ plant and yield per plant. The data was subjected to diallel analysis and the heterosis for economic check and batter parents parent were worked and using the methods of Hays *et al.* (2).

Analysis of variance with respect to eight characters in parents and hybrids revealed that mean sum of squares due to characters in parent and hybrids were highly significant for different characters (Table 1). This indicates existence of high variation in parents and hybrids for all the characters studied. The variance due to interaction between crosses vs. parents and F_2s showed significant differences for all the characters. However, variance due to parents vs F_2 was significant for days to flowering, plant height, width of fruit and yield/ plant. This differential variance indicates the chances of expression of heterosis for these characters. Among 45 hybrids, 18 crosses gave the significant heterosis over standard check. While 16 crosses showed the hetero-beltiosis (Table 2). Six crosses namely, P7 × KS -446, BO-2 × KS-305, BO2 × KS419, KS-450 × KS-419, KS-439 x KS-446 and KS419 × Azad Bhindi-2 flowered earlier than their respective early maturing parents. These

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Table 1. Analysis of variance for eight characters in 10 parents diallel cross of F_1 generation in okra.

Source of variance	Degree of freedom	Mean sum of squares for different characters							
		Days to flowering	Plant height	No. of branches /plant	No. of nodes /plant	Fruit length	Fruit width	No. of fruits/ plant	Yield/ plant
Replication	2	0.589	6.876	0.359	0.378	0.786	0.013	0.433	99.773
Treatment	54	29.695**	696.984**	1.698**	1.639**	8.889**	0.056**	15.169**	3789.553**
Parents	9	38.715**	350.799**	1.069**	0.972**	8.733**	0.059**	20.162**	2564.116**
F_1 hybrids	44	26.728**	806.986**	1.980**	1.886**	8.937**	0.039*	17.658**	4068.164**
Parents vs F_1s	1	80.094**	4698.084**	2.335**	2.628**	4.595*	0.309**	6.915**	9979.800**
Error	109	3.065	12.096	0.198	0.199	0.861	0.038	0.875	79.989

*, ** significant at 5 and 1% levels, respectively.

cross combinations can use for development of early maturing genotypes.

In respect of plant height nineteen and seven hybrids showed desirable heterosis over better and economic parent thereby suggesting possibility of producing taller genotype than existing varieties. Heterosis of similar magnitude has also been reported for both characters by Yadav *et al.* (9), Khatik *et al.* (3), Singh and Kumar (8), and Ashwani *et al.* (1). Six cross combinations, *viz.*, P7 × KS-305, P7 × KS-450, KS-305 × KS 419, Arka Anamika × Azad Bhindi-2, Arka Anamika × KS-439 and KS-442 × Azad Bhindi-2 revealed significant and positive heterosis over both parents (better and economic check). Similar results have been reported by Sood and Sharma (9), Singh and Kumar (8), and Yadav *et al.* (9). For number of nodes per plant, ten hybrids exhibited significant positive heterosis over their respective better parent, while 12 hybrids showed significant positive heterosis over economic check. These findings are in agreement with the findings of Sood and Sharma (9), Khatik *et al.* (3), and Yadav *et al.* (9). None of the cross combination was found to excel the fruit width compared to both parents. It indicates that fruit width could not be selected to improve the yield in okra. Similar findings were reported by Sharma *et al.* (5), Yadav *et al.* (9), and Singh and Kumar (8). Fifteen and ten crosses showed positive and significant heterosis over better parent and economic check, respectively for higher number of fruits per plant. It indicates that these hybrids may be used for further exploiting heterosis for the improvement of this character. Positive and significant heterosis for numbers of fruits per plant was reported by Singh *et al.* (7), Sood and Sharma (9), Kumar and Sreeparvadhy (4), and Yadav *et al.* (9). Out of 45 cross combinations, 14 crosses revealed the significant and positive heterosis over better parent, while, 18 crosses showed positive and significant heterosis over economic check for fruit yield per plant. It is pertinent to mention that the crop has potential to produce desired heterotic cross combination, which can be further used for improvement of this crop. Four crosses, namely, KS-450 × KS-419, KS-442 × Azad Bhindi-2, Arka Anamika × Azad Bhindi-2 and Arka Anamika × KS-442 were found significant for fruit yield. On the basis of the study, and *per se* performance hybrid Arka Anamika × Azad Bhindi-2 over both parents (better economic check) for fruit yield per plant could be exploited commercially.

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Table 2. Estimation of heterosis over better parent and economic check for best cross combination in diallel design in okra.

Cross		Days to flowering	Plant height	No. of branches/ plant	No. of nodes/ plant	Fruit length	Fruit width	No. of fruits / plant	Yield/ plant
P-7 × KS-439	BP	2.088	23.133**	-2.840	-2.825	24.386**	9.633	24.946**	7.048
	EC	-1.839	-28.740**	-1.856*	-1.885	6.896	1.441	-0.689	11.884**
P-7 × KS-446	BP	-9.189**	19.085**	-36.849**	-36.834**	-1.655	-0.166	24.633**	27.624**
	EC	67.740**	13.543**	-29.786	-29.855**	-15.063**	-8.0449	-8.888	15.039**
BO-2 × KS-305	BP	-6.446*	25.106**	-17.484	-17.448	15.999**	3.848	21.848**	-22.499**
	EC	-9.388**	-1.944	-8.546	-8.564	3.619	-7.549	7.587	13.844**
BO-2 × KS-419	BP	-8.589**	-66.579**	17.369	17.354	-4.336	1.546	1.898	33.826**
	EC	-11.640**	25.199**	19.188**	19.465**	-14.541**	-6.346	8.548**	45.340**
BO-2 × Arka Anamika	BP	-2.898	-26.334**	23.645**	23.696*	-6.993	-3.649	3.035	44.868**
	EC	-5.899**	-26.334**	-9.644	-9.336	-7.069	-3.642	9.833	44.308**
KS-305 × Arka Anamika	BP	17.847**	-10.592**	7.349	7.364	-1.496	2.029	-18.047**	20.999**
	EC	14.621**	-10.848**	18.898	18.883	-6.486	6.426	12.348	13.824**
KS-305 × KS-450	BP	0.694	0.698	2.488	-2.433	5.338**	13.641**	-12.496**	16.310**
	EC	-2.872	-20.743**	40.209**	-40.486	-5.896	-4.688	19.643**	68.024**
KS-305 × KS-439	BP	-4.996	45.036**	-4.243	-4.498	3.686	6.866	-28.108**	-1.234
	EC	-8.486**	14.538**	-5.538	-5.543	-7.456	-3.641	-1.346	41.859**
Arka Anamika × KS-442	BP	-0.947	5.462	30.066**	30.945**	-2.948	18.498**	26.846**	14.848**
	EC	-3.687	-17.043**	40.054**	44.635**	-12.643**	-2.456	0.670	23.578**
Arka Anamika × KS-446	BP	5.936*	-3.386	-8.229	-8.025	1.993	9.343	35.349**	24.828**
	EC	2.088	-3.688	-3.335	-3.316	-3.279	0.743	10.779	29.905**
Arka Anamika × Azad Bhindi-2	BP	-1.533	-10.135*	26.566**	26.551**	-4.665	1.533	41.033**	63.825**
	EC	-0.194	-10.544*	34.346**	34.336**	-8.949	-5.436	22.838**	66.649**
KS-442 × KS-439	BP	1.163	0.846	11.898	11.880	24.834**	-3.338	22.036**	58.995**
	EC	1.193	0.846	45.626**	-1.882	24.844**	-3.328	22.826	58.996**
KS-442 × KS-419	BP	-1.898	-0.865	-1.888	-1.872	-4.333	4.813	19.858**	48.389**
	EC	-2.394	-14.886**	-1.888	-1.882	6.337	-3.699	5.823	50.830**
KS-442 × KS-446	BP	-2.448	11.382	10.789	10.765	-2.926	4.380	20.879**	23.589**
	EC	-6.024*	-4.483	-12.086	-12.064	8.740	-3.335	-4.585	30.160**
KS-442 × Azad Bhindi-2	BP	0.828	49.038**	25.066**	24.991**	-5.368	-0.433	44.832**	43.840**
	EC	2.369	28.669**	27.145**	17.106**	5.442	-7.244	24.333**	55.898**
KS-450 × KS-419	BP	-9.433**	40.448**	-2.880	-2.765	8.933*	-5.468	30.844**	38.354**
	EC	-9.433**	40.468**	-2.689	-3.664	20.898**	-5.358	30.844**	39.556**
KS-450 × Azad Bhindi-2	BP	-0.633	14.093*	1.883	1.768	9.433	2.749	12.542	3.446
	EC	-1.148	-14.988**	3.634	3.696	-6.134	-4.398	-0.570	11.344*
KS-419 × KS-446	BP	-0.685	27.038**	-0.686	-0.564	18.376**	-3.248	10.634	13.036**
	EC	-4.279	0.146	-16.863	-16.688	0.855	-12.646*	-11.989	18.054*

*,** significant at 5 and 1% levels, BP = Better parent, EC = Economic check.

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Received : December, 2011; Revised : December, 2012; Accepted : March, 2013