Madras Agric. J. 89 (10-12) : 608-612 October-December 2002
https://doi.org/10.29321/MAJ.10.A00271

Combining ability analysis in certain okra hybrids (*Abelmoschus esculentus* (L.) Moench) and Parents

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Abstract : The general combining ability of four parents and specific combing ability of six direct crosses were estimated through combining ability analysis for yield and eleven other related traits in okra using a half diallel analysis. The ratio of *gca* to sca suggested the preponderance of non-additive gene action for inheritance of all the characters. The significant sca of the crosses were due to combinations of high x high, high x low, low x low gca of parents for individual fruit weight, plant height at final harvest, number of branches per plant and yield/ plant indicating additive x additive, additive x dominant and dominant x dominant types of interactions. The parent Varsha Uphar was adjudged as best general combiner and the hybrids MF-3 x Varsha Upphar, MF-3 x Anamika and Varsha Uphar x Arka Anamika were adjudged as the best specific combiners.

Key words : Okra, Combining ability.

Introduction

The analysis of combining ability helps the breeder in selecting suitable genotypes as parents for hybridization and for characterizing the nature and magnitude of gene action in the expression of particular trait. In okra the combining ability analysis made earlier revealed the significance of *gca* variance for days to flower and sca variance for plant height. In the present paper an attempt was made to study the combining ability variance and effects in four crosses involving a selected set of parents.

Materials and Methods

Seven parents resistant to yellow vein mosaic virus *viz.* MF-1, MF-2, MF-3, OHD-1, OHD-2, Arka Anamika and Varsha Uphar were raised during February-May 1998 at College orchard, Horticultural Colloege and Research Institute, Tamil Nadu Agricultural University, Coimbatore, in a randomized block design. From the results of the first season trial, four parents *viz.* MF-3(P1),OHD-1(P2,), Varsha Uphar (P3) and Arka Anamika (P4) were selected and raised during July-October. Combining ability analysis (Griffing, 1956) was carried out through a half-diallel design. The parents and hybrids were evaluated for plant height at first flower bud appearance, number of fruits plants^{-1}, individual fruit weight, fruit length, fruit girth, plant height at final harvest, number of branches plant^{-1}, yield plant^{-1}, phenol, carbohydrate, protein and crude fibre content

Results and Discussion

The variances of combining ability for 12 characters are presented in Table 1. A perusal of analysis of variance for combining ability showed that the variance associated with *gca* was significant for yield of fruits plant^{-1}. The variances due to sca was significant for the seven characters *viz.* plant height at first flowering, number of fruits plant^{-1}, individual fruit weight, number of branches plant^{-1}, plant height at final harvest, yield plant^{-1} and crude fibre content suggesting the importance of non-additive gene action. However the mean squares for sca was larger than those for *gca*. Similarly the estimated component of variance of sca was larger than those of *gca* for every character. The ratio of *gca* to sca was less than unity for all the characters suggesting the preponderance of non-additive gene action for inheritance of all the characters. A similar view

Table 1. Analysis of variance for combining ability in F_1 hybrids

Source	df	Plant height of first flower bud appearance	No.of fruits/ plant	Indivi-dual fruit weight	Fruit length	Fruit girth	Plant height at final harvest	No.of branches / plant	Yield/ Plant	Phenol	Carbo-hydrate	Protein	Crude fibre
GCA	3	0.600	1.244	1.063	0.070	0.111	0.179	1.059	338.337**	0.0004	0.038	0.0013	0.169
SCA	6	3.549*	12.567*	8.071*	0.611	0.305	46.733*	3.295*	3465.630**	0.009	0.288	0.105	7.715**
Error	18	0.022	0.622	0.268	0.098	0.008	9.344	0.258	15.356	0.0001	0.054	0.017	0.398
GCA/SCA		0.169	0.099	0.132	0.115	0.365	0.004	0.321	0.098	0.047	0.132	0.012	0.022

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

Table 2. Estimates of *gca* effects of parents in okra

Parents	Plant height of first flower bud appearance	No.of fruits/ plant	Indivi-dual fruit weight	Fruit length	Fruit girth	Plant height at final harvest	No.of branches / plant	Yield/ Plant	Phenol	Carbo-hydrate	Protein	Crude fibre
MF-3	0.197**	0.642*	-1.233**	-0.208	-0.465**	-0.818	-1.253**	-17.805**	-0.009**	-0.042	-0.055	0.643**
OHD-1	0.961**	-1686**	0.807**	-0.196	-0.333**	-1.026	1.223**	-13.387	-0.000	0.098	0.040	-0.490*
Varsha Uphar	-0.279**	0.872**	0.942**	0.421**	-0.097**	1.869	0.312	20.066**	0.002	0.225*	0.005	0.066**
Arka Anamika	-0.878**	0.172	-0.516*	-0.017	0.035	-0.026	-0.332	11.126**	0.007**	-0.281**	0.009	-0.219
SE (yi)	0.052	0.279	0.183	0.111	0.031	1.081	0.180	1.385	0.002	0.082	0.047	0.195
CD (0.01)	1.392	1.817	0.456	0.230	0.086	8.320	1.858	25.059	0.008	0.422	0.066	0.430
CE (0.05)	1.058	1.383	0.347	0.175	0.065	6.330	1.653	18.631	0.006	0.321	0.055	0.195

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

Table 3. Estimates of sca effects of hybrids

Hybrids	Plant height of first flower bud appearance	No.of fruits/ plant	Individual fruit weight	Fruit length	Fruit girth	Plant height at final harvest	No.of branches / plant	Yield/ Plant	Phenol	Carbo-hydrate	Protein	Crude fibre
MF-3 x OHD-1	0.915**	-4.215**	3.543**	0.442*	0.759**	0.413	-0.609	-51.834	-0.004	0.067	-0.158	3.552**
MF-3 x Varsha Uphar	-1.545**	3.870**	-4.162**	1.047**	-0.023	5.785**	0.418	-38.677	-0.026	0.373**	-0.290**	0.600
MF-3 x Arka Anamika	-2.346**	4.597**	0.247	0.016	-0.337**	9.913**	0.778	77.177	-0.008	0.146	-0.347**	-0.285
OHD-1 x Varsha Uphar	2.108**	-1.586**	-2.215**	0.451**	-0.590**	-9.174**	-1.057	-42.605	-0.028	0.070	-0.418**	3.100**
OHD-1 x Arka Anamika	1.107**	-1.169**	0.477	0.437*	-0.158*	0.920	-1.497	-9.148	-0.037	-1.127**	0.095	1.371**
Varsha Uphar x Arka Anamika	0.380**	0.150	-0.911*	-0.017	-0.483**	1.259	-2.836	-44.834	0.001	0.145	0.100	0.212
SE	0.094	0.499	0.318	0.198	0.056	1.933	0.322	2.478	0.003	0.147	0.083	0.399
CD (0.01)	3.409	4.063	1.019	0.516	0.192	18.604	1.192	53.450	0.016	0.943	0.201	0.585
CD (0.05)	2.592	3.091	0.775	0.392	0.146	14.155	1.145	40.843	0.014	0.717	0.146	0.393

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

in okra was shared by Sharma and Mahajan (1978), Singh and Singh (1979), Vijay and Manohar (1986), Nirmal Singh *et al.* (1995) and More and Patil (1997). The *gca*/sca ratio was highest for fruit girth (0.365) and lowest for plant height at final harvest (0.004).

The estimates of gca of parents is given in Table-2. The parent Arka Anamika showed high negative *gca* for plant height at first flower bud appearance, but its mean performance indicated a greater height. On the other hand OHD-1 flowered at a taller height however its *gca* was the highest. Such evidences reflect that ***per se*** performance did not relate to the *gca* for this character. Among the hybrids involving Arka Anamika, the sca was positive in two hybrids but negative in the hybrid MF-3 x Arka Anamika. Similarly the parent MF-3 showed positive *gca* effect while its hybrids showed high negative and significant sca indicating the role of both dominant and additive genes controlling the plant height at first flower bud apperance.

The higher sca in a hybird does not necessarily imply that the hybrid should perform well, as the sca represents deviation from the mean *gca* effects of its parents. Such instances have also been reported by Veeraragavathatham (1989) and Sivagamasundari (1991) for fruit number. This clearly indicates that a conclusion cannot be arrived at taking either *per se*

performance or *gca* or sca in isolation for successful heterosis breeding. However, testing of such hybrids over seasons or years may reveal a clear picture regarding the practical utility of these hybrids.

Individual fruit weight is yet another important yield component in bhendi. In the present study the parents varied widely in fruit weight. Analysis of variance for combining ability indicated that non-additive gene action also plays a role as indicated by significant variance due to sca. All the parents showed significant *gca* effect whereas the two hybrids Arka Anamika as male parent showed non-significant sca effect. The low x low general combiners resulted in a low sca hybirds revealed additive x additive genetic interaction (MF-3 x Arka Anamika). The hybirds MF-3 x OHD-1 and MF-3 x Varsha Uphar a high x low combiners expressed excellent heterotic effects due to the dominance created through the better parent. Srivastava *et al.* (1979) and Sivagama Sundari (1991) observed that the parents with such divergent mean performance always result in good hybrids, thus upholding the present result.

The *gcv* and sca variances showed non significance for phenol content. The hybrids OHD 1 x Arka Anamika, OHD-1 x Varsha Uphar, MF-3 x Varsha Uphar and Mf-3 x Arka Anamika representing low x low combinations resulted in high sca hybrids suggesting the role of inter-allelic interaction. The parents MF-3 and OHD-1 showed non-significant *gca* and sca of the MF-3 x OHD-1 also was found to be non-significant parents, parents with low sca resulted in hybrids with low *gca* indicating the role of additive genes for this character.

All the parents showed non-significant *gca* for protein content. The hybrids OHD-1 x Varsha Uphar, OHD-1 x Arka Anamika and MF-3 x Varsha Uphar produced negative and significant sca although the parents MF-3, OHD-1, Varsha Uhar and Arka Anamika had positive and non-significant *gca* thus indicating the role of dominance for this character.

The *gca* of parents coincides with the mean performance. Similarly the performance of most of the hybrids also reflect their sca. Further, the behavior of the hybrids was also predictable based on the *gca* of the parents thus indicating a strong additive gene action for crude fibre content. Similar observation have been reported by Sivagama Sundari (1991)

The hybrids involving MF-3 as female parent and Varsha Uphar as male parent expressed negative and significant sca for many characters, although both the parents had positive and significant *gca*. This indicated a complimentary gene action, which played a predominant role in controlling the character as reported by Basak and Dana (1971).

The significant sca of the crosses were due to the combinations of high x high, high x low or low x low *gca* parents for individual fruit weight, plant height at final harvest, number of branches per plant and yield per plant indicating additive x additive, additive x dominant and dominant x dominant types of interaction.

In conclusion, by selecting parents, it is possible to exploit the hybrid vigour through heterosis breeding. If it is obvious to consider the behavior of the traits like number of fruits per plant and individual fruit weight, the two most important yield-contributing traits. The parent Varsha Uphar was adjudged as the best general combiner for individual fruit weight, yield per plant, phenol content in leaves and crude fibre content in fruits. The hybrids MF-3 x Varsha Uphar, MF-3 x Arka Anamika and Varsha Uphar x Arka Anamika were adjudged as the best specific combiners for number of fruits per plant, individual fruit weight and yield per plant. However, testing the performance over years or locations may give a better

indication to select the appropriate hybrid or parent for practical exploitation.

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(Received : November 2000 ; Revised : June 2002)