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Gene Action Studies on Growth and Yield Attributing Traits in Okra (*Abelmoschus esculentus* (L.) Moench)

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ABSTRACT

Gene action for growth and fruit yield attributing traits in okra [*Abelmoschus esculentus* (L.) Moench.] were studied through half diallel analysis of 21 F_1 hybrids derived by crossing 7 parental lines (TCR-1674, SB-2, 440-10-1, VROB-178, TCR-1693, VRO-3 and VRO-6) and studied 14 growth and yield attributing traits. The ratio of *gca* to *sca* variances revealed that non-additive gene action was predominant over additive gene action in the inheritance of all the characters studied except for days to last picking. Hence, heterosis breeding is required to be followed for exploitation of all the traits under study.

Key words: *Gene action, Okra, Variance, Half diallel and Fruit yield*.

Okra [*Abelomoschus esculentus* (L.) Moench] commonly known as lady's finger belongs to the family Malvaceae. Tender okra fruits are used as vegetable in countries like India, Brazil, West Africa and is also available in dehydrated and canned forms. The sun-dried (Africa, India), frozen and sterilized (USA) fruits are other important market products. Okra fruit contains 90% water, 3% dietary fibre, 7% carbohydrates, 2% protein, good quantities of minerals, vitamin C and A and moderate contents of thiamin, folate and magnesium (Chopra *et al*., 1956). The roots and stems of okra are used for cleaning the cane juice. Mature fruits and stems containing crude fibre are used in the paper industry (Chauhan, 1972).

The knowledge of nature of gene action governing the expression of various traits could be helpful in predicting the effectiveness of selection. The efficient partitioning of genetic variance into its components like additive, dominance and epistasis will help in formulating an effective and sound breeding programme. Diallel mating design has been used extensively by several researchers to measure gene action for yield and yield components in okra (Jindal *et al*., 2009); (Singh *et al*., 2009). The present investigation was, therefore, undertaken with a set of half diallel crosses to elicit information about the nature and magnitude of gene action for yield and its components in okra so as to formulate suitable breeding strategy.

MATERIAL AND METHODS

Seven okra genotypes *viz.*, TCR-1674, SB-2, 440-10-1, VROB-178, TCR-1693, VRO-3 and VRO-6 were chosen in this study to represent substantial amount of genetic diversity for different quantitative traits and were maintained through selfing during 2020. These seven genotypes were involved in 7 × 7 half-diallel combinations to develop 21 F_1 hybrids during *Summer*, 2021. All the F_1's along with their parents were evaluated in a Randomized Block Design with three replications during *Kharif*, 2021 at College of Horticulture, Venkataramannagudem, Andhra Pradesh. The crop was raised in three rows of 4 m length with inter and intra row spacing of 60 and 30 cm, respectively. Five randomly selected plants from each entry were tagged in each replication for recording observations on different characters *viz.*, plant height (cm), days to first flowering, internodal length (cm), first flowering node, days to 50% flowering, days to first picking, days to last picking (days), number of fruits per plant, fruit length (cm), fruit girth (cm), average fruit weight (g), number of seeds per fruit, test weight of seeds (g) and fruit yield per plant (g). Data were analyzed according to

ANOVA techniques, as outlined by Panse and Sukhatme (1985) to determine the significant differences among genotypes for all the characters. Components of genetic variance were estimated from the data obtained on the diallel crosses by the method given by Griffing's Method-II and Model-I (Griffing, 1956) as outlined by (Singh and Chaudhary, 1979).

RESULTS AND DISCUSSION

The analysis of variance carried out for different traits of okra are presented in Table 1. The differences due to the treatments were significant for all the characters studied except for the days to last picking. The treatment means were further sub divided into parents, hybrids and parents versus hybrids. The parents showed significant difference for all the characters studied except for days to 50% flowering, days to last picking and fruit length. The hybrids showed significant difference for all the characters studied except for the days to last picking. The parents versus hybrids showed significant differences for the characters plant height, intermodal length, first flowering node, number of fruits per plant, fruit length, fruit girth, average fruit weight, number of seeds per fruit, test weight of seeds, fruit yield per plant and other characters are non significant. The variances for general combining ability and specific combining ability are highly significant for all the characters studied except for days to last picking. These results are in conformity with the findings of Tiwari *et al*. (2016), Shwetha *et al*. (2018), Hadiya *et al*. (2018), Koli and Patel (2020), Arvind *et al*. (2021) and Rajani *et al*. (2021) in okra.

The nature of gene action has been inferred from the estimates of GCA and SCA variances. The estimates of combining ability variances (ó^{2}gca and ó^{2}sca) and the ratio of ó^{2}gca/ó^{2}sca have been presented in Table 2. The estimates of ó^{2}gca/ó^{2}sca revealed the predominant role of non-additive gene action governing for all the traits except for days to last picking, as the ratio ó^{2}gca/ó^{2}sca is less than unity. Hence, heterosis breeding could be exploited for these traits. If ó^{2}sca is higher than ó^{2}gca under such conditions, recurrent selections shall prove effective. These results of the present investigation are in conformity to the findings of Koli and Patel (2020), Ratnakumari *et al*. (2020), Arvind *et al*. (2021) and Rajani *et al*. (2021) in okra. Since non-additive variances were found to be important in the genetic control of all quantitative traits in the present study, the use of a population improvement method in the form of diallel selective mating with concurrent random mating might be effective in improvement of yield and its attributes in okra.

The presence of non-additive gene action revealed that heterosis breeding is required to be followed for further improvement of okra. Sufficient genetic variability was generated for yield and related traits after crossing seven diverse genotypes of okra in a diallel mating design (excluding reciprocals).

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Table 1. Analysis of variance for combining ability of growth and yield traits in okra

Source	Df	Plant height (cm)	Days to first flowering	Internodal length (cm)	Days to 50% Flowering	First flowering node	Days to first picking	Days to last picking	Number of fruits per plant
Replicates	2	0.668	2.749	0.031	0.742	0.003	1.065	9.633	0.014
Treatments	27	96.771 **	4.474 **	0.173 **	2.865 **	0.782 **	10.605 **	6.998	11.539 **
Parents	6	148.413 **	6.546 **	0.130 **	2.195	1.362 **	31.506 **	6.396	18.092 **
Hybrids	20	83.967 **	3.877 **	0.180 **	2.991 **	0.574 **	4.863 **	7.527	9.903 **
Parent Vs. Hybrids	1	43.011 **	3.975	0.288 **	4.363	1.460 **	0.019	0.015	4.934 **
Error	54	5.3	1.119	0.015	1.268	0.016	1.231	6.077	0.219
GCA	6	74.368 **	2.423 **	0.096 **	1.410 **	0.218 **	6.170 **	3.875	7.619 **
SCA	21	20.225 **	1.225 **	0.047 **	0.825 *	0.273 **	2.782 **	1.892	2.768 **
Error	54	1.767	0.373	0.005	0.423	0.005	0.41	2.026	0.073

**** 1% level of significance, * 5% level of significance**

Table 1. Cont.

Source	Df	Fruit length (cm)	Fruit girth (cm)	Average fruit weight (g)	Number of seeds per fruit	Test weight of seeds (g)	Fruit yield per plant (g)
Replicates	2	0.002	0.01	0.202	8.11	0.005	31.562
Treatments	27	1.303 **	0.362 **	11.520 **	473.430 **	2.966 **	8230.461 **
Parents	6	0.106	0.205 **	4.106 **	548.302 **	1.776 **	7343.659 **
Hybrids	20	1.491 **	0.253 **	10.971 **	450.338 **	3.415 **	7276.519 **
Parent Vs. Hybrids	1	4.742 **	3.477 **	57.002 **	486.028 **	1.111 **	32630.100 **
Error	54	0.1	0.027	0.199	2.292	0.027	73.716
GCA	6	0.347 **	0.078 **	4.616 **	274.177 **	1.033 **	2893.303 **
SCA	21	0.460 **	0.133 **	3.618 **	124.562 **	0.976 **	2700.682 **
Error	54	0.033	0.009	0.066	0.764	0.009	24.572

**** 1% level of significance, * 5% level of significance**

Table 2. Combining ability variances and gene action for growth and yield traits in okra

Source	Plant height (cm)	Days to first flowering	Internodal length (cm)	Days to 50% Flowering	First flowering node	Days to first picking	Days to last picking	Number of fruits per plant	Fruit length (cm)	Fruit girth (cm)	Average fruit weight (g)	Number of seeds per fruit	Test weight of seeds (g)	Fruit yield per plant (g)
$\sigma^2 gca$	6.015	0.133	0.005	0.064	-0.006	0.376	0.22	0.538	-0.01	-0.01	0.11	16.623	0.006	21.402
$\sigma^2 sca$	18.46	0.852	0.041	0.402	0.267	2.371	-0.133	2.695	0.426	0.123	3.552	123.798	0.966	2676.11
s^2gca/s^2sca	0.325	0.156	0.13	0.161	-0.022	0.158	1.648	0.199	-0.03	-0.05	0.031	0.134	0.006	0.008

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