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Gene action studies for fruit yield and its components Okra (*Abelmoschus esculentus* (L.) Moench)

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Abstract

The present investigation was conducted at experimental research farm during summer-2022 (Crossing) and kharif 2022 (evaluation), with a view to study the gene action, of three crosses (each having P₁, P, F, F₂, BC₁ and BC₂ generations) in a Randomized block design with two replications. Analysis of variance for yield and yield components showed significant differences among the genotypes which indicated the presence of considerable. Variability in the material under study which means selection can be carried out with those generations. The scaling test exhibited that, there was presence of epistatic gene interaction. The duplicate epistasis were observed in, days to 50 per cent flowering, number of nodes per plant, number of branches per plant, number of fruits per plants and fruit length appeared in all three crosses. For plant height and weight of fruit in the crosses, Parbhani kranti x Varsha Uphar and Arka Abhay x EC-305672 and complementary epistasis for the characters viz., plant height, internodal length and weight of fruit detected duplicate epistasis. This suggests the need of specific breeding procedure such as intermating of most desirable segregants followed by selfing and selecting superior genotypes coupled with progeny testing to exploit the population under study. Both additive and non-additive gene actions were detected in all yield contributing characters. Selection in early generation would be effective, when additive effects are larger than non-additive ones. While if the non-additive portions are larger than additive one, the improvement of the character need intensive selection through later generations.

In all three crosses for all the traits under study (except number of fruits per plant in the cross) exhibited high heritability, which indicate that heritability of these traits were due to additive gene action. For improvement of such traits selection will be rewarding.

Keywords: High heritability, high heritability, contributing characters, randomized block design

Introduction

Okra (*Abelmoschus esculentus* (L.) Monech) is an important vegetable crop grown in the tropical and subtropical parts of the world. Okra belongs to family malvaceae with 2n =130 chromosomes and amphidiploid nature.

To achieve the increase in yield per unit area the yield level have been improved effectively through intensive and concerted breeding efforts and further yield advances seem to be more difficult necessitating the application of latest breeding approaches. The estimation of the type of gene effects in plant population is essential for selection of appropriate breeding procedure. Generation mean is the most common tool helping directly in estimation of gene effects and components of genetic variance. Generation mean analysis can be used to evaluate the mode of gene action for quantitative traits specifically yield components. Thus, studying the relationships and genetic diversity among breeding materials is essential to the plant breeders for the further improvement of the crop.

Developing early flowering and accordingly early maturing okra varieties with short growth cycle and higher fruit yield is important objective for the plant breeder. All the traits are polygenic in nature and their inheritance follow the Mendelian principles also, their expression is greatly influenced by the environmental fluctuations. By involving the polygenic traits, a certain type of families can be produced from which covariances of different kinds of relatives are calculated to draw out the genetic information for the genetic improvement programmes. Expression of yield is a result of the interaction of several contributing characters. In planning of breeding programme and achieving efficient results in the succeeding generations, the knowledge of genetic architecture and inheritance pattern of yield for the breeder is very essential. For effective implementation of the breeding programme, the availability of genetic information so far needs for further elaboration.

Scaling test and joint scaling test were used to detect the non-allelic interaction and gene effects, respectively. In okra, characters which are needed to be focused in crop improvement are early flowering, number of branches, higher fruit yield, fruit length, disease-pest resistance, fruit diameter, number of fruits per plant and plant height. Moreover, understanding the genetics of various characters, exploitation of hybrid vigour and the improvement of quality aspects according to export market need to be concentrated in okra improvement programmes.

Materials and Methods

The present investigation on “Assessment of genetic architecture of fruit yield and its related traits in Okra (*Abelmoschus esculentus* [L] Moench) through generation mean analysis” was accomplished during *Kharif* season.

Experimental material

The experimental material consisted of six generations *viz.*, P₁, P₂, F₁, F₂, BC₁ and BC₂ of each of the three crosses obtained by crossing diverse parents *viz.*, Parbhani Kranti, Varsha Uphar, Kokan Bhendi, Arka Anamika, Arka Abhay and EC- 305672 were used to study the genetic analysis of ten characters. The details of the experimental material used are given in Table 1.

Table 1: Details of experimental material used for experimentation

Generation	Cross- 1	Cross- 2	Cross-3
P ₁	Parbhani Kranti	Kokan Bhendi	Arka Abhay
P ₂	Varsha Uphar	Arka Anamika	EC- 305672
F ₁	Parbhani Kranti x Varsha Uphar	Kokan Bhendi x Arka Anamika	Arka Abhay x EC- 305672
F ₂	Self of F ₁	Self of F ₁	Self of F ₁
BC ₁	(Parbhani Kranti x Varsha Uphar) x Parbhani Kranti	(Kokan Bhendi x Arka Anamika) x Kokan Bhendi	(Arka Abhay x EC- 305672) x Arka Abhay
BC ₂	(Parbhani Kranti x Varsha Uphar) x Varsha Uphar	(Kokan Bhendi x Arka Anamika) x Arka Anamika	(Arka Abhay x EC- 305672) x EC- 305672
Check	Parbhani Kranti		

Crossing programme

The breeding material consisting F₁'s of three crosses and their six genetically diverse parents *viz.*, Parbhani Kranti, Varsha Uphar, Kokan Bhendi, Arka Anamika, Arka Abhay and EC- 305672 were grown in summer-2022 to advance the F₂'s (selfing of F₁) and to develop BC₁ and BC₂ crosses by hand emasculation and pollination. Thus, seed of six generation, P₁, P₂, F₁, F₂, BC₁ and BC₂ of three crosses were produced.

Observations Recorded

The observations were recorded on all the randomly selected plants from each genotypes and on the quantitative traits are given below.

A. Growth characteristics

- Plant height (cm)
- Inter nodal length (cm)
- Number of branches per plant
- Number of nodes per plant
- Days to 50 per cent flowering

B. Fruit characteristics

- Fruit length (cm)

- Fruit weight (g)
- Fruit diameter (cm)

C. Yield characteristics

- Number of fruits per plant
- Fruit yield per plant (g)

Statistical Methods

To test the significance of differences between treatments, the analysis of variance for Randomized Block Design (RBD) was carried out as per procedure given by Panse and Sukhatme (1985) [7] for all metric characters under study as below,

Results and Discussion

Scaling test and estimation of gene effects

Genetic analysis of mean values of all the six generation *viz.*, P₁, P₂, F₁, F₂, BC₁ and BC₂ for ten characters of three crosses were subjected to genetic analysis. The test of adequacy of scale is important because in most of the cases the estimation of additive and dominance component of variance is made assuming the absence of gene interaction. The simple scaling test of A, B, C and D of Mather (1949) [8] and joint scaling test of Cavalli's (1952) [11] applied to detect epistasis. When the scale is equate, the values of A, B, C and D should be zero within the limits of their respective standard error. The significance of any one of these scale and significant χ^2 indicated the presence of non-allelic interaction and six parameter (m, d, h, i, j and l) model as suggested Hayman (1958) [9] and Jink and Jones (1958) [10] was applied to partition gene effects into epistatic components including principle gene effects. The character and cross-wise results are presented in the Table 2.

Individual scaling tests A, B, C, and D depicts the existence of epistasis in all the crosses for all the traits. Hayman's (1958) [9] six-parameter model with three digenic interaction parameters was used as the generation means. All scaling tests A, B, C and D were found significant for the crosses, Parbhani Kranti x Varsha Uphar, Kokan Bhendi x Arka Anamika and Arka Abhay x EC-305672 for the traits *viz.*, number of nodes per plant, and fruit weight. The cross, Parbhani Kranti x Varsha Uphar was found significant for all the scaling tests *viz.*, A, B, C and D for the traits *viz.*, internodal length, number of branches per plant, days to 50 per cent flowering, diameter of fruit and fruit yield per plant. Significance of all four scaling test *viz.*, A, B, C and D were recorded in cross Kokan Bhendi x Arka Anamika for different traits *viz.*, plant height, internodal length, days to 50 per cent flowering, number of fruits per plant and fruit length. The cross Arka Abhay x EC-305672 was found significant for all the scaling tests *viz.*, A, B, C and D for the traits *viz.*, plant height, diameter of fruit and fruit yield per plant. The scaling tests B, C and D were found significant for the cross, Parbhani Kranti x Varsha Uphar for traits *viz.*, number of fruits per plant and fruit length. The significance of scaling tests B and C were found in the cross Parbhani Kranti x Varsha Uphar for the single trait plant height. The scaling traits A, B and D were found significant for the cross Arka Abhay x EC-305672 for days to 50 per cent flowering and fruit length.

The chi square (χ^2) values for the traits, *viz.*, plant height, internodal length, number of nodes per plant, number of branches per plant, days to 50 per cent, number of fruits per

plant, fruit length, diameter of fruit, weight of fruit and fruit yield per plant was recorded significant in all the three crosses indicated that, inadequacy of three parameter model to explain the genetic variability for this traits. The inadequacy of the model also showed the presence of non-allelic gene interaction (epistasis), which was also conclude from the generation means. As the three parameter model did not sufficiently explain the genetic diversity for internodal length,

length of fruit, diameter of fruit, fruit weight and fruit yield per plant therefore, a six parameter model was applied to accommodate epistatic interactions.

Gene effects

The results showed that non-allelic gene interactions of six parameter model of generation mean analysis was presented in Table 3.

Table 2: Scaling test and Joint scaling test for different characters of three crosses in okra

Crosses	A	B	C	D	X ² Values
Plant height (cm)					
Parbhani Kranti x Varsha Uphar	-8.10±4.16	17.10**±0.97	8.10*±3.53	-0.45±2.53	S
Kokan Bhendi x Arka Anamika	-39.10**±2.76	-36.30**±5.80	-112.00**±7.97	-18.30**±4.52	S
Arka Abhay x EC-305672	-23.50**±4.20	29.20**±4.16	-12.80*±5.33	-9.25**±2.54	S
Internodal Length (cm)					
Parbhani Kranti x Varsha Uphar	-0.55**±0.17	1.60**±0.06	4.07**±0.23	1.51**±0.11	S
Kokan Bhendi x Arka Anamika	-0.85**±0.16	-0.95**±0.20	-0.70**±0.20	0.55**±0.14	S
Arka Abhay x EC-305672	0.10±0.15	-1.20**±0.25	-2.30**±0.39	-0.60**±0.18	S
Number of nodes per plant					
Parbhani Kranti x Varsha Uphar	1.50**±0.21	3.00**±0.15	3.10**±0.34	-0.70**±0.13	S
Kokan Bhendi x Arka Anamika	-2.20**±0.55	-2.80**±0.27	-13.20**±1.27	-4.10**±0.62	S
Arka Abhay x EC-305672	-3.90**±0.34	-4.70**±0.26	-1.70*±0.72	3.45**±0.35	S
No. of branches per plant					
Parbhani Kranti x Varsha Uphar	0.20**±0.04	-0.10**±0.03	-0.90**±0.08	-0.50**±0.01	S
Kokan Bhendi x Arka Anamika	0.80**±0.04	0.10±0.07	0.20**±0.07	-0.35**±0.03	S
Arka Abhay x EC-305672	-0.20**±0.06	0.30**±0.03	0.00±0.03	-0.05±0.03	S
Days to 50(%) flowering					
Parbhani Kranti x Varsha Uphar	2.70**±0.16	-5.80**±0.38	-7.70**±0.31	-2.30**±0.16	S
Kokan Bhendi x Arka Anamika	-4.40**±0.35	-2.00**±0.18	-3.60**±0.40	1.40**±0.107	S
Arka Abhay x EC-305672	1.00**±0.17	-1.60**±0.14	0.30±0.18	0.45**±0.06	S

Crosses	A	B	C	D	X ² Values
No. of fruits per plant					
Parbhani Kranti x Varsha Uphar	0.10±0.40	2.80**±0.14	-13.30**±0.17	-8.10**±0.22	S
Kokan Bhendi x Arka Anamika	0.70**±0.21	-1.80**±0.16	-12.30**±0.76	-5.60**±0.38	S
Arka Abhay x EC-305672	0.20±0.24	-2.40**±0.68	2.20**±0.29	2.20**±0.33	S
Fruit length (cm)					
Parbhani Kranti x Varsha Uphar	-0.28±0.59	-2.50**±0.30	2.69**±0.13	2.73**±0.33	S
Kokan Bhendi x Arka Anamika	0.76**±0.06	2.50**±0.07	1.45**±0.36	-0.91**±0.18	S
Arka Abhay x EC-305672	1.03**±0.04	-0.14*±0.05	-0.20±0.19	-0.54**±0.09	S
Diameter of fruit (cm)					
Parbhani Kranti x Varsha Uphar	-0.16**±0.02	0.19**±0.01	0.15**±0.02	0.06**±0.01	S
Kokan Bhendi x Arka Anamika	0.02±0.01	0.26**±0.00	0.17**±0.02	-0.05**±0.00	S
Arka Abhay x EC-305672	-0.14**±0.03	-0.20**±0.02	-0.27**±0.03	0.04*±0.02	S
Weight of fruit (g)					
Parbhani Kranti x Varsha Uphar	-1.99**±0.18	-0.50*±0.23	9.02**±0.59	5.76**±0.26	S
Kokan Bhendi x Arka Anamika	1.37**±0.33	1.90**±0.50	5.77**±0.92	1.25**±0.43	S
Arka Abhay x EC-305672	-4.06**±0.47	-2.37**±0.36	2.43**±0.63	4.43**±0.24	S
Fruit yield per plant (g)					
Parbhani Kranti x Varsha Uphar	-14.69**±4.83	19.47**±4.62	178.09**±5.28	86.65**±2.92	S
Kokan Bhendi x Arka Anamika	29.39**±2.38	-3.19±4.63	-81.46**±4.92	-53.83**±1.86	S
Arka Abhay x EC-305672	-40**±1.20	-69.30**±4.63	52.69**±6.13	81.28**±3.85	S

* and ** significant at 5 and 1 per cent level respectively.

The highly significant mean values from the generation mean analysis in three crosses showed that, the six generation differed from each other and these all studied traits are quantitatively inherited. The additive component (d) was found negatively significant for the characters viz., plant height, internodal length, number of nodes per plant, fruit weight and fruit yield per plant in the crosses, Parbhani Kranti x Varsha Uphar and Arka Abhay x EC-305672. The additive (d) effect was found positively significant for plant height, internodal length, number of nodes per plant, number of

branches per plant, number of fruits per plant and fruit yield per plant in the cross Kokan Bhendi x Arka Anamika whereas, negatively significant for the traits, viz., days to 50 per cent flowering, length of fruit and diameter of fruit in cross Kokan Bhendi x Arka Anamika. The additive (d) effect in a cross Parbhani kranti x Varsha Uphar exhibited positive and significant interaction for the traits viz., number of branches per plant, days to 50 per cent flowering and fruit length, while, negative and significant interaction was noticed for the traits, number of fruits per plant and diameter of fruit.

The additive (d) effect found positively significant in cross, Arka Abhay x EC-305672 for the traits days to 50 per cent flowering and fruit length, whereas negative and significant effect of additive component was recorded for the character number of branches per plant.

All the three hybrids viz., Parbhani kranti x Varsha Uphar, Kokan Bhendi x Arka Anamika and Arka Abhay x EC-305672 showing positive and significant dominance (h) effects for traits, viz., plant height and number of branches per plant. The positive and significant and positive dominance (h) effect was observed in cross, Parbhani Kranti x Varsha Uphar for the traits such as, number of nodes per plant, days to 50 per cent flowering and number of fruits per plant, while, negatively significant dominance (h) effect were observed for the characters viz., internodal length, fruit length, diameter of fruit, weight of fruit and fruit yield per plant. The cross Kokan Bhendi x Arka Anamika shows significant and positive dominance (h) effect for the internodal length, number of nodes per plant, number of fruits per plant, fruit length, diameter of fruit and fruit yield per plant whereas, negative and significant dominance (h) effect observed in days to 50 per cent flowering. The hybrid Arka Abhay x EC-305672 showing negative and significant dominance (h) effects for traits viz., number of nodes per plant, days to 50 per cent flowering, number of fruits per plant, weight of fruit and fruit yield per plant, whereas, positive and significant dominance effect was noticed for fruit length. Greater importance of dominance effect in the expression of all the studied traits, was evaluated through result by estimating magnitude of dominance (h) component, which was higher than that of additive (d) gene effect. For the exploitation of dominance effect non-conventional breeding procedure might be adopted. Epistasis gene effects are known to contribute a sizable part of

variation in the genetic makeup of character which shows higher estimate of dominance effects (Gamble, 1962). In the present investigation also, high estimate of dominance (h) effect for above traits were associated with significant epistasis interaction in the respective crosses.

The crosses Parbhani kranti x Varsha Uphar and Kokan Bhendi x Arka Anamika were showing positive and significant additive x additive (i) effects for number of nodes per plant, number of branches per plant and number of fruits per plant, while, negative and significant for the additive x additive (i) effects in the internodal length. The cross Parbhani kranti x Varsha Uphar was recorded negatively significant for the additive x additive (i) effects for fruit length, diameter of fruit, fruit weight and fruit yield per plant, whereas, positive and significant additive x additive (i) effects was observed for days to 50 per cent flowering. The additive x additive (i) effects was found positively significant in cross Kokan Bhendi x Arka Anamika for the characters like, plant height, fruit length, diameter of fruit and fruit yield per plant, whereas, negatively significant of days to 50 per cent flowering. The characters viz., plant height, internodal length, fruit length and diameter of fruit were showing positive and significant additive x additive (i) effect in cross Arka Abhay x EC-305672, while, negative and significant additive x additive (i) effect was noticed for the traits viz., number of nodes per plant, days to 50 per cent flowering, number of fruits per plant, fruit weight and fruit yield per plant.

The character weight of fruit was found negatively significant additive x dominance (j) gene effect in all three crosses, Parbhani Kranti x Varsha Uphar, Kokan Bhendi x Arka Anamika, and Arka Abhay x EC-305672. The hybrids Kokan Bhendi x Arka Anamika and Arka Abhay x EC-305672 were showing positive and significant.

Table 3: Estimates of gene effects in three crosses for 10 characters in okra

Crosses	m	d	h	i	j	l	Type of Epistais
Plant height (cm)							
Parbhani Kranti x Varsha Uphar	114.675**±0.765	-9.800**±2.01	23.400**±5.141	0.900±5.063	-12.600**±2.068	-9.900±8.813	D
Kokan Bhendi x Arka Anamika	73.900**±1.753	20.900**±2.858	39.400**±9.244	36.600**±9.047	-1.400±2.979	38.800**±13.937	C
Arka Abhay x EC-305672	110.62**±0.580	-40.30**±2.26	32.850**±5.622	18.500**±5.082	-26.350**±2.572	-24.20*±10.499	D
Internodal length (cm)							
Parbhani Kranti x Varsha Uphar	8.080**±0.048	-1.050**±0.069	-3.845**±0.247	-3.020**±0.236	-1.075**±0.085	1.970**±0.364	D
Kokan Bhendi x Arka Anamika	7.025**±0.044	0.500**±0.120	7.750**±0.302	-1.100**±0.298	0.050±0.130	2.900**±0.523	C
Arka Abhay x EC-305672	7.50**±0.080	-0.300**±0.097	-0.450±0.391	1.20**±0.375	0.65**±0.146	-0.10±0.553	C
Number of nodes per plant							
Parbhani Kranti x Varsha Uphar	14.400**±0.056	-1.100**±0.075	3.150**±0.299	1.400**±0.269	-0.750**±0.112	-5.900**±0.455	D
Kokan Bhendi x Arka Anamika	10.250**±0.288	2.00**±0.236	9.500**±1.276	8.200**±1.246	0.300±0.245	-3.200*±1.588	D
Arka Abhay x EC-305672	14.475**±0.156	-0.700**±0.167	-6.500**±0.731	-6.900**±0.708	0.400*±0.183	15.500**±0.984	D

Continued...

Crosses	m	d	H	i	j	l	Type of Epistais
No. of branches per plant							
Parbhani Kranti x Varsha Uphar	1.250**±0.008	0.200**±0.000	1.050**±0.049	1.000**±0.032	0.150**±0.017	-1.100**±0.081	D
Kokan Bhendi x Arka Anamika	1.575**±0.004	0.100**±0.033	1.050**±0.078	0.700**±0.069	0.350**±0.037	-1.600**±0.154	D
Arka Abhay x EC-305672	1.325**±0.004	-0.100**±0.033	0.250**±0.071	0.100±0.069	-0.250**±0.037	-0.200±0.138	D
Days to 50% flowering							
Parbhani Kranti x Varsha Uphar	40.00**±0.008	3.300**±0.167	5.150**±0.370	4.600**±0.335	4.250**±0.186	-1.500*±0.738	D

Kokan Bhendi x Arka Anamika	41.00**±0.008	-1.600**±0.105	-2.400**±0.295	-2.800**±0.213	-1.200**±0.158	9.200**±0.588	D
Arka Abhay x EC-305672	39.225**±0.004	0.800**±0.067	-2.600**±0.163	-0.900**±0.135	1.300**±0.108	1.500**±0.324	D
No. of fruits per plant							
Parbhani Kranti x Varsha Uphar	11.250**±0.040	-2.200**±0.211	17.450**±0.453	16.200**±0.45	-1.350**±0.21	-19.100**±0.86	D
Kokan Bhendi x Arka Anamika	10.90**±0.184	2.40**±0.105	12.050**±0.772	11.20**±0.766	1.250**±0.126	-10.100**±0.870	D
Arka Abhay x EC-305672	15.750**±0.008	-0.300±0.335	-4.600**±0.687	-4.400**±0.671	1.300**±0.364	6.600**±1.372	D

* and ** significant at 5 and 1 per cent level respectively

Additive x dominance (j) gene effect for number of fruits per plant and fruits yield per plant. Additive x dominance (j) gene effect found negatively significant in cross, Parbhani Kranti x Varsha Uphar for plant height, internodal length, number of nodes per plant, number of fruits per plant, diameter of fruit and fruits yield per plant, while, positively significant for number of branches per plant, days to 50 per cent flowering and fruit length. Additive x dominance (j) gene effect found negatively significant in the cross, Kokan Bhendi x Arka Anamika for days to 50 per cent flowering, fruit length and diameter of fruit, whereas, positive and significant additive x dominance (j) gene effect was revealed for number of branches per plant. Plant height and number of branches per plant was recorded negative and significant additive x dominance (j) gene effect in cross Arka Abhay x EC-305672, whereas, internodal length, number of nodes per plant, days to 50 per cent flowering and fruit length were noticed positive and significant additive x dominance (j) gene effect.

The dominance x dominance (l) effects were found negative and significant for number of nodes per plant, number of branches per plant and number of fruits per plant in hybrids Parbhani Kranti x Varsha Uphar and Kokan Bhendi x Arka Anamika. The crosses, Parbhani Kranti x Varsha Uphar and Arka Abhay x EC-305672 exhibited significant and positive dominance x dominance (l) effects for the characters such as, fruit diameter, fruit weight and fruit yield per plant. The characters, internodal length and fruit length in cross, Parbhani Kranti x Varsha Uphar were exhibited positive and significant dominance x dominance (l) gene effects, whereas, the character days to 50 per cent flowering shows significant and negative dominance x dominance (l) effects. Kokan Bhendi x Arka Anamika recorded significant and positive dominance x dominance (l) effects for the characters viz., plant height, internodal length and fruits yield per plant, while, negative and significant dominance x dominance (l) effects were noticed for the characters length of fruit, diameter of fruit and fruits yield per plant. The dominance x dominance (l) effects in cross Arka Abhay x EC-305672 were found positive and significant for number of nodes per plant, days to 50 per cent flowering and number of fruits per plant, while, negative and significant dominance x dominance (l) effects was exhibited for the traits plant height and fruit length.

The opposite sign of dominance (h) and dominance x dominance (l) parameter indicates the presence of duplicate type of epistasis in the inheritance of a character and similar type of gene action was observed for many traits in the present investigation. The presence of duplicate epistasis would be detrimental for rapid progress, making it difficult to fix genotypes with increased level of character manifestation because the opposite effect of one parameter would be deleted out by the negative effect of another parameter. Duplicate epistasis was exhibited in all three crosses viz., Parbhani Kranti x Varsha Uphar, Kokan Bhendi x Arka Anamika, and Arka Abhay x EC-305672 for the traits such as, number of

nodes per plant, number of branches per plant, days to 50 per cent flowering, number of fruits per plants, fruit length and fruit yield per plant. Duplicate epistasis was observed in the cross Parbhani Kranti x Varsha Uphar for all characters studied. In cross Kokan Bhendi x Arka Anamika duplicate type of epistasis was recorded in diameter of fruit. The cross Arka Abhay x EC-305672 reported duplicate type of epistasis for plant height and weight of fruit.

The alike sign of dominance (h) and dominance x dominance (l) parameters show the involvement of complementary epistasis in the manifestation of a characteristic. The cross Kokan Bhendi x Arka Anamika exhibited the presence of complementary type of epistasis for plant height, internodal length and weight of fruit. Also cross Arka Abhay x EC-305672 reported complementary epistasis for internodal length and diameter of fruit. This suggests the need of specific breeding procedure such as intermating of most desirable segregants followed by selfing and selecting superior genotypes coupled with progeny testing to exploit the population under study. When additive effects are larger than non-additive ones, selection in early generation would be effective, while, if the non-additive portions are larger than additive one, the improvement of the character need intensive selection through later generation.

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