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Detection of the presence of non-allelic interaction for fruit yield and its attributing traits in Okra (*Abelmoschus esculentus)* (L) Moench

RC Mahajan, DJ Sonawane and SV Yamgar

Abstract
The experiment comprised the study detection of the presence of non-allelic interaction for fruit yield and its attributing traits in okra. The experimemental material consisting parents were crossed to produce five single cross hybrids (Parbhani Kranti x Shagun, Arka Anamika x PBN-1, Shagun x AKO-107, Akola bahar x PBN-13, AKO-107 x Pusa sawani) between different parents (Parbhani Kranti, Arka Anamika, Shagun, Akola Bahar, AKO-107, PBN-1, PBN-13, Pusa Sawani) along with check Ankur-40 (Hybrid). material was evaluated during *kharif* 2013 in a randomized block design with randomization of generation replicated twice. The characters studied were plant height (cm), internodal length (cm), number of branches per plant, days to 50% flowering, fruit length (cm), fruit weight (g), fruit diameter (cm), number of fruit per plant, fruit yield per plant (g), fruit yield per ha. (q). the results were reveal that In most of the crosses, additive x additive type of gene action played an important role in the inheritance of days to 50 % flowering. Dominance type gene action was observed to be important in the inheritance of characters like yield per plant, plant height, fruit length and fruit diameter. Dominance type of gene action would favour for production of hybrids. Most of the characters under study showed duplicate type of gene action, as such, trangressive variation can be obtained in the characters. Complimentary type of gene action was observed to play an important role in the inheritance fruit diameter to greater extent

Keywords: okra, Gene action and yield components,

Introduction
Besides, the utility of its tender green fruits as vegetable Okra cortex is shown to be useful as one of the potential sources of mucilage. It is used in curries, stewed with meat and cooked into soups. Fruits are also canned, green or dried for off season uses. The roots and stems of okra are used for cleaning the cane juice from which *gur* or brown sugar is prepared. Its ripe seeds are roasted, ground and used as a substitute for coffee in some countries. Mature fruits and stems containing crude fiber are used in paper industry. Extracts from the seeds of okra is viewed as alternative source for edible oil. The greenish yellow edible oil has a pleasant taste and odor, and is high in unsaturated fats such as oleic acid and linoleic acid. The oil content of the seed is quite high at about 40 %. Besides it has also been put to several domestic and medicinal uses. Okra cortex is shown to be useful as one of the potential sources of mucilage.

Materials and Methods
The parents were crossed to produce five single cross hybrids (Parbhani Kranti x Shagun, Arka Anamika x PBN-1, Shagun x AKO-107, Akola bahar x PBN-13, AKO-107 x Pusa sawani) between different parents (Parbhani Kranti, Arka Anamika, Shagun, Akola Bahar, AKO-107, PBN-1, PBN-13, Pusa Sawani) along with check Ankur-40 (Hybrid). The material was evaluated during *kharif* 2013 in a randomized block design with randomization of generation replicated twice. The characters studied were plant height (cm), internodal length (cm), number of branches per plant, days to 50% flowering, fruit length (cm), fruit weight (g), fruit diameter (cm), number of fruit per plant, fruit yield per plant (g), fruit yield per ha. (q). The experimental plot size 6.3m x 3.6m and net plot size were 5.7m x 3m, spaced at 30cm x 30cm between and within rows in separate RBD for each cross. The plot were dibbled and thinned to 20 plants per row. Each plot consisted spacing of 30 cm between rows and 30 cm within row. Experiment were carried out at the Experimental Farm, Department of Agricultural Botany, College of Agriculture, Latur

Results and Discussion
The analysis of variance for randomized block design was carried out for plant height,

intermodal length, days to 50 per cent flowering, number of branches per plant, number of fruit per plant, diameter of fruit, length of fruit, weight of fruit, green fruit yield per plant, fruit yield per hectare. Analysis of variance showed highly significant differences and were present among the crosses studied for all the characters. This indicated the existence of sufficient variation for effective selection for all the characters in the material studied. The estimates of epistatic gene effects of plant hight were also similar to results observed in six parameter model. Estimates of gene effects are presented in Table 1. This indicated additive component to be negatively significant in all five crosses except the cross AKO-107 x Pusa Sawani which was positively significant. The dominance components was found to be positively significant in three crosses *viz.* Parbhani Kranti x Shagun, Arka Anamika x PBN-1 and Shagun x AKO-107, the cross AKO-107 x Pusa Sawani which was observed to be negatively significant. Additive x additive component was positive and significant in three crosses Parbhani Kranti x Shagun, Arka Anamika x PBN-1 and Shagun x AKO-107 and two crosses Akola Bahar x PBN-13 and AKO-107 x Pusa Sawani were non significant. Additive x Dominance interaction was positive and significant present in two crosses Shagun x AKO-107 and Akola Bahar x PBN-13. Dominance x dominance was significant in all crosses but positive in two crosses Akola Bahar x PBN-13 and AKO-107 x Pusa Sawani. Duplicate type of interaction was observed to be present in all five crosses as (h) and (L) components have different signs. Estimates of gene effects for Internodal length (cm) presented in Table-1 indicated that additive components was positive and significant in all five crosses except the cross Shagun x AKO-107 found to be negatively significant. Dominance component was negative and significant in all crosses except cross Parbhani Kranti x Shagun were non significant. Additive x additive interaction was positive and non significant in the crosses Parbhani Kranti x Shagun and Shagun x AKO-107, whereas, the cross Akola Bahar x PBN-13 which was negatively non significant. Additive x Dominance interaction was significant in all five crosses, except two crosses *viz.* Akola Bahar x PBN-13 and AKO-107 x Pusa Sawani were negative and non significant. Dominance x dominance interaction was positively significant in all five crosses, except in the cross Parbhani kranti x Shagun which was observed non significant interaction. Duplicate type of interaction was observed to be present in all five crosses as (h) and (L) components have different signs. Estimate of gene effects for number of branches per plant presented in Table-1 indicated that additive component was positively significant in three crosses *viz*. Parbhani Kranti x Shagun, Arka Anamika x PBN-1 and AKO-107 x Pusa Sawani and non significant in two crosses Shagun x AKO-107 and Akola Bahar x PBN-13. Dominance component was positively significant in all five crosses. As regards gene effect Additive x additive interaction was positively significant in the all crosses Parbhani Kranti x Shagun, Shagun x AKO-107, AKO-107 x Pusa Sawani and Akola Bahar x PBN-13 except the cross Arka Anamika x PBN-1 was observed non significant. Additive x dominance interaction was negative and significant in the cross AKO-107 x Pusa Sawani and two crosses were positively signifikant Arka Anamika x PBN-1 and Shagun x AKO-107 and only one cross Akola Bahar x PBN-13 which was positively non significant. Dominance x dominance interaction was negative and significant in four crosses *viz*. Parbhani Kranti x Shagun, Arka Anamika x PBN-1, Shagun x AKO-107 and Akola Bahar x PBN-13 and cross AKO-107 x Pusa Sawani which was negatively non significant interaction. Duplicate type of interaction was observed to be present in all five crosses as (h) and (L) components have different signs. The estimates of epistatic gene effects days to 50% flowering given in Table-1 were also similar to the results observed in six parameters model. In the crosses Shagun x AKO-107 and Akola Bahar x PBN-13 which was positive and significant interaction, whereas, three crosses negative and significant for additive component. Dominance component was observed to be significant for all the crosses, except the cross AKO-107 x Pusa Sawani which was observed negative and significant interaction. The Additive x additive componant was observed to be positively significant in crosses Parbhani Kranti x Shagun and Arka Anamika x PBN-1, negatively significant in crosses, Shagun x AKO-107, Akola Bahar x PBN-13 and AKO-107 x Pusa Sawani. Additive x dominance interaction was observed to be significant and positive in three crosses and cross the Shagun x AKO-107 observed to be negatively significant and cross AKO-107 x Pusa Sawani which was observed to to be non significant. Dominance x dominance interaction was observed to be significant and negative in the tow crosses Parbhani Kranti x Shagun and Arka Anamika x PBN-1, it was Positively significant in three crosses *viz*. Shagun x AKO-107, Akola Bahar x PBN-13 and AKO-107 x Pusa Sawani. Duplicate type of interaction was observed to be present in all five crosses as (h) and (L) components have different signs. Estimate of gene effects for Fruit Length (cm) presented in Table-1 indicated that Additive component was negatively significant in two crosses Shagun x AKO-107 and AKO-107 x Pusa Sawani. Dominance component was negatively significant in only one cross AKO-107 x Pusa Sawani and positively significant in four crosses Parbhani Kranti x Shagun, Arka Anamika x PBN-1, Shagun x AKO-107 and Akola Bahar x PBN-13.As regards to gene effect Additive x additive interaction was positively significant in four crosses Parbhani Kranti x Shagun, Arka Anamika x PBN-1, Shagun x AKO-107 and Akola Bahar x PBN-13 and it was negatively significant in the cross AKO-107 x Pusa Sawani. Additive x dominance interaction was negative and significant in all crosses, except the cross Arka Anamika x PBN-1 which was observed to be non significant. Dominance x dominance interaction were positive and significant in only one cross AKO-107 x Pusa Sawani and two crosses Arka Anamika x PBN-1, Shagun x AKO-107 showed non significant interaction and two crosses Parbhani Kranti x Shagun and Akola Bahar x PBN-13 which was observed to be negatively significant interaction. Duplicate type of interaction is present in all crosses as (h) and (L) component have same sign.In the crosses for Fruit weight (g) Parbhani Kranti x Shagun, Arka Anamika x PBN-1 and Akola Bahar x PBN-13 additive interaction were significant and positive and two crosses were negatively non significant Shagun x AKO-107, AKO-107 x Pusa Sawani. Dominance interaction were significant and positive in all crosses. Additive x additive interaction were significant and positive in all five crosses, except the cross AKO-107 x Pusa Sawani which was observed to be non significant. Additive x dominance interaction was significant and positive in two crosses, Shagun x AKO-107, AKO-107 x Pusa Sawani. Dominance x dominance interaction was negatively significant interaction in two crosses Arka Anamika x PBN-1, Akola Bahar x PBN-13 other three crosses were non significant. In the five crosses four cross were genetic components (h) and (l) were having opposite sign indicated duplicated type of gene action. However the cross Shagun x AKO-107 genetic components

(h) and (l) were having same sign this indicating complimentary type of gene action.

Estimate of gene effects for diameter of fruit (cm) indicated that additive component was positive and significant in three crosses *viz*. Parbhani Kranti x Shagun, Arka Anamika x PBN-1 and Akola Bahar x PBN-13 and the cross Shagun x AKO-107 observe to be non-significant. Dominance component was positive and significant in all crosses, except the cross Shagun x AKO-107 which showed negatively significant interaction and cross AKO-107 x Pusa Sawani which was observed to be non-significant interaction. As regard interaction effect of gene among the interaction, Additive x additive interaction was positive and significant in all the crosses except the cross Shagun x AKO-107 which was negative and significant. Additive x dominance interaction was negatively significant in two cross Parbhani Kranti x Shagun and AKO-107 x Pusa Sawani and two crosses were positive and non-significant cross Parbhani Kranti x Shagun and Shagun x AKO-107. Dominance x dominance interaction was positively significant in the cross Shagun x AKO-107. In the crosses Parbhani Kranti x Shagun and AKO-107 x Pusa Sawani cross which was observed to be non-significant interaction. Duplicate type of gene effect was present in four crosses. In cross AKO-107 x Pusa Sawani genetic components (h) and (l) were having same sign there by indicating Complimentary type of gene effect. Estimate of gene effects Number of fruit per plant In all the crosses additive components were significant except two crosses were negatively significant in cross Parbhani Kranti x Shagun and Akola Bahar x PBN-13. While dominance component was significant and negative in only one cross Arka Anamika x PBN-1 and in other four crosses it was positive and significant interaction. Among the interactions, Additive x additive interaction was significant and positive in the crosses Parbhani Kranti x Shagun, Shagun x AKO-107, Akola Bahar x PBN-13, AKO-107 x Pusa Sawani. While it was significant and negative in cross Arka Anamika x PBN-1. Additive x dominance interaction was positive and significant in three crosses but in cross Akola Bahar x PBN-13 it was negatively significant and cross AKO-107 x Pusa Sawani showed positively non significant interaction. Dominance x dominance interaction was negative and significant in all crosses except cross Arka Anamika x PBN-1 which showed positive and significant interaction and cross AKO-107 x Pusa Sawani which was observed to be non significant interaction. Duplicate type of interaction is present in all crosses as (h) and (L) component have same signs.The estimates of epistatic gene effects Fruit yield per plant (g) were also similar to results observed in six parameter model. Estimate of gene effects presented in Table-8, showed that additive component was positive and significant in the cross Parbhani Kranti x Shagun, whereas, two crosses Shagun x AKO-107 and AKO-107 x Pusa Sawani were negatively significant and two crosses Arka Anamika x PBN-1and Akola Bahar x PBN-13 which was observed to be non significant interaction. Dominance component was significant and positive in all crosses except the cross Arka Anamika x PBN-1 which showed negative and significant gene effects. Among the gene interaction, Additive x additive type of gene interaction was negatively significant in only one cross Arka Anamika x PBN-1whereas other four crosses were positive and significant. Additive x dominance interaction was positively significant in four crosses Parbhani Kranti x Shagun, Arka Anamika x PBN-1, Shagun x AKO-107 and AKO-107 x Pusa Sawani, but negative and significant in cross Akola Bahar x PBN-13. Dominance x dominance interaction were positively significant in only one cross Arka Anamika x PBN-1 whereas other four crosses were negative and significant. In the crosses component (h) and (l) were having opposite signs thus showing duplicate type of interaction. Estimates of gene effects for Fruit yield per hectare (q) indicated that additive component was significant and positive in two crosses. Parbhani Kranti x Shagun and Akola Bahar x PBN-13, the cross Arka Anamika x PBN-1 observed to be non significant interaction. Dominance component was positively significant in all crosses except the cross Arka Anamika x PBN-1 which showed negative and significant gene effects. Genetic interaction data indicated that among the interactions, Additive x additive type of interaction was significant and positive in four crosses *viz*. Parbhani Kranti x Shagun, Shagun x AKO-107, Akola Bahar x PBN-13, AKO-107 x Pusa Sawani. Additive x Dominance interaction was positively significant in four crosses Parbhani Kranti x Shagun, Arka Anamika x PBN-1, Shagun x AKO-107, AKO-107 x Pusa Sawani and it was negatively significant in one cross Akola Bahar x PBN-13. Dominance x dominance interaction was significant and negative in all five crosses except the cross Arka Anamika x PBN-1 which showed positive and significant gene interaction. In the crosses components (h) and (l) were having different sign thus showing duplicate type of gene action.

Table 1: Estimates of gene effects in 5 crosses of okra for 10 characters in okra

Character and Crosss	m	d	h	I	J	L	Types of epistasis	X^2 values
Plant height (cm)								
Parbhani kranti x Shagun	123.02**±0.50	-0.50**±0.05	36.94**±1.27	12.48**±0.50	-1.26**±0.17	-21.26**±0.84	Duplicate	S
Arka Anamika x PBN-1	120.48**±0.55	-0.50**±0.10	46.96**±1.54	17.02**±0.54	-0.21±0.25	-25.44**±1.03	Duplicate	S
Shagun x AKO-107	129.43**±0.61	-1.08**±0.07	21.61**±1.76	7.65**±0.60	0.75*±0.29	-10.94**±1.17	Duplicate	S
Akola Bahar x PBN-13	136.97**±0.55	-0.65**±0.12	-2.81±1.33	-0.12±0.54	2.33**±0.19	4.34**±0.88	Duplicate	S
AKO-107 x Pusa Sawani	137.92**±0.27	1.00**±0.06	-10.76**±0.66	-0.26±0.27	-1.97**±0.09	12.84**±0.42	Duplicate	S
Internodal length (cm)								
Parbhani kranti x Shagun	8.85**±0.11	0.25**±0.02	-0.05±0.27	0.00±0.01	0.35**±0.04	0.30±0.17	Duplicate	N
Arka Anamika x PBN-1	9.00**±0.15	0.10*±0.03	-2.60**±0.35	-0.40*±0.15	0.20*±0.04	1.80**±0.21	Duplicate	S
Shagun x AKO-107	8.50**±0.11	-0.10**±0.02	-1.10*±0.27	0.20±0.11	-0.20**±0.04	1.00**±0.16	Duplicate	S
Akola Bahar x PBN-13	8.85**±0.11	0.35**±0.02	-1.95**±0.27	-0.20±0.11	-0.05±0.04	1.70**±0.17	Duplicate	S
AKO-107 x Pusa Sawani	9.75**±0.21	0.45**±0.03	-5.35**±0.49	-1.40**±0.21	-0.15±0.06	3.70**±0.31	Duplicate	S
Number of branches per plant								
Parbhani kranti x Shagun	3.51**±0.10	0.25**±0.04	3.47**±0.24	0.74**±0.09	-0.12±0.04	-1.98**±0.17	Duplicate	S
Arka Anamika x PBN-1	3.41**±0.28	0.25**±0.04	2.80**±0.68	0.34±0.28	0.38**±0.09	-1.84**±0.42	Duplicate	S
Shagun x AKO-107	0.93**±0.17	0.06±0.03	8.68**±0.52	3.00**±0.17	0.43**±0.09	-5.12**±0.35	Duplicate	S
Akola Bahar x PBN-13	2.73**±0.13	0.06±0.03	5.28**±0.31	1.70**±0.13	0.03±0.04	-3.02**±0.19	Duplicate	S
AKO-107 x Pusa Sawani	3.30**±0.19	-0.37**±0.04	1.39*±0.49	0.95**±0.18	-1.00**±0.08	-0.19±0.30	Duplicate	S
Days to 50 % flowering								

Parbhani kranti x Shagun	39.96**±0.25	-0.66**±0.09	7.60**±0.64	4.70**±0.23	0.51**±0.12	-3.07**±0.42	Duplicate	S
Arka Anamika x PBN-1	38.30**±0.22	-0.16*±0.06	13.07**±0.57	6.19**±0.21	2.19**±0.08	-7.38**±0.51	Duplicate	S
Shagun x AKO-107	50.74**±0.28	0.79**±0.13	-17.38**±0.67	-6.20**±0.24	-1.19**±0.14	10.81**±0.41	Duplicate	S
Akola Bahar x PBN-13	48.48**±0.77	0.57**±0.05	-12.22**±1.58	-3.10*±0.77	0.47**±0.07	5.70**±0.83	Duplicate	S
AKO-107 x Pusa Sawani	46.30**±0.24	-0.30**±0.05	-8.18**±0.63	-2.28**±0.23	0.16±0.10	5.13**±0.41	Duplicate	S
Fruit length (cm)								
Parbhani kranti x Shagun	10.97**±0.10	0.42**±0.02	1.75**±0.25	0.70**±0.10	-0.17**±0.03	-0.65**±0.14	Duplicate	S
Arka Anamika x PBN-1	11.45**±0.10	0.25**±0.01	2.00**±0.23	1.40**±0.10	0.05±0.02	-0.80***±0.14	Duplicate	S
Shagun x AKO-107	11.97**±0.06	-0.92**±0.01	1.77**±0.24	0.20*±0.06	-0.37**±0.03	-0.25±0.32	Duplicate	S
Akola Bahar x PBN-13	9.95**±0.08	0.55**±0.01	5.20**±0.23	2.90**±0.08	-0.20**±0.03	-2.40**±0.15	Duplicate	S
AKO-107 x Pusa Sawani	13.75**±0.14	-0.15**±0.02	-4.10**±0.43	-0.50*±0.14	-0.90**±0.07	3.60**±0.28	Duplicate	S

Character and Crosss	m	d	h	I	J	L	Types of epistasis	X^2 values
Fruit weight (g)								
Parbhani kranti x Shagun	14.78**±0.45	0.86**±0.01	4.36**±1.34	1.78**±0.48	-0.65*±0.21	-1.64±0.88	Duplicate	S
Arka Anamika x PBN-1	13.43**±0.22	0.87**±0.17	7.04**±0.61	3.64**±0.13	-0.24±0.18	-2.83**±0.40	Duplicate	S
Shagun x AKO-107	14.65**±0.13	-0.55**±0.10	2.34**±0.40	1.60**±0.08	0.35*±0.11	0.30±0.26	Complimentary	S
Akola Bahar x PBN-13	13.65**±0.12	0.35*±0.09	7.00**±0.35	3.50**±0.08	-0.30*±0.09	-2.80**±0.23	Duplicate	S
AKO-107 x Pusa Sawani	16.85**±0.31	-0.45**±0.01	0.10±0.94	0.40*±0.31	0.75**±0.15	-0.60±0.63	Duplicate	S
Fruit diameter (cm)								
Parbhani kranti x Shagun	1.73**±0.03	0.08**±0.00	0.26*±0.07	0.10*±0.03	-0.03*±0.01	-0.04±0.04	Duplicate	S
Parbhani kranti x Shagun	0.95**±0.03	0.05*±0.01	2.16**±0.08	0.82**±0.03	0.01±0.01	-5.40**±0.24	Duplicate	S
Shagun x AKO-107	2.05**±0.01	-0.02±0.00	-0.99**±0.05	-0.28**±0.01	0.00±0.01	0.74**±0.03	Duplicate	S
Akola Bahar x PBN-13	1.64**±0.01	0.03**±0.00	0.31**±0.03	0.18**±0.01	0.03**±0.00	-0.13**±0.02	Duplicate	S
AKO-107 x Pusa Sawani	1.73**±0.01	-0.02**±0.00	0.03±0.02	0.08**±0.01	-0.01**±0.00	0.03*±0.01	Complimentary	S
Number of fruit per plant								
Parbhani kranti x Shagun	10.63**±0.10	-0.33**±0.03	5.11**±0.37	1.70**±0.10	1.48**±0.05	-1.74*±0.53	Duplicate	S
Arka Anamika x PBN-1	17.33**±0.12	0.43**±0.02	-10.13**±0.32	-4.65**±0.12	0.53**±0.03	6.91**±0.37	Duplicate	S
Shagun x AKO-107	12.49**±0.21	0.16**±0.03	3.34**±0.53	0.00±0.20	0.50**±0.08	-2.01**±0.33	Duplicate	S
Akola Bahar x PBN-13	9.48**±0.10	-0.16*±0.05	9.36**±0.26	2.68**±0.08	-0.33**±0.05	-5.35**±0.18	Duplicate	S
AKO-107 x Pusa Sawani	11.20**±0.23	0.11**±0.02	3.27**±0.70	1.01**±0.23	0.06±0.11	-0.73±0.47	Duplicate	S
Fruit yield per plant (g)								
Parbhani kranti x Shagun	152.07**±3.44	5.14*±1.50	142.89**±8.07	51.82**±0.09	17.21**±1.57	-49.96**±5.58	Duplicate	S
Arka Anamika x PBN-1	246.23**±4.01	-3.62±1.06	-77.86**±9.06	-29.98**±3.71	5.96*±1.66	80.84**±5.21	Duplicate	S
Shagun x AKO-107	181.15**±3.52	-4.21*±1.34	86.30**±6.82	21.83**±3.25	12.40**±1.91	-28.20**±6.54	Duplicate	S
Akola Bahar x PBN-13	114.44**±6.69	1.47±0.02	248.57**±13.62	90.47**±.606	-9.31**±1.05	-126.09**±6.97	Duplicate	S
AKO-107 x Pusa Sawani	188.52**±2.28	-3.51**±0.35	57.83**±5.84	22.13**±2.25	10.34**±0.86	-21.54**±3.83	Duplicate	S
Fruit yield per ha (q)								
Parbhani kranti x Shagun	168.99**±3.75	5.71**±1.50	158.60**±8.68	57.56**±3.43	19.08**±1.57	-55.37**±6.02	Duplicate	S
Arka Anamika x PBN-1	275.00**±5.18	-4.02±2.19	-89.37**±11.69	-34.73**±4.70	6.63*±2.24	91.26**±6.72	Duplicate	S
Shagun x AKO-107	201.28**±4.00	-4.68*±1.17	95.88**±11.33	24.25**±3.61	13.78**±2.29	-31.33*±8.20	Duplicate	S
Akola Bahar x PBN-13	127.14**±3.71	1.63*±1.26	276.22**±10.01	100.54**±3.49	-10.35**±1.8	-140.12**±6.6	Duplicate	S
AKO-107 x Pusa Sawani	209.47**±3.26	-3.90**±0.39	64.22**±8.96	24.58**±3.24	11.48**±1.40	-23.91**±5.93	Duplicate	S

*, **significance at 5% and 1 % respectively

Conclusion

In most of the crosses, additive x additive type of gene action played an important role in the inheritance of days to 50 % flowering. Dominance type gene action was observed to be important in the inheritance of characters like yield per plant, plant height, fruit length and fruit diameter. Dominance type of gene action would favour for production of hybrids. Most of the characters under study showed duplicate type of gene action, as such, trangressive variation can be obtained in the characters. Complimentary type of gene action was observed to play an important role in the inheritance fruit diameter to greater extent

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