The study of genetic components in okra [(*Abelmoschus esculentus* L.) Moench] crop

ABSTRACT

The present study of the genetic component in okra [*Abelmoschus esculentus* (L.) Moench]" crop was conducted during Kharif 2019 to ziad 2020 at the research farm of shri Durgaji post-graduate college Chaneshwar Azamgarh U.P. with ten genotypes Azad Bhindi1, Azad Bhindi 2, Azad Bhindi 3, KS 312, VRO5, KS 442, KS 439, BO2, Arka Abhay and Prabhani Kranti along with 11 characters viz days to flowering, height of plant, number of branches per plant /main shoot, number of first fruiting node height of first fruiting node number of nodes per plant, length of internodes, length of fruit, width of fruits, number of fruits per plant and fruit yield per plant. The genetic component of variance showed significant values for additive components $(\hat{D})$ for all the characters in both the generations except the height of the plant and the number of branches in F_1 generation. The dominance components $(\hat{H})$ were also highly significant for all the characters in both generations except fruit yield per plant in F_2 population. The degree of dominance $(\hat{H}_1/D)^{0.5}$ showed dominance for all the characters in both generations. The ratio $(\hat{h}^2/\hat{H}_2)$ showed less than unity for all the characters in both generations.

Analysis of variance for combining ability showed highly significant values both for gca and sca variances based on both generations. However, the magnitude of the GCA variance was more than the sca variance for all the characters in both F_1 and F_2 generations. Additive gene action was observed for all the characters in both generations.

Keywords: genotypes, okra variety, chromosome, mucilage

Introduction

“Bhindi [*Abelmoschus esuculentus* (L.) Moench] is an important vegetable crop in India. It belongs to the family Malvaceae and has chromosome number 2n = 130. It behaves as often cross-pollinated crop although it is a potentially self-pollinated crop, with 8.75 to 9.61 percent outcrossing” (Purewal and Randhawa, 1947). “Okra is believed to have originated in the Hindustani center of origin. However, Ethiopia is also considered as its native place from where it disseminated into Arabia down the Nile Valley and was introduced into Europe by the Moors and further into Louisiana during the early 17th century by French colonists” (Woodruff, 1927). “Additional utilization of vegetables in the human diet may be ample nutritive value of food as they are profusely nutritive. It is a better source of vitamins A’, ‘B’, ‘C’, protein, and minerals” (Choudhury *et al*., 2021). (Singh *et al.,* 1974) analyzed fruits and reported, 6.60 to 10.40 percent crude fiber, 84.60 to 90.50 percent edible portion, 14.40 to 18.60 percent protein, and 8.20 to 9.16 percent ash of the total dry weight (Tanni *et al*., 2019).

“Okra is not only nutritive but has medicinal value also. The Ayurveda considered it as a virility. The root powder of okra mixed with sugar is used for the treatment of *leucorrhea* which proved to be a very effective remedy for this disease in women. People consume it for renal infections (i.e., stones in the kidney). Eating fresh raw fruits in the early morning nourishes the body and increases the semen content” (Tanni *et al*., 2020). Yawalkar (1965) reported “it as an excellent source of iodine which helps in the control of goiter”. Woodruff (1927) reported that “mucilage from the stem and roots is used for cleaning sugar cane juice in jaggery manufacturing in India. Fully ripened fruits and stems containing crude fiber are used in paper making”. Its ripe seeds are roasted, ground, and used as a substitute for coffee in Turkey (Mehta, 1959).

Material and Methods

The study of variability heritability and genetic advance in okra [*Abelmoschus esculentus*(L.) Moench]" crop was conducted during Kharif 2019 to ziad 2020 at the research farm of shriDurgaji post-graduate college Chaneshwar Azamgarh U.P. with ten genotypes Azad Bhindi1, Azad Bhindi 2, Azad Bhindi 3, KS 312, VRO5, KS 442, KS 439, BO2, Arka Abhay and Prabhani Kranti along with 11 characters viz days to flowering, height of plant, number of branches per plant /main shoot, number of first fruiting node height of first fruiting node number of nodes per plant, length of internodes, length of fruit, width of fruits, number of fruits per plant and fruit yield per plant The following statistics were also estimated for concluding.

Results:

$(\hat{H}_1/\hat{D})^{1/2}$ = Mean degree of dominance

$(\hat{H}_2/4\hat{H}_1)$ = Proportion of positive and negative effects of genes in the Parents,

$\frac{4(\hat{D}\hat{H}_1)^{1/2}+\hat{F}}{4(\hat{D}\hat{H}_1)^{1/2}-\hat{F}}$ = It is used for F_1 generation and is also represented by KD/KR, which is the proportion of dominant and recessive genes in parents; F being significantly different from zero,

$\frac{[1/4\,(4\,\hat{D}\hat{H}_1)]^{1/2}+(1/2)\,\hat{F}}{[1/4\,(4\,\hat{D}\hat{H}_1)]^{1/2}-(1/2)\,\hat{F}}$ = It is used for F_2 generations

$(\hat{h}^2/\hat{H}_2)$ = Gene group governing the character.

The estimated value of the additive $(\hat{D})$ component of variation representing the additive effect of genes was significant for all the characters in F_1 and F_2 generations except the height of the plant and the number of branches per plant in the F_1 generation. In the F_1 and F_2 generations the value of dominance variance $(\hat{H}_1 \,\&\, \hat{H}_2)$ was found highly significant for all the characters except fruit yield per plant in the F_2 generation. The value of the dominant component was also higher than the additive component for all the characters in both generations. The value of $\hat{h}^2$ component was found significant and positive for days to following, number of branches per plant, length of internode, and number of fruits per plant in F_1 generation only. The value $\hat{h}^2$ was positive and non-significant for all remaining characters in both generations. The value of $\hat{F}$ the component was found positive for characters number of branches per plant, number of nodes per plant, length of internode and length of fruit in F_1 and F_2 generations, height of plant and number of first fruiting node in F_1 and height of first fruiting node in F_2 generation only. Negative value of $\hat{F}$ component was exhibited for the characters days to flowering, width of fruit, number of fruits per plant and fruit yield per plant in both the generations, height of first fruiting node in F_1 and height of plant and number of first fruiting node in F_2 generation only. The estimated value of the expected environmental component $(\hat{E})$ was observed in positive and non-significant responses for all the characters in both generations. The value of the average degree of dominance $(\hat{H}_1/\hat{D})^{0.5}$ was observed more than unity for all the characters in both generations. The proportion of positive and negative alleles in parents denoted by ratio $(\hat{H}_2/4\hat{H}_1)$ was less than the theoretical value of 0.25 for all the characters in both generations. The ratio of dominant and recessive genes in parents i.e. $[(4\hat{D}\hat{H})^{0.5} + F / (4\hat{D}\hat{H})^{0.5} - F]$ was recorded as less than unity for all the characters in both the generations except the number of branches per plant, number of nodes per plant, length of internode, and length of fruit in both the generations, height of plant and number of first fruiting node in F_1 and height of first fruiting node in F_2 generation only. The value of the ratio $(\hat{h}^2/\hat{H}_2)$ was found less than unity for all the characters in both generations.

Discussion and conclusion

The genetic component of variance showed significant values for additive components $(\hat{D})$ for all the characters in both generations except the height of the plant and the number of branches in F_1 generation. The dominance components $(\hat{H})$ were also highly significant for all the characters in both generations except fruit yield per plant in F_2 population. The degree of dominance $(\hat{H}_1 / D)^{0.5}$ showed dominance for all the characters in both generations. The ratio of dominance and recessive genes in parents was recorded as less than unity for all the characters in both the generations except number of branches per plant, number of nodes per plant, length of internode and length of fruit in both generations, height of plant and number of first fruiting node in F_1 and height of first fruiting node in F_2 generation only. The ratio $(\hat{h}^2 / \hat{H}_2)$ showed less than unity for all the characters in both generations. Analysis of variance for combining ability showed highly significant values both for gca and sca variances based on both generations. However, the magnitude of the GCA variance was more than the sca variance for all the characters in both F_1 and F_2 generations. Additive gene action was observed for all the characters in both generations.

Table 1: Estimates of genetic components and related statistics for different characters under study in okra [*Abelmoschus esculentus* (L.) Moench]

Components	Genera-tion	Characters										
		Days to flowering	Height of plant	Number of branches per plant/main shoot	Number of first fruiting node	Height of first fruiting node	Number of nodes per plant	Length of internode	Length of fruit	Width of fruit	Number of fruits per plant	Fruit yield per plant
$\hat{D}$	F1	13.27**	76.65	0.50	1.88**	8.57**	6.26**	4.11**	3.51**	0.11**	5.28**	414.50*
	SE±	1.98	45.13	0.06	0.29	0.83	1.99	1.19	1.18	0.03	1.53	188.11
	F2	13.26**	76.73*	0.51*	1.89**	8.53**	6.44**	4.11**	3.57**	0.12*	5.39**	7813.28**
	SE±	2.76	35.49	0.25	0.31	1.81	1.78	1.04	0.89	0.06	2.17	217.37
$\hat{H}_1$	F1	14.36**	275.35**	1.00**	2.78**	7.00**	14.99**	13.19**	8.33**	0.34**	10.46**	2347.17**
	SE±	4.22	96.06	0.13	0.62	1.77	4.23	2.54	2.50	0.06	3.26	400.41
	F2	110.20**	1474.63**	13.97**	16.11**	65.24**	107.74**	57.08**	36.63**	2.05**	74.73**	9601.53**
	SE±	23.53	302.21	2.15	2.63	14.40	15.12	8.86	7.57	0.47	18.48	1850.77
$\hat{H}_2$	F1	10.58**	200.85*	0.90**	2.32**	6.24**	9.61**	8.64**	5.44**	0.28**	6.94**	1834.37**
	SE±	3.59	71.64	0.11	0.53	1.50	3.60	2.16	2.13	0.05	2.77	340.31

	F2	103.86**	1280.70**	11.41**	14.36**	55.19**	103.45**	46.38**	26.59**	1.97**	65.73**	7813.28**
	SE±	20.00	256.84	1.83	2.24	13.09	12.85	7.53	6.44	0.40	15.71	1572.95
$\hat{h}^2$	F1	5.43*	-0.14	0.27**	0.07	1.83	-.0.06	3.03*	0.30	0.01	3.82**	138.24
	SE±	2.140	54.65	0.07	0.35	1.01	2.41	1.44	1.42	0.03	1.85	227.79
	F2	5.23	22.46	0.05	0.50	3.75	0.05	0.25	0.51	0.00	2.71	50.02
	SE±	3.35	42.98	0.31	0.37	2.19	2.15	1.26	1.08	0.07	2.63	263.22
$\hat{F}$	F1	-6.31	14.62	0.02	1.15	-0.71	5.56	4.61	4.00	-0.02	-3.83	-212.09
	SE±	4.56	104.13	0.14	0.67	1.92	4.49	2.75	2.71	0.06	3.53	434.03
	F2	-7.43	-149.49	0.70	-0.83	8.11	0.73	5.17	8.08	-0.07	-6.00	-297.74
	SE±	12.75	163.79	1.16	1.43	8.34	8.20	4.80	4.14	0.26	10.02	1003.08

Contd….

Components	Genera - tion	Days to flowering	Height of plant	Number of branches per plant/main shoot	Number of first fruiting node	Height of first fruiting node	Number of nodes per plant	Length of internode	Length of fruit	Width of fruit	Number of fruits per plant	Fruit yield per plant
$\hat{E}$	F1	0.23	2.15	0.02	0.03	0.15	0.27	0.07	0.13	0.01	0.21	28.21

	SE±	0.60	13.61	0.02	0.09	0.25	0.60	0.36	0.35	0.01	0.16	56.72
	F2	0.31	2.06	0.02	0.02	0.19	0.09	0.07	0.07	0.01	0.09	18.09
	SE±	0.83	10.70	0.08	0.09	0.55	0.54	0.31	0.27	0.02	0.65	65.54
$(\hat{H}_1/\hat{D})^{½}$	F1	1.04	1.90	1.40	1.22	0.90	1.55	1.79	1.54	1.73	1.41	2.38
	F2	2.89	4.38	5.26	2.92	2.77	4.09	3.73	3.20	4.19	3.72	4.76
$(¼\hat{H}_1/\hat{D})^{½}$	F1	0.52	0.95	0.70	0.61	0.45	0.77	0.89	0.77	0.86	0.70	1.19
	F2	1.44	2.19	2.63	1.46	1.38	2.04	1.86	1.60	2.09	2.86	2.38
$(\hat{H}_2/4\hat{H}_1)$	F1	0.18	0.18	0.23	0.21	0.22	0.16	0.16	0.16	0.21	0.17	0.20
	F2	0.24	0.22	0.20	0.22	0.21	0.24	0.20	0.18	0.24	0.22	0.20
$\frac{(4\hat{D}\hat{H}_1)^{½} + \hat{F}}{(4\hat{D}\hat{H}_1)^{½} - \hat{F}}$	F1	0.03	1.10	1.02	1.12	0.91	1.81	1.91	2.17	0.90	0.59	0.81
$\frac{¼(4\hat{D}\hat{H}_1)^{½} + (½)\hat{F}}{¼(4\hat{D}\hat{H}_1)^{½} - (½)\hat{F}}$	F2	0.82	0.64	1.30	0.86	1.42	1.03	1.41	2.11	0.87	0.74	0.97
$\hat{h}^2/\hat{H}_2$	F1	0.51	-0.0	0.30	0.03	0.29	-0.01	0.35	0.06	0.04	0.55	0.08
	F2	0.05	0.02	0.01	0.03	0.07	0.00	0.00	0.02	0.00	0.04	0.01
r	F1	-0.39	-0.14	-0.21	-0.58	-0.09	0.16	0.71	0.10	-0.30	0.23	0.39

	F2	0.26	0.24	-0.10	-0.44	0.33	-0.10	-0.21	0.36	0.55	-0.39	0.10

Note: * significant at a 5 percent level
** significant at 1 percent level

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