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Variability Studies for Various Quantitative Traits for Selection of Elite Genotypes in Okra (*Abelmoschus esculentus* L. Moench)

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ABSTRACT

The present study was conducted to assess the magnitude of variability among twenty-four different quantitative traits in Okra germplasm. The analysis of variance revealed high significant differences for all characters under study. High GCV and PCV noticed for YVMV Infestation on Fruits, Co-efficient of YVMV Infection, YVMV Infestation on Plants, Severity of YVMV Infestation, FSB infestation on fruits, marketable yield/plant, FSB infestation on shoots, total yield/plant, marketable fruits/plant, branches/plant, leaves/plant and seeds/fruit. High heritability (h^2 bs) was observed for all characters studied. High genetic gain coupled with high heritability recorded for YVMV Infestation on Fruits (%), Severity of YVMV Infestation, Co-efficient of YVMV Infection, FSB infestation fruits, marketable yield/plant, FSB infestation on shoots, total yield/plant, marketable fruits/ plant, branches/plant, leaves/plant, seeds/fruit, fruits/plant, fruit weight, 100 seed weight, plant height, internodal distance and first flowering node indicating the role of additive genetic variance in the expression of these traits. Thus, these traits may serve as an effective selection parameter during breeding programme for crop improvement. Based on the mean performance for pod yield, yield component traits and relative resistance to YVMV and FSB, genotypes 2012/OKYVRES-5, 2012/OKYVRES-6, 2012/OKYVRES-2, 10/OKYVRES-2 and 10/OKYVRES-3 found superior in performance than check varieties. These could be used as parental material in further crop improvement program after considerable selection to fix the desirable traits.

Key words: *Okra, genetic variability, heritability, genetic gain, Yellow vein mosaic virus.*

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) also known as 'bhindi' or 'Lady's finger', belongs to family Malvaceae. Chromosome number 2n=130.It is native of Africa. It is widely distributed and cultivated in the tropics, sub-tropics and warmer portions of temperate region of world on a varying scale[5]. It is a multipurpose crop due to its various uses.

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Despite many benefits, okra is neglected because of the non-availability of high yielding and locally adopted cultivars and its vulnerability to Yellow Vein Mosaic Virus, Fruit and Shoot Borer. There is a need to explore genetic variability which is basis for crop improvement. The selected material with novel traits can be used as parents in breeding programme.

MATERIAL AND METHODS

The present investigation conducted in Randomized Block Design with three replications at Experimental Research Field, Department of Genetics and Plant breeding, SHUATS, U.P during the Kharif season. The experimental material for this study comprised twenty three genotypes including four standard checks varieties (Arka Abhay, Arka Anamika, Pusa Sawani and VRO-6) collected from Indian Institute Vegetable Research, Varanasi, U.P. Biometric data were recorded on five randomly selected plants in each germplasm line in each replication for days to 50% flowering , first flowering node, first fruiting node, fruit length (cm), fruit width (cm), fruit girth (cm), fruit weight (g), fruits per plant, marketable fruits per plant, total yield per plant (g), marketable yield per plant (g), plant height (cm), branches per plant, leaves per plant, internodal distance (cm), seeds per fruit, 100 seed weight (cm), days to first appearance of YVMV infestation in plot, YVMV infestation on plants (%), YVMV infestation on fruits (%), severity of YVMV infestation (%), co-efficient of YVMV infection (%), fruit and shoot borer infestation on shoots (%), fruit and shoot borer infestation on fruits (%). Statistical analysis followed includes analysis of variance[11], estimation of heritability[2] and Genetic advance[8].

RESULTS AND DISCUSSION

In this investigation, all twenty-four studied quantitative characters showed significant differences in the mean sum of squares due to genotypes (or) treatments. This indicates that the genotypes of Okra were genetically divergent. So, there is a huge scope for selection of promising lines. The calculated value of variance ratio was significant at 5% level in all the characters under study.

A wide range of variation was observed among different genotypes or treatments regarding different characters (Table 1). Maximum range of variability was observed for marketable yield per plant (31.90 – 283.01g) followed by total yield per plant (75.31 – 301.449 g). Moderate range of variability has found for FSB and YVMV traits followed by seeds per fruit (33 – 82.5), leaves per plant (15 – 41.66) and plant height (38 – 82.33). The characters having high range of variation have more scope for improvement.

For all characters under study phenotypic variances (Vp) were higher than corresponding genotypic variances (Vg) table except for fruit width. The Phenotypic and Genotypic variance were highest for total yield per plant (Vp 3216.49, Vg 3002.92) followed by marketable yield per plant (Vp 3061.09, Vg 2895.91). Moderate values of Phenotypic and Genotypic variance noticed in all YVMV traits followed by seeds per unit (Vp 111.91, Vg 111.37) and plant height (Vp 81.75, Vg 75.32). Lowest values of Phenotypic and Genotypic variance noticed in fruit width (Vp 0.02, Vg 0.02), fruit girth (Vp 0.23, Vg 0.17), intermodal distance (Vp 0.22, Vg 0.19) and branches per plant (Vp 0.54, Vg 0.51). For most the traits phenotypic variance is higher than genotypic variance it indicates the influences of environment on the expression of traits. Value of phenotypic and genotypic variance were much close for fruit width and some other characters can be considered as stable due to less influence of environment. High genotypic variance for total yield per plant, marketable yield per plant, YVMV & FSB traits, seeds per fruit and plant height indicates the presence of high heritable variation for the traits.

The phenotypic coefficient of variation (PCV) and genotypic coefficient of variance (GCV) values were classified as low (<10.00%) moderate (10.00 – 20.00%) and high (>20.00%) as suggested by[13]. The estimates of PCV and GCV were high for YVMV infestation on fruits (108.31 and

107.64) followed by co-efficient of YVMV infection (101.33 and 100.65), YVMV infestation on plants (77.83 and 77.53), severity of YVMV infestation (65.34 and 64.9), days to first appearance of YVMV infestation in plot (52.7 and 52.56), fruit and shoot borer infestation on fruits (51.79 and 50.19), marketable yield per plant (46.02 and 44.76), Fruit And Shoot Borer infestation on shoots (39.54 and 39.08), total yield per plant (38.19 and 36.9), marketable fruits per plant (32.6 and 31.91), branches per plant (27.95 and 27.2), leaves per plant (27.68 and 26.4), fruits per plant (22.86 and 22.21) and seeds per fruit (22.06 and 22.01), similar results were also reported by[4] for marketable yield per plant, total number of fruits per plant and YVMV infestation on plants [6,9,12]reported for total yield per plant. These traits having high genotypic coefficients of variability possesses better potential for further gain and improvement through selection. Moderate values of PCV and GCV (between10-20%) was observed for fruit weight (20.02 and 19.36), 100 seed weight (17.02 and 16.48), plant height (15.25 and 14.64), first flowering node (13.34 and 12.44), inter nodal distance 12.98 and 12.3) and first fruiting node (11.44 and 10.26). Low value of PCV and GCV (Below 10 %) was observed for fruit length (10.5 and 9.32), fruit width (8.79 and 7.97), fruit girth (8.79 and 7.46) and days to 50% flowering (5.43 and 4.47).

Broad sense heritability ranged from (67.79 %) Days to 50% flowering to (99) (seeds per fruit, all YVMV traits). The estimates of heritability were of high magnitude (>60%) for all traits. Similar results reported for all the three growth attributes (plant height, number of branches and intermodal length) by[6,12,1,10].

The genetic gain ranged from 7.59 (days to 50% flowering) to 220.35 (YVMV infestation on fruits). The estimates of Genetic gain were of high magnitude (>20% as suggested by[7]) recorded for YVMV infestation on fruits (220.35) followed by co-efficient of YVMV infection (205.95), YVMV infestation on plants (159.08), severity of YVMV infestation (132.79), days to first appearance of YVMV infestation in plot (107.96), Fruit and Shoot Borer infestation on fruits (100.2), marketable yield per plant (89.69), Fruit and Shoot Borer infestation on shoots (79.57), total yield per plant (73.44), marketable fruits per plant (64.34), branches per plant (54.54), leaves per plant (51.85), seeds per fruit (45.23), fruits per plant (44.44), fruit weight (38.55), 100 seed weight (32.86), plant height (28.96), inter nodal distance (24.02) and first flowering node (23.90). Similarly, high magnitude of genetic gain as percent of mean were also reported by[12,10,3] for total number of fruits per plant, [9,14]for total yield per plant and [4]for marketable yield per plant and for YVMV infestation on plants. High heritability combined with high genetic gain indicates additive gene action; hence direct simple selection can be done. Moderate values of genetic gain (10-20%) were recorded for first fruiting node (18.95), fruit length (17.05), fruit width (14.88) and fruit girth (13.09). Moderate magnitude of genetic advance as percent of Mean was also reported by[12] for fruit width. High heritability with moderate genetic gain as percent of mean indicating that these characters were governed by additive gene interaction. Low values of genetic advance as percent of mean (10-20 %) were recorded for days to 50% flowering (7.59). High heritability coupled with low genetic gain as percent of mean indicating non-additive gene action for these traits, hence heterosis breeding would be recommended for the trait.

Based on Mean performance (Table 2) for pod yield, yield component traits and relative resistance to biotic stresses like Yellow Vein Mosaic Virus and Fruit and Shoot Borer genotypes 2012/ OKYVRES–5, 2012 OKYVRES–6, 2012/OKYVRES–2, 10/OKYVRES–2, 10/OKYVRES-3 found superior in performance than check varieties. These could be used as parental material in further crop improvement program after considerable selection to fix the desirable traits.

Table 1: Estimates of Range, Mean and Components of variance for various quantitative characters in Okra genotypes

S.NO.	Character	Range	Mean	GCV%	PCV%	h^2(bs) (%)	GA	GA as % of mean
1	Days to 50% Flowering	36.33 - 43.33	39.28	4.47	5.43	68	2.98	7.59
2	First Flowering Node	5.33 - 9.26	6.43	12.44	13.34	87	1.54	23.90
3	First Fruiting Node	5.90 - 9.46	6.83	10.26	11.44	80	1.30	18.95
4	Fruit Length (cm)	9.61 - 14.36	11.11	9.32	10.50	79	1.89	17.05
5	Fruit Width (cm)	1.51 - 2.22	1.79	7.97	8.79	82	0.27	14.88
6	Fruit Girth (cm)	4.58 - 6.13	5.52	7.46	8.76	73	0.72	13.09
7	Fruit Weight (g)	8.66 - 16.16	11.84	19.36	20.02	93	4.57	38.55
8	Fruits/ Plant	7.80 - 18.63	12.29	22.21	22.86	94	5.46	44.44
9	Marketable Fruits/ Plant	3.50 - 17.50	9.89	31.91	32.60	96	6.37	64.34
10	Total Yield/ Plant (g)	75.31 - 301.44	148.51	36.90	38.19	93	109.07	73.44
11	Marketable Yield/ Plant (g)	31.90 - 283.01	120.21	44.76	46.02	95	107.82	89.69
12	Plant Height (cm)	38.00 - 82.33	59.29	14.64	15.25	92	17.17	28.96
13	Branches/ Plant	1.80 - 5.10	2.61	27.20	27.95	95	1.43	54.54
14	Leaves/ Plant	15.05 - 41.66	21.91	26.40	27.68	91	11.36	51.85
15	Internodal Distance (cm)	2.76 - 4.40	3.58	12.30	12.98	90	0.86	24.02
16	Seeds/ Fruit	33.66 - 82.50	47.94	22.01	22.06	99	21.69	45.23
17	100 Seed Weight (g)	2.76 - 6.18	4.82	16.48	17.02	94	1.58	32.86
18	Days to First Appearance of YVMV Infestation in Plot	0.00 - 70.33	42.26	52.56	52.70	99	45.62	107.96
19	YVMV Infestation on Plants (%)	0.00 - 76.66	32.91	77.53	77.83	99	52.36	159.08
20	YVMV Infestation on Fruits (%)	0.00 - 67.83	20.12	107.64	108.31	99	44.34	220.35
21	Severity of YVMV Infestation	0.00 - 74.00	34.83	64.90	65.34	99	46.25	132.79
22	Co-efficient of YVMV Infection	0.00 - 56.77	16.66	100.65	101.33	99	34.33	205.95
23	Fruit and Shoot Borer Infestation on Shoots (%)	5.86 - 62.06	42.60	39.08	39.54	98	33.90	79.57
24	Fruit and Shoot Borer Infestation on Fruits (%)	5.74 - 40.33	16.07	50.19	51.79	94	16.11	100.20

Table 2: Mean performance of genotypes

Genotypes	Characters																							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
11/OKYVRES-2	43.3	5.9	6.1	10.0	1.6	4.7	9.0	8.3	3.5	75.3	31.9	50.4	2.4	19.2	4.0	45.0	4.3	29.3	76.7	67.8	74.0	56.8	52.4	40.3
11/OKYVRES-4	40.3	5.8	6.2	10.4	1.8	6.1	10.7	8.1	6.7	86.9	71.5	59.1	2.1	19.4	4.0	45.9	5.0	65.0	14.7	15.0	8.7	1.4	39.0	14.2
11/OKYVRES-5	38.0	5.3	6.1	14.4	1.8	6.1	13.6	10.5	9.4	142.9	127.8	54.0	2.2	21.0	3.6	54.9	4.6	36.0	26.7	10.0	34.3	9.2	50.7	20.6
11/OKYVRES-6	38.3	5.3	5.9	11.5	1.5	4.9	11.5	11.4	9.8	132.1	113.1	59.3	2.2	17.5	3.8	55.5	4.4	0.0	0.0	0.0	0.0	0.0	42.9	10.7
10/OKYVRES-1	39.7	6.4	7.1	9.6	1.8	5.9	9.8	11.4	8.4	112.4	82.9	60.7	2.0	23.0	3.7	35.5	5.6	35.0	43.1	26.7	55.3	23.9	60.7	26.0
10/OKYVRES-2	36.7	5.8	6.4	11.0	1.6	5.4	14.8	15.4	12.7	228.1	188.6	59.7	2.3	16.4	3.3	39.2	4.7	66.3	60.5	0.0	42.5	25.8	61.4	12.6
10/OKYVRES-3	36.3	5.4	6.7	11.7	1.7	5.7	15.6	11.7	6.7	183.2	104.8	52.7	2.3	18.6	3.0	50.6	4.6	50.7	29.4	30.0	39.0	11.5	54.7	23.7
10/OKYVRES-4	36.7	5.9	6.2	9.7	1.6	5.0	8.8	13.3	12.5	116.5	110.0	52.0	2.6	15.1	3.3	43.0	6.2	0.0	0.0	0.0	0.0	0.0	60.2	9.7
10/OKYVRES-5	40.3	6.5	7.1	10.6	1.8	5.5	8.7	12.7	10.5	110.2	91.3	54.0	2.7	18.9	3.3	45.6	5.8	51.7	8.0	0.0	19.3	1.6	61.4	11.1
10/OKYVRES-6	38.3	7.2	7.6	10.8	1.8	5.7	14.1	7.8	7.1	109.8	100.1	59.1	2.2	16.7	4.4	34.2	4.4	68.3	27.8	0.0	46.2	12.9	55.5	19.2
10/OKYVRES-7	37.7	6.4	6.6	11.2	1.9	6.1	9.5	10.2	5.0	96.6	47.2	60.1	2.2	16.6	3.5	43.5	5.8	49.0	72.6	31.7	62.3	45.3	22.8	14.5
10/OKYVRES-8	40.7	6.8	7.0	10.9	1.9	5.5	12.9	12.8	10.4	165.2	135.2	53.0	2.8	22.5	2.8	55.0	5.4	54.7	57.9	48.7	57.3	33.3	49.2	25.6
10/OKYVRES-9	39.3	7.1	7.5	10.9	1.8	5.5	10.8	10.6	9.7	114.0	105.0	57.3	2.1	19.3	3.6	40.3	4.3	56.0	8.0	0.0	14.7	1.2	22.1	11.6
12/OKYVRES-1	40.3	6.4	6.7	13.0	2.0	6.1	11.1	12.3	11.4	136.2	126.2	56.7	2.5	19.2	3.0	56.4	5.0	0.0	0.0	0.0	0.0	0.0	5.9	8.9
12/OKYVRES-2	40.3	6.8	7.2	12.1	1.9	5.5	13.3	15.7	14.0	208.8	185.5	67.9	2.4	26.8	3.9	60.0	3.8	0.0	0.0	0.0	0.0	0.0	23.7	5.9
12/OKYVRES-3	42.0	9.3	9.5	10.8	1.7	5.4	9.7	9.0	7.2	87.8	70.5	82.3	5.1	30.7	4.1	40.2	3.8	49.0	43.6	38.3	48.9	21.3	17.8	9.8
12/OKYVRES-4	38.7	6.2	6.9	11.5	1.8	5.8	11.3	13.2	10.1	150.1	114.1	75.7	3.1	21.9	4.3	49.9	4.6	53.3	63.3	36.0	54.8	34.7	28.0	13.4
12/OKYVRES-5	42.3	6.4	6.4	10.5	2.2	5.8	16.2	18.6	17.5	301.4	283.0	38.0	3.8	41.7	2.8	82.5	4.2	70.3	14.9	0.0	32.5	4.8	45.9	5.7
12/OKYVRES-6	40.7	6.4	7.0	11.4	1.8	5.1	13.5	16.7	14.1	225.6	189.6	67.0	3.1	27.3	3.8	54.2	4.9	49.0	46.6	30.7	42.2	19.7	22.4	12.9
ARKA ABHAY	40.3	6.5	6.6	10.1	1.7	4.6	8.8	13.8	11.5	120.8	100.9	58.0	2.9	24.5	3.4	33.7	5.6	49.0	31.7	30.3	36.7	11.6	62.1	13.4
PUSA SAWANI	37.7	6.7	6.8	10.1	1.6	5.4	11.3	12.2	7.8	137.6	87.8	61.8	2.2	19.1	3.8	49.5	5.5	41.3	72.6	64.0	61.7	44.8	42.3	26.3
ARKA ANAMIKA	38.3	7.0	7.3	11.6	1.8	5.6	13.3	12.9	11.3	171.6	150.8	61.1	3.2	26.9	3.8	43.6	5.5	51.0	18.3	1.3	23.0	4.2	53.7	12.6
VRO-6	37.3	6.2	6.5	11.8	1.8	5.6	14.1	14.4	10.4	202.7	147.2	63.9	1.8	22.1	3.4	44.7	2.8	47.0	40.9	32.3	47.7	19.5	45.3	20.9
Mean	**39.3**	**6.4**	**6.8**	**11.1**	**1.8**	**5.5**	**11.8**	**12.3**	**9.9**	**148.5**	**120.2**	**59.3**	**2.6**	**21.9**	**3.6**	**47.9**	**4.8**	**42.3**	**32.9**	**20.1**	**34.8**	**16.7**	**42.6**	**16.1**

Note: 1. Days to 50% flowering, 2.first flowering node, 3. First fruiting node, 4. Fruit length (cm), 5. Fruit width (cm), 6. Fruit girth (cm), 7. Fruit weight (g), 8. Fruits/plant, 9. Marketable fruits/plant, 10. Total yield/plant (g), 11. Marketable yield/plant (g), 12. Plant height (cm), 13. Branches per plant, 14. Leaves per plant, 15. Internodal distance (cm), 16. Seeds/ fruit, 17. 100 seed weight (cm), 18. Days to first appearance of YVMV infestation in plot, 19. YVMV infestation on plants (%), 20. YVMV infestation on fruits (%), 21. Severity of YVMV infestation (%), 22. Co-efficient of YVMV infection (%), 23. Fruit and shoot borer infestation on shoots (%), 24. Fruit and shoot borer infestation on fruits (%)

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