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Genetic analysis in okra (*Abelmoschus esculentus* (L.) Moench)

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Abstract : A study was conducted to determine gene action, heritability and number of effective genes controlling twelve characters from seven parents raised in a half diallel design. Over dominance governed most of the traits including yield components. Genetic and graphic analysis showed that there is preponderance of non-additive gene action for the characters viz. plant height at first flowering, individual fruit weight, fruit length, fruit girth, plant height at final harvest, yield per plant and protein content in fruits. This study has brought out that the hybrids Varsha Uphar x Arka Anamika and OHD-1 x Varsha Uphar could be selected for the exploitation of heterosis and commercial utilization.

Key words: Okra, Half diallel, Over dominance, Yield components.

Introduction

Okra (*Abelmoschus esculentus* (L.) Moench) is a major vegetable crop grown throughout India for its green tender fruits during summer and rainy seasons. In India, it is widely cultivated in Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu. In biometrical studies, component of variance analysis is commonly employed to elucidate gene action for different characters. The estimates of genetic parameters indicate whether the gene action is additive or non-additive, dominant or recessive, etc. The nature of gene action for a number of biometric traits in okra has been studied by different workers (Kulkarni, *et al.* 1976; Arumugam, 1977; Sharma and Dhillon, 1983 and Veeraragavathatham, 1989). However, as the gene action differs from genetic material to genetic material, an investigation was attempted in the present study using seven YVM resistant genetic accessions.

Materials and Methods

Seven parents, resistant to yellow vein mosaic virus, viz. MF-1, MF-2, MF-3, OHD-1, OHD-2, Arka Anamika and Varsha Uphar were raised during February - May 1999 in a randomized block design at the University Orchard, TNAU, Coimbatore 3. From the results of the first season trial, 4 parents viz. MF-3, OHD-1, Varsha Uphar and Arka Anamika were selected and raised in a randomized block design with three replications in a half diallel design during July - October 1999. Pusa Sawani was used in the border row. The genetic parameters viz. D, H_1 , H_2 , h^2 and E and the standard ratios of these genetic parameters were worked out by component of

variance methods, using the second degree statistics and error mean square (Hayman, 1954)

Results and Discussion

The estimates of additive genetic variance was positive and significant for the characters, number of fruits per plant, number of branches per plant, phenol, carbohydrate and crude fibre content indicating high transmissibility in the progeny. Therefore, direct selection will be of much use for such characters which is in accordance with Srivatsava *et al.* (1979) and Sivagama Sundari (1991). The 'F' value is not significant for all the 12 characters implying less of dominant alleles in the parents (Table 1). The estimates of components of variation due to dominance (H_1) and proportion of dominance due to positive and negative genes (H_2) showed the preponderance of non-additive gene action for all the characters except for fruit girth. The estimated mean degree of dominance (H_1/D)^{1/2} estimate was more than unity for all the characters except for number of fruits per plant (0.803) indicating over dominance or presence of repulsive phase linkage. Similar observation has been recorded by Srivatsava *et al.* (1979).

The ratio of total dominant to recessive alleles KD / KR pooled over all of the parents also indicated the prevalence of dominance for all the characters like plant height at first flowering, plant height at final harvest, yield per plant and protein content which showed the estimated units. This suggested values less than the prevalence of recessive alleles over dominant ones. The distribution of positive and negative alleles were unequal for all the characters except for the characters like number of fruits per plant, plant

Table 1. Estimates of genetic parameters for F_1 hybrids

S.No.	Characters	D	F	H_1	H_2	h^2	E
1.	Plant height at first flower bud appearance	1.339±1.243	-0.101±3.192	12.569±3.612	11.895**±3.334	6.540**±2.253	0.163±0.556
2.	Number of fruits / plant	39.612±1.727**	0.284±4.436	25.545**±5.020	25.186**±4.634	28.621 **±3.131	0.790±0.772
3.	Individual fruit weight	3.249±3.149	6.534±8.089	37.424**±9.153	26.634**±8.449	2.606±5.709	0.149±1.408
4.	Fruit length	0.035±0.142	0.127±0.364	1.528**±0.412	1.029**±0.381	0.013±0.257	0.081±0.063
5.	Fruit girth	0.077±0.252	0.313±0.648	1.206±0.733	0.964±0.677	0.319±0.457	0.100±0.133
6.	Plant height at final harvest	6.768±5.462	-15.357±14.033	49.731 **±15.878	50.289**±14.657	80.118**±9.904	7.054**±2.443
7.	Number of branches/plant	2.799±1.315*	1.951±3.379	11.997**±3.823	10.252**±3.529	7.341 **±2.385	0.345±0.588
8.	Yield/plant	138.442±934.263	-934.277±2400.166	9554.0**±2715.8	7073.241**±2506.892	2182.402±1693.957	85.065±17.815
9.	Phenol content	0.0005**±0.0001	0.0001±0.0001	0.0007**±0.0001	0.0005**±0.0001	-0.0001±0.0001	0.0001±0.0001
10.	Carbohydrate content	0.552**±0.054	0.041±0.139	0.569**±0.157	0.562**±0.145	0.687**±0.098	0.029±0.024
11.	Protein content	0.031±0.031	-0.055±0.081	0.255**±0.092	0.233**±0.085	-0.003±0.057	0.006±0.014
12.	Crude fibre content	6.413**±2.924	5.66±7.513	19.460**±8.501	17.884**±7.847	3.141±5.303	0.052±1.308

* Significance at 5 per cent level

**Significance at 1 per cent level

height at final harvest and carbohydrate content as indicated by $H_2/4H_1$ which is less than 0.25 for these traits.

The h^2/H_1 ratio indicated the preponderance at dominant alleles for number of fruits per plant, plant height at final harvest and carbohydrate content and recessive alleles for rest of the characters. Heritability estimates in the narrow sense was moderate for plant height at first flowering, fruit weight, fruit length, plant height at final harvest, number of branches per plant and crude fibre content (Table 2).

The low heritability estimate was shown by the character fruit girth (8.250). The rest of the characters *viz.* number of fruits per plant, yield per plant, phenol content in leaves, carbohydrate and protein content in fruits had high heritability in the narrow sense and suggested pedigree selection will be useful for improvement of these character.

The graphic analysis showed the regression coefficient (b) values less than unity for all the characters indicating the presence of epistasis. The 'Y' intercept was positive for number of fruits per plant, fruit girth, yield per plant, carbohydrate and crude fibre content implying partial dominance (Table 3). These results are in accordance with the results of Veeraragavathatham (1989) and Sivagama Sundari, (1991).

Over dominance was suggested for plant height at first flower bud appearance, individual fruit weight, fruit length, plant height at final harvest, number of branches per plant and protein content in fruits. Complete dominance was suggested for phenol content in leaves.

The present study revealed the predominance of non-additive gene action emphasizing the role of over dominance in expression of yield components in okra. Therefore, crop improvement in okra through a hybrid-breeding programme to exploit heterosis would pay rich dividends.

Based on the two season trials, two hybrid combinations *viz.* Varsha Uphar x Arka Anamika and OHD-1 x Varsha Uphar have been adjudged as superior in respect of yield per plant and resistance to yellow vein mosaic disease which deserve further evaluation and release.

Table 2. Ratios of genetic parameters for F_1

S.No.	Characters	$(H_1/D)^{1/2}$	$H_1/4H_2$	KD/KR	h^2/H_2	Heritability (NS) per cent
1	Plant height at first flower bud appearance	3.063	0.237	0.976	0.549	25.21
2.	Number of fruits / plant	0.803	0.245	1.009	1.136	73.69
3.	Individual fruit weight	3.395	0.178	1.843	0.098	35.53
4.	Fruit length	6.619	0.168	1.757	0.012	37.55
5.	Fruit girth	3.947	0.200	3.106	0.331	8.250
6.	Plant height at final harvest	2.711	0.253	0.409	1.593	35.46
7.	Number of branches/plant	2.070	0.214	1.405	0.716	30.83
8.	Yield/plant	8.307	0.185	0.422	0.309	48.95
9.	Phenol content	1.190	0.179	1.141	-0.145	55.53
10.	Carbohydrate content	1.016	0.247	1.076	1.223	60.35
11.	Protein content	2.866	0.229	0.526	-0.014	45.45
12.	Crude fibre content	1.742	0.230	1.694	0.176	20.43

Table 3. Estimates of Y intercept (a) and slope (b) of fitting regression line.

Characters	VrWr	VrWr
	a	b
Plant height at first flower bud appearance	-0.610	+ 0.373 ± 0.110
Number of fruits / plant	+5.909	+ 0.839 ± 0.0083
Fruit weight	- 3.802	+ 0.444 ± 0.641
Fruit length	- 0.078	+ 0.205 ± 0.495
Fruit girth	+0.021	- 0.117 ± 0.055
Plant height at final harvest	-1.519	+ 0.469 ± 0.436
Number of branches / plant	-1.728	+ 0.796 ± 0.379
Yield / plant	+314,143	+ 0.004 ± 0.072
Phenol content	+ 0.0001	+ 0.448 ± 0.528
Carbohydrate content	+0,008	+ 0.916 ± 0.129
Protein content	-0,009	+ 0.447 ± 0.252
Crude fibre content	+3,851	- 0.403 ± 1.984

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