



Research Article

Genetic architecture of resistance to yellow vein mosaic and leaf spot diseases in okra (*Abelmoschus esculentus* (L.) Moench)

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Abstract

Generation mean analysis of four crosses of okra (*Abelmoschus esculentus* (L.) Moench) viz., NBPGR/TCR-1498 x NBPGR/TCR-2060, NBPGR/TCR-2019 x Parbhani Kranti, MDU-1 x Varsha Uphar, NBPGR/TCR-985 x Parbhani Kranti was conducted for studying gene action of resistance to two major diseases viz., yellow vein mosaic (YVM) and Alternaria leaf spot under Kerala conditions. Duplicate gene action was observed for resistance to both diseases, which indicated hindrance to improvement by simple selection. Hence reciprocal recurrent selection would be useful for the effective utilisation of both types of additive and non-additive gene effects simultaneously.

Key words

Abelmoschus esculentus, gene action, epistasis, dominance, additive, yellow vein mosaic, leaf spot

Introduction

Okra, a highly adaptable crop, is grown throughout the country for its tender green fruits. In spite of high production, the average productivity of okra in our country is still very low. The major problem underlying this low productivity is the high susceptibility of most of the cultivars now in vogue to various biotic stresses including diseases such as yellow vein mosaic (YVM) and leaf spot. Hence, it is highly essential to develop high yielding varieties and hybrids of okra possessing resistance to these biotic stresses. Efficiency of selection for the improvement of both qualitative and quantitative traits depends upon the nature and magnitude of gene effects involved in the inheritance of a particular character. Studies on the inheritance pattern of resistance to various biotic stresses in okra, carried out so far, are very much limited.

Generation mean analysis helps to understand the nature and magnitude of gene action using the means of various generations. Hence an attempt was made to study the inheritance pattern of resistance to these two major diseases in okra, utilising four selected crosses employing generation mean analysis.

Material and method

Generation mean analysis of four crosses, involving parents of diverse origin, viz., NBPGR/TCR-1498 x NBPGR/TCR-2060, NBPGR/TCR-2019 x Parbhani Kranti, MDU-1 x Varsha Uphar, NBPGR/TCR-985 x Parbhani Kranti was conducted for resistance to diseases

such as YVM and leaf spot. Among the parents, NBPGR/TCR-2060, Parbhani Kranti and Varsha Uphar were highly resistant to YVM. The four selected F₁s were backcrossed to their respective parents to produce B₁ and B₂ generations during Kharif season.

Simultaneously, the F₁s were selfed to develop F₂ generation. The six generations (P₁, P₂, F₁, F₂, B₁ and B₂) of each F₁ hybrid combination (24 treatments) were evaluated during next Rabi in a randomised block design with three replications. Six generations viz., P₁, P₂, F₁, F₂, B₁ and B₂ of four crosses were grown in randomised block design with three replications during summer season under field conditions at the Department of Plant Breeding and Genetics, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala. Seeds were dibbled at a spacing of 60 x 45 cm between rows and plants respectively. Parents and F₁s were grown in single rows while F₂ and back cross generations were raised in two rows. Data on five randomly selected plants from each replication five plants from each plot in parents and F₁ and fifteen plants per plot in F₂, BC₁ and BC₂ were recorded for the disease incidence of yellow vein mosaic and leaf spot. The experiment was completely devoid of plant protection measures. A local susceptible variety was grown all around the experimental area to ensure the adequate inoculum for heavy disease incidence. Intensity of YVM disease was scored as per the rating scale suggested by Arumugam *et al.* (1975). Leaves of the observational plants were observed

for leaf spot incidence and disease intensity was scored as per the rating scale with scores ranging from 1 to 5. Using the data, generation mean analysis was carried out using the six parameter model (Hayman, 1958).

Result and discussion

A sound understanding of the genetic architecture of genotypes and also their behaviour in differing genetic backgrounds is the basic requirement in adopting the most suited breeding strategy. Generation mean analysis assumes greater relevance in this context as it derives additional knowledge on epistasis also.

The estimates of gene effects with respect to incidence of two diseases of the four crosses are presented in the Table 1. Significance of at least one scale of the six parameter model in the crosses indicated the presence of digenic/epistatic interactions. Prevalence of duplicate epistasis compared to complementary in majority of the cases is broadly in agreement with the previous conclusion (Lal *et al.*, 1975).

Yellow vein mosaic (YVM): The effect *d* was positively significant in crosses NBPGR/TCR-1498 x NBPGR/TCR-2060 and NBPGR/TCR-2019 x Parbhani Kranti while *h* and *l* were negatively significant in crosses MDU-1 x Varsha Uphar and NBPGR/TCR-985 x Parbhani Kranti. Positively significant *l* effect was observed in crosses MDU-1 x Varsha Uphar and NBPGR/TCR-985 x Parbhani Kranti. Considering the magnitude, *m* was the highest in cross NBPGR/TCR-1498 x NBPGR/TCR-2060, followed by *d* whereas *h* was the highest in crosses NBPGR/TCR-2019 x Parbhani Kranti and MDU-1 x Varsha Uphar. In NBPGR/TCR-985 x Parbhani Kranti, both *h* and *l* were the highest and equal in magnitude.

Epistasis was absent in crosses NBPGR/TCR-1498 x NBPGR/TCR-2060 and NBPGR/TCR-2019 x Parbhani Kranti whereas it was duplicate in the other two crosses for YVM incidence. Analysis of the segregation pattern for YVM reaction in F₁, F₂ and backcross generations of two crosses *viz.*, IIHR 1 – 16 x Key stone and IIHR 2 – 48 x Key stone and suggested the involvement of two loci in imparting resistance for YVM (Sadashiva, 1988). Negatively significant dominance and additive x additive effects in crosses MDU-1 x Varsha Uphar and NBPGR/TCR-985 x Parbhani Kranti suggest that heterosis breeding and selection of desirable segregants carrying YVM resistance would be highly beneficial. Contradictory to the duplicate epistasis observed in the present study, control of YVM resistance by two complementary dominant

genes was reported earlier (Sharma and Dhillon, 1983; Thakur, 1976).

Leaf spot: Significant value of *m* effect was observed in all the crosses. Negatively significant *d* effect was present in crosses NBPGR/TCR-1498 x NBPGR/TCR-2060 and MDU-1 x Varsha Uphar while *h* and *i* were positively significant in crosses MDU-1 x Varsha Uphar and NBPGR/TCR-985 x Parbhani Kranti. Negatively significant values were noticed for *j* in MDU-1 x Varsha Uphar and *l* in crosses MDU-1 x Varsha Uphar and NBPGR/TCR-985 x Parbhani Kranti. In magnitude, the highest was *m* in crosses NBPGR/TCR-1498 x NBPGR/TCR-2060 and NBPGR/TCR-2019 x Parbhani Kranti and *l* in the other two crosses. Epistasis was duplicate in nature in all the crosses.

Suitability of the direct selection of desirable genotypes resistant to leaf spot was indicated by the negative significance of additive gene action in crosses NBPGR/TCR-1498 x NBPGR/TCR-2060 and MDU-1 x Varsha Uphar while none of the genetic components was significant in NBPGR/TCR-2019 x Parbhani Kranti. In MDU-1 x Varsha Uphar, additive x dominance and dominance x dominance effects also were negatively significant suggesting that heterosis breeding and recombination breeding also would be useful. Significant dominant x dominant interaction in NBPGR/TCR-985 x Parbhani Kranti reveals its suitability of heterosis breeding.

Duplicate gene action observed for resistance to all the biotic stresses under study indicates hindrance to improvement by simple selection or resistant genotypes. In this situation, reciprocal recurrent selection would be useful for the effective utilisation of both types of additive and non-additive gene effects simultaneously.

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Table 1 Estimates of genetic parameters of resistance to YVM and leaf spot diseases in okra

Cross	Incidence of	Genetic parameters							Scales			
		<i>m</i>	<i>d</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>l</i>	<i>Epistasis</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
NBPGR/TCR-1498 x NBPGR/TCR-2060	YVM	1.53**	1.07**	-0.83	-	-	-	-	0.47	-	0.47	0.00
	Leaf spot	2.45**	-0.46*	-0.92	-0.79	-0.21	1.80	D	-0.71*	-0.29	-0.21	0.40
NBPGR/TCR-2019 x Parbhani Kranti	YVM	1.45**	0.40*	-1.49	-	-	-	-	0.20	-	0.79	0.49
	Leaf spot	2.07**	-0.22	0.03	0.54	-0.09	-1.66	D	0.47*	0.65	0.58	-0.27
MDU-1 x Varsha Uphar	YVM	1.98**	0.20	-3.71**	-3.51**	-	3.51**	D	0.00	-	3.51**	1.75**
	Leaf spot	2.30**	-0.62**	1.69**	1.75**	-0.43*	-3.06**	D	0.23	1.09**	-0.43	-0.87**
NBPGR/TCR-985 x Parbhani Kranti	YVM	1.69**	0.20	-2.75**	-2.35**	-	2.75*	D	-0.40	-	1.95**	1.17**
	Leaf spot	2.33**	-0.02	1.52**	1.41**	0.09	-2.48**	D	0.62**	0.45	-0.34	-0.70**

* significant at 5%

** significant at 1 %

D - Duplicate epistasis