Bulletin of Insectology **60** (2): 303-304, 2007
ISSN 1721-8861

Screening and development of resistant sesame varieties against phytoplasma

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Abstract

Initially 150 germplasm, 32 released varieties and 4 wild spp. of sesame were evaluated under field conditions during Kharif-2005 and promising lines selected under artificial conditions during subsequent two seasons. Three intra- and two interspecific crosses were selected to study the inheritance of phyllody resistance in sesame whereas, two each of intra- and interspecific crosses were identified to test the allelic relationship between resistant genes. The F_2 and backcross segregation analysis in intraspecific crosses revealed that a single recessive gene governs phyllody resistance whereas that of interspecific combinations suggested the involvement of a single dominant gene. Allelic test on intraspecific crosses revealed recessive resistance to be governed by two independent non-allelic genes exhibiting duplicate dominance whereas, interspecific crosses showed the dominance nature of resistance with the involvement of one dominant and one recessive gene.

Key words: Sesame phyllody, phytoplasma, inter- and intraspecific crosses, resistance, inheritance.

Introduction

Sesame (*Sesamum indicum*) is one of the oldest and traditional oilseed crops grown in India from antiquity. India is world leader in area (29.3%), production (26%) and export (40.0%) of sesame. The productivity level of 421 kg/ha achieved during the year 2001-'02 is the record in the history of sesame cultivation and first time national average has surpassed the world average of 405 kg/ha, even though the yield potential of this crop is very low compared to major oilseed crops. Major factors that limit its productivity besides narrow genetic base are extreme susceptibility to biotic and abiotic stresses. Phyllody, an important disease of sesame is caused by a pleomorphic mycoplasma-like organism (phytoplasma) and transmitted by leaf hopper (Vasudeva and Sahambi, 1955) (figure 1). The affected plants become stunted and the floral parts being modified in to leafy structures bearing no fruits and seeds causing yield loss up to 33.9 per cent (Abraham *et al*., 1977). Reliable screening techniques for the inoculation of phytoplasma were missing for a long time. Also, there was often confusion between resistance of the plant to the phytoplasma and resistance to the insect vector. Now, it is almost established that the use of resistant varieties provides an efficient and sustainable approach to control susceptibility of phytoplasmas. The present investigation was planned and executed with a view to develop high yielding phyllody resistant cultivars of sesame through intra and interspecific hybridization.

Materials and methods

A set of 150 sesame germplasm, 32 released varieties and 4 wild spp. were initially evaluated under field condition during Kharif-2005 for agronomic traits and phytoplasma incidence. The resistance level of identified promising strains against phytoplasma disease was confirmed under artificial condition during summer 2006 and succeeding crop season. Parents for the inheritance of resistance to sesame phyllody were selected from the preliminary screening experiment. Meanwhile large number of intra- and interspecific cross combinations were attempted between selected donors and good agronomic bases, which were susceptible to phytoplasma. Only true F1s identified on the basis of contrasting morphological traits of the parents were used for backcross and advancement to F2 generation. All the seven F1s along with their parents, F2s and backcross populations were planted in 5-meter row having inter- and intra- row distance of 30 and 10 cm, respectively. Screening was done after making an effort to transmit the disease from periwinkle maintained nearby as an alternate host to the healthy sesame plants through dodder (*Cuscuta campestris*) transmission (Sertkaya, 1999). Dodders were grown from seeds and placed on periwinkle, a donor as well as reservoir of phytoplasma. The dodders were used as the bridge between the recipient

Figure 1. Symptoms of sesame phyllody after inoculation of phytoplasma using dodder as bridge and periwinkle as donor.

Table 1. Segregation and reaction of F_2 and backcross populations against phytoplasma in sesame.

Crosses	Generations	Segregation Observed T	R	S	Expected R	S	Expected ration R:S	χ^2
KMR14 x RT54	F_2	381	91	290	95.25	285.75	1:3	0.252
"	BC1 (F_1 x KMR14)	30	17	13	15	15	1:1	0.534
Pragati x ORM17	F_2	347	84	263	86.75	260.25	1:3	0.116
"	BC1 (F_1 x Pragati)	28	13	15	14	14	1:1	0.142
Pragati x KMR75	F_2	367	86	281	91.75	275.25	1:3	0.480
"	BC1 (F_1 x Pragati)	32	15	17	16	16	1:1	0.124
OMR17 x *S. alatum*	F_2	369	282	87	276.75	92.25	3:1	0.397
"	BC2 (F_1 x *S. alatum*)	32	15	17	16	16	1:1	0.124
RT54 x *S. mulayanum*	F_2	354	269	85	265.50	88.50	3:1	0.184
"	BC2 (F_1 x *S. mulayanum*)	38	12	16	14	14	1:1	0.570

host (healthy sesame) and the donor plant. The dodder bridges were left for 3-4 weeks for inoculation of phytoplasma. Thereafter, the dodder was removed. Chi-square test was used to check the goodness of expected ratio in segregating generations (Stansfield, 1986).

Results

Disease incidence of parental lines recorded on individual plant basis indicated that seven cultigens viz, RJS78, RJS147, KMR14, KMR79, Pragati, IC43063 and IC43236 and two wild spp. i.e. *Sesamum alatum* and *Sesamum mulayanum* were resistant to phytoplasma with mean incidence of below 5 per cent in all the parental lines. All the three F1s of intraspecific crosses were susceptible, indicating that susceptibility was dominant over resistance. The reactions of F2 populations between resistant and susceptible parents presented in table 1 gave a segregating ratio of 1R:3S. The backcrosses of these F1s with their respective resistant parent gave 1:1 (R:S) segregation ratio and thus corroborated the segregation pattern of F2 generation. The F1s of interspecific crosses were found to be resistant whereas, their F2 generations showed a good fit to a segregation ratio of 3R:1S, which was conferred by this segregation patter of their backcross populations.

Five resistant donors were intercrossed in order to determine the allelic relationship of their respective resistance genes. Data on the phyllody reactions of four F1 crosses and F2 populations derived after intercrossing the donors have been presented in table 2. The F1 hybrids from all the crosses were resistant. The F2 populations of RJS 147 and Pragati with KMR 14 showed a segregation pattern of 15R:1S whereas F2 of interspecific crosses revealed a segregation pattern of 13R:3S.

Table 2. Allelic relationship based on the reaction of F_1 and F_2 populations in sesame.

Cross combinations	X^2 Value 13R:3S	15R:1S	Genes
RJS147 x KMR14	-	0.385	DD
Pragati x KMR14	-	0.299	DD
Pragati x *S. mulayanum*	0.09	-	OD & OR
KMR14 x *S. alatum*	0.239	-	OD & OR

DD= Duplicate dominant, OD & OR= one dominant and one recessive.

Discussion

It is clear from the results that a single recessive gene governs resistance in cultivated varieties (KMR14 and Pragati); whereas wild species possess a single dominant gene conferring resistance against phytoplasma. All the F_1 plants of resistant x resistant combinations of interspecific crosses were resistant whereas, their F_2 populations segregated in to resistant and susceptible classes under controlled condition. The F_2 data showed 13:3 ratios with good fit and indicated the existence of different resistance genes in these genotypes. F_2 segregation pattern (15R:1S) of intraspecific crosses suggested the involvement of a single dominant and/or recessive gene which segregated independently.

Significant findings are that these genotypes have not been previously studied in details for phyllody resistance except two wild species and duplicate control of phyllody resistance in three crosses viz., KMR14 x RT54, Pragati x ORM17 and Pragati x KMR75 is a new report. The resistant genotypes reported here can be used as confirmed sources of resistance and utilized in breeding programme for the development of elite phyllody resistant sesame lines. Progeny these crosses would be handled properly depending upon the nature of resistant genes to introgress phyllody resistance.

Acknowledgements

The authors are thankful to Council of Science & Technology, U. P., India for providing financial support.

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