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MULTILOCATIONAL TESTING OF PIGEONPEA FOR BROAD-BASED RESISTANCE TO STERILITY MOSAIC IN INDIA

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Abstract : During the 5-year period (1978-79 to 1982-83), 88 pigeonpea germplasm lines that had been found resistant to sterility mosaic (SM) at ICRISAT Centre, Patancheru; Agricultural Research Station, Marathwada Agricultural University, Badnapur; and Chandra Shekhar Azad University of Agriculture and Technology, Kanpur were tested at 10 different locations in India to identify lines with stable and broad-based resistance. The multilocation evaluation was carried out through the joint Indian Council of Agricultural Research (ICAR) and ICRISAT Uniform Trial for Pigeonpea Sterility Mosaic Resistance. These tests helped to identify SM resistant genotypes at each of the 10 locations—Badnapur, Bangalore, Dholi, Pantnagar, Faizabad, Kanpur, Ludhiana, Patancheru, Vamban and Varanasi. Three lines—ICP 7867, ICP 10976, and ICP 10977—were found to be resistant or tolerant at all the 10 locations. These lines are now being used by breeders at ICRISAT as well as in the Indian national programme for developing SM resistant and high yielding cultivars.

Keywords : *Cajanus cajan*, Pigeonpea, Broad-based resistance, Sterility mosaic, Stable resistance

Sterility mosaic (SM) is the most important disease of pigeonpea (*Cajanus cajan* (L.) Millsp.) in India and is particularly damaging in the states of Bihar, Gujarat, Karnataka, Tamil Nadu and Uttar Pradesh (Kannaiyan *et al*, 1984). The high incidence of SM in these areas in spite of numerous mixed cropping and crop rotation practices followed by the farmers indicates that these practices are unable to check the disease. Although there are no reports of experiments designed to research the effect of crop rotations on SM incidence, inter-cropping of pigeonpea with sorghum was found to increase the disease incidence (ICRISAT, 1980; Bhatnagar *et al*, 1984). Control of SM by using acaricide sprays to control the vector *Aceria cajani* Channa Basavanna, although feasible, is not considered economical. Control of the disease through the use of resistant cultivars is the most practical way.

The availability of stable and broad-based sources of resistance is essential for resistance breeding programme. Screening of the world collection of germplasm accessions for resistance to SM at ICRISAT Centre revealed the presence of genotypes

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apparently immune (no visible symptoms) to the disease (Nene and Reddy, 1976). However, the performance of these lines at other SM-endemic locations had not been studied. To identify lines with stable and broad-based resistance to SM, multilocation screening of the lines identified as resistant at ICRISAT Centre, Patancheru; Agricultural Research Station, Marathwada Agricultural University (MAU), Badnapur; and Chandra Shekhar Azad University of Agriculture and Technology (CSAUAT), Kanpur was undertaken during 1978–79 to 1982–83. This screening was carried out jointly by the scientists of ICRISAT and of the All India Coordinated Pulses Improvement Project (AICPIP) of the ICAR.

MATERIALS AND METHODS

Pigeonpea genotypes for multilocation testing

The majority of the genotypes tested were germplasm accessions; 83 accessions found resistant to SM under artificial epiphytotic conditions at ICRISAT Centre (Nene and Reddy, 1976). These genotypes included both original germplasm accessions that showed uniform resistance to SM and resistant selections made from segregating germplasm lines. Two lines were contributed by the MAU and three by CSAUAT. Seed collected from the self-resistant plants in ICRISAT's SM screening nursery was used for the multilocation testing. Each year, newly identified resistant lines were entered into the nursery. Thus the entries were not always the same in all the years of testing.

Selection of the test locations

Screening was done at selected research stations of the AICPIP and at ICRISAT Centre. These locations were jointly selected by the pulse pathologists of ICRISAT and AICPIP at the annual *kharif* (rainy season) pulses workshops based on the local SM incidence levels and facilities available for SM evaluation.

Multilocation screening procedure

Multilocation screening was carried out through ICAR-ICRISAT Uniform Trial for Pigeonpea Sterility Mosaic Resistance (IIUTPSMR). For each entry, 50 seeds were sown in one 4 m row, with 2 replications in a randomized block design. The inter- and intra-row spacings used were 75 and 10 cm, respectively. After two test rows, a row of the susceptible check ICP 7182 was planted. No insecticides were sprayed in the trial for the control of insect pests as these sprays might kill the vector mites and adversely affect the build up of SM in the nursery. At most of the locations, artificial inoculations either by leaf-stapling (Nene and Reddy, 1976) or by the infector hedge technique (Reddy and Nene, 1981) were done to augment the natural incidence of SM. Wherever SM build up occurred late and was not uniform, the main crop was ratooned and re-inoculation was carried out on the newly formed leaves.

Observations on SM incidence and severity

Final observations on the SM incidence and severity in the main or ratoon plants were usually recorded at the time of maturity. In each genotype, plants showing severe mosaic (SeM), mild mosaic (MM) or ring spot (RS) symptoms were separately recorded. Genotypes with less than 15 per cent of the plants showing SeM, MM or RS in all the

seasons of testing were considered resistant. Lines with 16-40 per cent SeM and/or MM or 16-100 per cent RS were considered tolerant and lines with more than 41 per cent SeM or MM were considered susceptible. Results from the locations where SM incidence in the susceptible check ICP 7182 was 20 per cent or less were rejected.

RESULTS

During this study, 88 pigeonpea genotypes were evaluated for SM resistance in 28 trials at 10 different locations. The genotypes ICP 6344, ICP 7228, ICP 7378, ICP 7870, ICP 8090, ICP 8124 and Purple-1 only were tested for 2 seasons. All others were tested for only one season. At Faizabad, Ludhiana and Varanasi, though evaluation was done for 2 seasons, and no line was evaluated for 2 seasons. Except at Kanpur, where SM during the 1982-83 season was 28 per cent, the incidence of SM on ICP 7182 in all the five years was between 47 and 100 per cent (Table 1). At each of these 10 locations, a few to many lines were found resistant to SM. Of the 7 lines tested for 2 seasons at 7 locations, at least one of them was found resistant at each of these locations (Table 1).

TABLE 1: Pigeonpea lines resistant to sterility mosaic at different locations in India (1978-79 to 1982-83)

Locations*	No. of lines tested	No. of seasons tested	Lines resistant for 2 years†	Average per cent SM in the susceptible check (range)
Badnapur	50	3	ICP 6344, 7228, 7378, 7870, 8090	97 (90-100)
Bangalore	41	2	ICP 7378	97 (94-100)
Dholi	72	4	ICP 6344	87 (76-100)
Kanpur	41	2	ICP 6344, 8090	63 (28-98)
Pantnagar	41	2	ICP 7378, 7850	54 (47-61)
Patancheru	92	5	ICP 7228, 7870, 8090	100
Vamban	60	3	ICP 6344, Purple-1	80 (65-100)

*At Faizabad, Ludhiana and Varanasi, no line was tested for 2 seasons but several lines were resistant in one season testing. The SM incidence in the susceptible check at these locations was 63 (29-100), 60 (20-100) and 57 (13-100) per cent respectively. A few lines resistant at these locations are listed in Table 2.

†A line was considered resistant only when it was resistant in all the years of testing at one location. The entries were not the same in all the years.

However, the reaction of many lines differed from one location to another. For example, several lines that showed resistance at ICRISAT Centre showed susceptibility at Dholi (Bihar) and Vamban (Tamil Nadu). But three lines, ICP 7867, ICP 10976 and ICP 10977 were found to be resistant or tolerant at all the 10 locations (Table 2). ICP 11146 was resistant or tolerant at 9 locations and ICP 10983 was resistant or tolerant at 8 locations. All these lines were evaluated for one season at all the locations. But they were found to be resistant in the subsequent multilocation trials.

DISCUSSION

The present study helped to identify pigeonpea lines resistant to SM at each of the 10 SM-endemic locations in India chosen for this study. This is the first time that such

TABLE 2 : Pigeonpea lines with stable resistance to sterility mosaic

Entry	Badnapur	Bangalore	Dholi	Faizabad	Hyderabad	Kanpur	Ludhiana	Pantnagar	Vamban	Varanasi	No. of locations resistant/ tolerant
ICP 7867	R	T	R	R	R	R	R	R	T	R	10
ICP 10976	R	R	R	R	R	R	R	R	R	R	10
ICP 10977	R	R	T	R	R	R	R	T	R	R	10
ICP 10983	R	S	T	R	T	R	R	R	T	S	8
ICP 11146	R	T	S	R	R	R	R	R	R	T	9
ICP 7182 (Susc. check)	S	S	S	S	S	S	S	S	S	S	0

S - Susceptible = 41-100 per cent Severe mosaic (SeM) or mild mosaic (MM), R - Resistant = 0-15 per cent SeM or MM or ring spot (RS), T - Tolerant = 16-40 per cent SeM or MM or 16-100 per cent RS. ICP 7867 is also fusarium wilt resistant at many locations.

good sources of resistance to SM have been identified at most of these locations. In addition, the multilocation screening work also helped to identify three lines that showed resistance or tolerance at all the 10 locations. One of these lines, ICP 7867, which is a germplasm collection from Karnataka, is also resistant to fusarium wilt. Other lines that showed broad-based resistance were selections made by ICRISAT pathologists from germplasm accessions. All these are medium to long duration in-determinate types and have originated in India. Lines with such broad-based resistance may also have durable resistance, but it will be a few years before we find this out. These sources of resistance are now used extensively by ICRISAT and national programme breeders in pigeonpea improvement programmes. The study also indicated the possible existence of variation in the SM pathogen and/or in the mite vector *A. cajani*, which needs to be investigated further. The strains of SM pathogen/mite vector from Bangalore, Dholi, Vamban and Varanasi appear to be more virulent than those at Badnapur, Hyderabad, Pantnagar, Kanpur, Ludhiana, and Faizabad (Table 2). Seeds of lines reported to be resistant in this paper can be obtained from ICRISAT.

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