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## Multi-location evaluation of pigeonpea (*Cajanus cajan*) for broad-based resistance to sterility-mosaic disease in India

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### ABSTRACT

A multi-location trial was conducted from 1983-84 to 1989-90 to evaluate 141 germplasm accessions and 725 breeding lines of pigeonpea [*Cajanus cajan* (L.) Millsp.], for resistance to sterility mosaic at 13 locations. 'ICP 7035', a line from Madhya Pradesh, was resistant at 12 locations and susceptible only at Ranchi. Other germplasm lines ('ICP 6997', 'ICP 7197', 'ICP 7234', 'ICP 7867', 'ICP 8094', 'ICP 8862', 'ICP 10976', 'ICP 10979', 'ICP 10996', 'ICP 11049', 'ICP 11204', 'ICP 11206') and breeding lines ('ICPL 335', 'ICPL 342', 'ICPL 366', 'ICPL 8324', 'BSMR 235') were resistant at 10 locations. 'DPPA 85-2', 'DPPA 85-13', 'DPPA 85-14' and 'DPPA 85-15' were resistant or moderately resistant at all the 6 locations tested (Dholi, Kanpur, Patancheru, Kumarganj, Pantnagar and Ranchi). 'Bahar', a long-duration variety, was resistant or moderately resistant at all the 11 test locations (Badnapur, Bangalore, Coimbatore, Dholi, Kanpur, Kumarganj, Pantnagar, Patancheru, Rahuri, Vamban, Varanasi) it was evaluated. 'DA 32', 'PDA 2', 'Pusa 15', 'Pusa 17' and 'Pusa 18' of long duration tested in Pigeonpea Co-ordinated Trial were resistant or moderately resistant at all the 5 or more locations in which they were tested.

Surveys carried out during 1975-80 show an annual loss of Rs 1 000 million due to the

combined effect of fusarium wilt and sterility mosaic in India (Kannaiyan *et al.* 1984). There

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have been reports of increased incidence of sterility mosaic recently, especially in Gujarat and Maharashtra, causing a loss of Rs 7 050 million annually. A large number of germplasm lines resistant to sterility mosaic have been identified and breeding lines with sterility-mosaic resistance and high yield potential have been developed (Reddy *et al.* 1990). A few germplasm lines with broad-based resistance to sterility mosaic were also identified (Nene *et al.* 1989). The purpose of the present investigation was to evaluate the newly identified germplasm and breeding lines for broad-based and stable resistance to sterility mosaic. The results of sterility-mosaic evaluation carried out at 13 locations in India during 7 years are presented in this paper.

#### MATERIALS AND METHODS

During 1983–84 to 1989–90, 141 germplasm accessions and 725 breeding lines were evaluated for resistance to sterility mosaic. These accessions were identified as resistant to sterility mosaic at different locations. The breeding lines included in evaluation were the newly-bred, high-yielding lines entered into the Pigeonpea Co-ordinated Trials by the breeders of the All-India Co-ordinated Pulses Improvement Project (AICPIP) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The germplasm accessions and breeding lines were evaluated in 3 trials. In the first trial 124 lines including mostly germplasm accessions and a few breeding lines were evaluated during 1983–84 to 1989–90. The majority of these accessions were from the ICRISAT. In the second trial 17 germplasm lines were evaluated between 1988–89 and 1989–90. All these accessions were from the Directorate of Pulses Research (DPR), Kanpur. In the third trial 725 lines comprising all the 5 maturity groups were evaluated between

1983–84 and 1989–90. Since outcrossing occurs in pigeonpea, selfed seeds were used for evaluation.

The locations for evaluation were selected jointly by the pulse pathologists of AICPIP and ICRISAT at the workshops held on the rainy-season (*kharij*) pulses, depending on the importance of sterility mosaic in the area, availability of trained pathologists and facilities for sterility-mosaic evaluation. The locations were Badnapur (Maharashtra), Bangalore (Karnataka), Dholi (Bihar), Gulbarga (Karnataka), Kanpur (Uttar Pradesh), Kumarganj (Uttar Pradesh), Ludhiana (Punjab), Pantnagar (Uttar Pradesh), Patancheru (Andhra Pradesh), Rahuri (Maharashtra), Ranchi (Bihar), Vamban (Tamil Nadu) and Varanasi (Uttar Pradesh). The germplasm accessions in the first and second trials were evaluated at 13 and 6 locations respectively. The lines in the Pigeonpea Co-ordinated Trials in the third trial were evaluated at 11 locations.

Fifty seeds of each test entry were sown in a 5 m row at a spacing of 75 cm x 10 cm, in randomized block design with 2 replications. Every 2 test entries were alternated by 1 row of a line susceptible to sterility mosaic, 'BDN 1' ('ICP 7182'). At most of the locations the trials were artificially inoculated either by leaf-stapling or infector-hedge technique (Reddy and Nene 1981). In leaf-stapling technique the seedlings of 10–15 days were stapled with diseased leaves harbouring mites. In the infector-hedge technique, 4 rows of 'NP (WR) 15', a sterility mosaic-susceptible variety moderately resistant to wilt, were sown 4–6 months in advance of the normal sowing time on the western border of the nursery. These rows were inoculated with sterility mosaic by leaf-stapling for multiplication of the pathogen and mite vector.

The incidence of sterility mosaic in the test lines was recorded at maturity. The lines

showing 0–10% sterility mosaic incidence were categorized resistant; 11–20%, moderately resistant; 21–30%, moderately susceptible; and 31–100%, susceptible. Since the lines showed variation in sterility-mosaic incidence between the seasons at the same loca-

tion, mean incidence of sterility mosaic in different seasons was calculated.

#### RESULTS AND DISCUSSION

Evaluation for disease resistance was very effective at all the 13 locations, as indicated

Table 1 Incidence (%) of sterility mosaic in pigeonpea germplasm and breeding lines with broad-based resistance during 1983–84 to 1989–90

Pigeonpea line	Pedigree or origin	Location													Average
		1	2	3	4	5	6	7	8	9	10	11	12	13	
'BSMR 235'	'BDN 1' x 'ICP 7035 Sel'	0	NT	44	NT	5	10	31	9	0	9	NT	0	2	11
'ICP 999'	ICRISAT	0	NT	18	NT	NT	NT	NT	0	0	NT	NT	NT	NT	5
'ICP 6997'	'DSLR 17'	0	NT	10	0	13	7	88	6	3	0	55	25	0	17
'ICP 7035'	'DSLR 55'	3	2	6	2	0	5	13	13	1	0	46	0	0	7
'ICP 7197'	'Bahar'	3	NT	54	NT	25	19	9	1	0	0	NT	0	0	11
'ICP 7234'	'UQ 16'	4	26	21	4	4	8	27	19	3	0	30	6	8	12
'ICP 7867'	'ANM 252'	1	8	26	12	0	10	75	20	0	0	34	0	0	14
'ICP 8094'	'ANM 449'	8	35	59	5	8	22	28	14	5	2	0	88	18	22
'ICP 8109'	ICRISAT	3	NT	13	NT	NT	NT	NT	0	0	NT	NT	NT	NT	4
'ICP 8129'	ICRISAT	0	NT	9	NT	NT	NT	NT	0	0	NT	NT	NT	NT	2
'ICP 8862'	'Hy 3C'	7	13	25	15	3	5	58	25	4	0	19	2	18	15
'ICP 10976'	'ICSMR Sel 70'	4	42	8	2	0	3	33	13	1	32	37	0	8	14
'ICP 10979'	'ICSMR Sel 457'	0	NT	NT	NT	0	10	NT	5	1	3	NT	18	0	5
'ICP 10996'	'ICSMR Sel 2812'	4	NT	43	4	4	20	NT	4	2	0	NT	NT	5	10
'ICP 11040'	ICRISAT	0	NT	8	NT	NT	NT	NT	0	0	NT	NT	NT	NT	2
'ICP 11049'	'ICSMR Sel 5124'	1	NT	NT	0	NT	0	NT	5	0	3	NT	5	1	2
'ICP 11204'	'ICSMR Sel 8102'	0	NT	NT	19	NT	4	NT	3	0	12	NT	0	1	5
'ICP 11206'	'ICSMR Sel 8104'	1	NT	NT	2	NT	1	NT	5	0	3	NT	0	0	2
'ICPL 342'	'ICP 4601 Sel'	7	17	16	3	7	11	40	30	1	0	6	36	0	13
'ICPL 335'	'C 11' x 'ICP 6997'	5	NT	58	2	2	5	31	30	1	0	8	43	6	16
'ICPL 366'	ICRISAT	10	13	62	0	5	7	NT	30	7	2	24	0	10	14
'ICPL 8324'	'ICP' x '74146'	1	NT	97	4	NT	6	0	0	0	0	NT	0	0	11
'ICPL 85012'	'90 C'	7	5	43	14	32	11	100	38	3	0	1	8	10	21
'ICP 7182'	'BDN 1'	100	100	100	100	45	99	100	58	100	82	100	100	66	88

1, Badnapur; 2, Bangalore; 3, Dholi; 4, Gulbarga; 5, Kanpur (DPR); 6, Kumarganj; 7, Ludhiana; 8, Pantnagar; 9, Patancheru (ICRISAT Centre); 10, Rahuri; 11, Ranchi; 12, Vamban; 13, Varanasi

NT, Not tested; \* susceptible control

by high disease incidence (45–100%) in the susceptible control.

The 124 germplasm accessions and breeding lines evaluated in the first trial showed different reactions at different locations. The lines, in general, showed higher susceptibility at Dholi than at the other locations. However, at each location a few to several lines were resistant or moderately resistant. Twenty-three lines were resistant or moderately resistant at more than 50% locations (Table 1). 'ICP 7035' showed 0–13% sterility mosaic incidence at 12 locations, and higher susceptibility (46% incidence) only at Ranchi. This line and a few others ('ICP 10979', 'ICP 11049', 'ICP 11204', 'ICP 11206') showing lower incidence (20% or less) at most of the locations may be considered to have broad-based resistance. Among the breeding lines, 'ICPL 335', 'ICPL 342', 'ICPL 366', 'ICPL 8324' and 'ICPL 85012' were resistant to sterility mosaic at several locations. These lines are of short, medium and long duration and are high-yielding.

Of the 17 medium- and long-duration lines evaluated in the second trial, 'DPPA 85-13', 'DPPA 85-14' and 'DPPA 85-15' showed

20% or less incidence at all the 6 locations (Dholi, Kanpur, Patancheru, Kumarganj, Pantnagar, Ranchi) evaluated.

Out of the 725 newly-bred high-yielding lines evaluated in the third trial, only 6 lines ('Bahar', 'PDA 2', 'DA 32', 'Pusa 15', 'Pusa 17', 'Pusa 18') showed 20% or less incidence in different locations (Table 2). 'Bahar' released for northern India (DPR, Kanpur 1988), was resistant at all the 11 locations evaluated. As the line showed broad-based resistance to sterility mosaic in the present multi-location trials, it may prove to be more stable. The other germplasm and breeding lines that showed broad-based resistance in the present study are suggested as donors for resistance-breeding programmes or as varieties for areas endemic to sterility mosaic.

Different responses shown by different germplasm lines could be attributed to variation in the population of the mite vector at different locations, and to the biotype of the mites as well as the strains of the sterility-mosaic pathogen. Reddy *et al.* (1991) reported that sterility-mosaic pathogen has distinct strains.

Table 2 Incidence (%) of sterility mosaic in pigeonpea lines tested in Pigeonpea Co-ordinated Trials with broad-based resistance during 1983–84 to 1989–90

Pigeonpea line	Pedigree or origin	Location											Average
		1	2	3	4	5	6	7	8	9	10	11	
'Bahar'	'Sci Mouhari'	10	2	0	21	2	5	6	4	2	0	10	6
'DA 32'	RAU, Dholi	NT	NT	19	0	3	0	NT	0	8	0	NT	4
'PDA 2'	DPR	NT	3	NT	17	9	NT	NT	5	0	NT	NT	7
'Pusa 15'	'DT' x 'Bahar'	NT	NT	0	NT	4	9	NT	0	0	NT	NT	3
'Pusa 17'	IARI, Pusa	NT	NT	0	NT	4	0	NT	0	3	NT	NT	1
'Pusa 18'	IARI, Pusa	NT	NT	0	NT	0	0	NT	0	0	NT	NT	0
'ICP 7182'	'BDN 1'	100	100	53	100	100	100	99	58	82	100	66	87

1, Badnapur; 2, Bangalore; 3, Dholi; 4, Gulbarga; 5, Kanpur (DPR); 6, Kumarganj; 7, Ludhiana; 8, Pantnagar; 9, Patancheru (ICRISAT Centre); 10, Rahuri; 11, Ranchi; 12, Vamban; 13, Varanasi

NT, Not tested; \* susceptible control

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