Reprint from

PROGRESS IN ACAROLOGY

Volume 2

Editors
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C.A. VIRAKTAMATH

OXFORD & IBH PUBLISHING CO. PVT. LTD.
New Delhi Bombay Calcutta

9.21 ROLE OF AN ERIOPHYID MITE *ACERIA CAJANI* (ACARI: ERIOPHYIDAE) IN TRANSMISSION AND SPREAD OF STERILITY MOSAIC OF PIGEONPEA

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INTRODUCTION

Sterility mosaic (SM) is one of the most important diseases of pigeonpea (*Cajanus cajan* (L.) Millsp.) in India causing an annual loss of 205,000 tonnes of grain, especially in the states of Bihar, Gujarat, Karnataka and Uttar Pradesh (Kannaiyan *et al.*, 1984). The disease is presumed to be caused by a virus, although the causal agent is yet to be determined (Capoor, 1952). Seth (1962) and Nene (1972) reported that the eriophyid mite, *Aceria cajani* ChannaBasavanna could transmit SM. However, in spite of the lack of evidence of the viral nature of this pathogen and its association with the diseased plants, mite toxaemia could be the possible cause of SM (Slykhuis, 1980). There is also no information on the nature and extent of spread of the disease under field conditions and the relationship between the mite vector and SM pathogen. In this paper, results of the studies on the possibility of a mite-transmitted pathogen being the cause of SM, relationship between the mite vector and SM pathogen, and spread of the disease and the mite vector under field conditions are reported.

Toxaemia or feeding by eriophyid mites does not incite sterility mosaic

As there is no evidence of viral etiology of SM and some eriophyid mites produce toxaemias (Slykhuis, 1980), we conducted experiments to elucidate whether eriophyid mites could produce toxaemia in pigeonpea.

During the summer of 1977, one apparently healthy plant was located among a group of potted plants of SM-susceptible cultivar, BDN 1, that were artificially inoculated with SM, by the leaf stapling technique (Nene and Reddy, 1976). Microscopic examination of the leaves of this plant revealed heavy colonization by the eriophyid mite vector. The plant was isolated from the diseased plants and after a week, the eriophyid mites were transferred onto healthy plants of SM-susceptible cultivar BDN 1. The eriophyid mites multiplied rapidly but none of these plants developed SM, indicating that SM is not caused by the feeding of eriophyid mites or toxaemia. Subsequent serial transfer of these eriophyid mites to several batches of healthy plants of BDN 1 for over five years did not result in SM symptoms.

Experiments were conducted to find out whether the eriophyid mites maintained on healthy BDN 1 plants had the ability to transmit SM pathogen. These eriophyid mites were exposed to SM diseased pigeonpea leaf discs (1 cm^2) floated on water for 30 minutes and were transferred to healthy plants of BDN 1 at the rate of 10 eriophyid mites/plant. Four out of six

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such inoculated plants developed SM symptoms. Thus the eriophyid mite population maintained on healthy BDN 1 could transmit the SM pathogen. These eriophyid mites were used to transmit SM pathogen repeatedly in several experiments. This confirms that these eriophyid mites had an ability to transmit SM pathogen (Seth, 1962).

SM pathogen-vector relationship

Experiments were conducted to determine the relationship between the SM pathogen and the eriophyid mite vector, and the pattern of distribution of the vector.

Number of eriophyid mites and SM transmission efficiency

Mites maintained on SM infected cultivar BDN 1 potted plants at ICRISAT Center were used for this study. Seven to ten-day-old BDN 1 plants grown in 10 cm plastic pots (one plant/pot) were used for transmission studies. The number of eriophyid mites used for inoculation ranged from one to 20 per plant. Uninoculated plants served as controls. For each treatment, seven to ten plants were inoculated. Final observations of SM infection were made 30 days after inoculation. The experiment was repeated four times.

The percentage transmission obtained with one eriophyid mite/plant ranged from 20 to 60 (average 35.5%). With two to ten eriophyid mites/plant, the transmission ranged from 37.5 to 100%. With 20 eriophyid mites/plant, 100% transmission was obtained consistently (Table 1).

Table 1
Influence of number of eriophyid mites (*Aceria cajani*) on transmission of pigeonpea sterility mosaic pathogen

Number of mites per seedling	Trial I (1982-83)		Trial II (1982-83)		Trial III (1983-84)		Trial IV (1983-84)		
	No. of plants inoculated	No. of plants infected	No. of plants inoculated	No. of plants infected	No. of plants inoculated	No. of plants infected	No. of plants inoculated	No. of plants infected	Mean % SM infection
1	10	4	10	2	10	6	9	2	35.5
2	10	8	10	7	10	9	9	7	79.5
3	10	7	10	7	10	10	10	7	77.5
4	10	7	9	5	10	10	7	6	77.9
5	10	10	8	3	10	10	8	8	84.4
10	10	10	8	4	10	10	9	7	82.0
20	10	10	10	10	NT	NT	NT	NT	100.0
check	10	0	10	0	10	0	10	0	0

NT = not tested

Acquisition of SM pathogen by eriophyid mite

Nonviruliferous eriophyid mites maintained on potted BDN 1 plants in the incubator (24 h light, 30°C) at ICRISAT Center were used in this study. Detached pigeonpea SM infected leaves, free of eriophyid mites and held in acrylic cages (Tashiro, 1967) were used for acquisition of SM pathogen by the mite. Acquisition access periods ranging from five minutes to six hours were tested. Seven to ten-day-old BDN 1 plants grown in 10 cm plastic pots (one plant/pot) were used as test plants. Ten eriophyid mites/plant were used in trial 1 and five in trial 2. Observations on SM infection were recorded 25 days after the transfer of the eriophyid mites. In both the trials eriophyid mites could acquire the SM pathogen within five minutes (Table 2).

Table 2
Influence of acquisition access period on transmission of pigeonpea sterility mosaic pathogen by *Aceria cajani*

Acquisition access period	Trial 1		Trial 2	
	No. of plants inoculated	No. of plants infected	No. of plants inoculated	No. of plants infected
5 min	10	4	8	1
15 min	NT	NT	9	1
30 min	10	0	10	0
1 hr.	10	0	8	0
2 hr.	10	10	10	0
4 hr.	10	0	10	0
6 hr.	10	0	8	0
0 hr. (Control)	10	0	10	0

NT = Not tested

Influence of inoculation access period on SM transmission by eriophyid mite

Viruliferous eriophyid mites maintained on SM-infected potted plants of BDN 1 were used in the study. Seven to ten-day-old BDN 1 plants grown in 10 cm plastic pots were used as test plants. Inoculation access periods of ten minutes to four hours were tested. After the required inoculation access periods, the eriophyid mites were killed by spraying 0.1% methyl demeton. One eriophyid mite/plant was used in trial 1 and in trial 2, five mites/plant were used. Observations on SM infection were recorded 30 days after transfer of the mites.

The data presented in Table 3 show that more than ten minutes of inoculation access period was required for SM transmission.

Table 3
Influence of inoculation access period on transmission of pigeonpea sterility mosaic pathogen by *Aceria cajani*

Inoculation access feeding period	Trial 1 (82-83)		Trial 2 (84–85)	
	No. of plants inoculated	Per cent SM infection	No. of plants inoculated	Per cent SM infection
10 min	10	0	10	0
20 min	10	0	10	30
30 min	10	10	10	10
1 hr	10	50	10	20
4 hr	NT	NT	10	30
Continued feeding (Unsprayed check)	10	40	10	100

NT = Not tested

Spread of SM under field conditions

Wind is considered to be the principal means of dispersal of the eriophyid mites (Slykhuis, 1980). There was no information on the extent of spread of mite vector and SM under field conditions in relation to wind direction

During a period of four years from 1980 to 1984 several experiments were conducted in the field to study the extent of spread of SM from the inoculum source in relation to wind direction. The results are briefly reported.

In all the experiments, a four-row hedge of an SM-tolerant cultivar (NPWR 15), sown yearly in November-December and artificially inoculated with SM by the leaf stapling technique, served as an inoculum source for the spread of the disease to the normal crop sown in June-July, the following year.

Spread of SM downwind from inoculum source in a crop

The extent of spread of SM from an inoculum source infector hedge onto susceptible cultivar BDN 1 sown at intervals of 10 m in a screening block up to 216 m was studied within a span of four years. The disease incidence was recorded at monthly intervals from sowing to maturity of the crop. The final SM incidence recorded at the maximum distance studied in each of four years is presented in Table 4. The SM incidence was almost 100% up to a distance of 200 m from the infector hedge in all the four years.

Table 4

Extent of spread of pigeonpea sterility mosaic from source of inoculum downwind across the crop at ICRISAT Center

Year	Maximum distance (m) of spread from source studied	Days for spread	Per cent disease in susceptible genotype (BDN 1) control rows
1980-81	216	211	99.4
1981-82	205	218	99.9
1982-83	206	224	100.0
1983-84	206	210	98.0

The SM incidence recorded at different intervals at different distances from the inoculum source during the 1982-83 season is presented in Fig. 1. Up to about one month, the SM incidence showed a progressive decrease with increasing distance from the source of inoculum

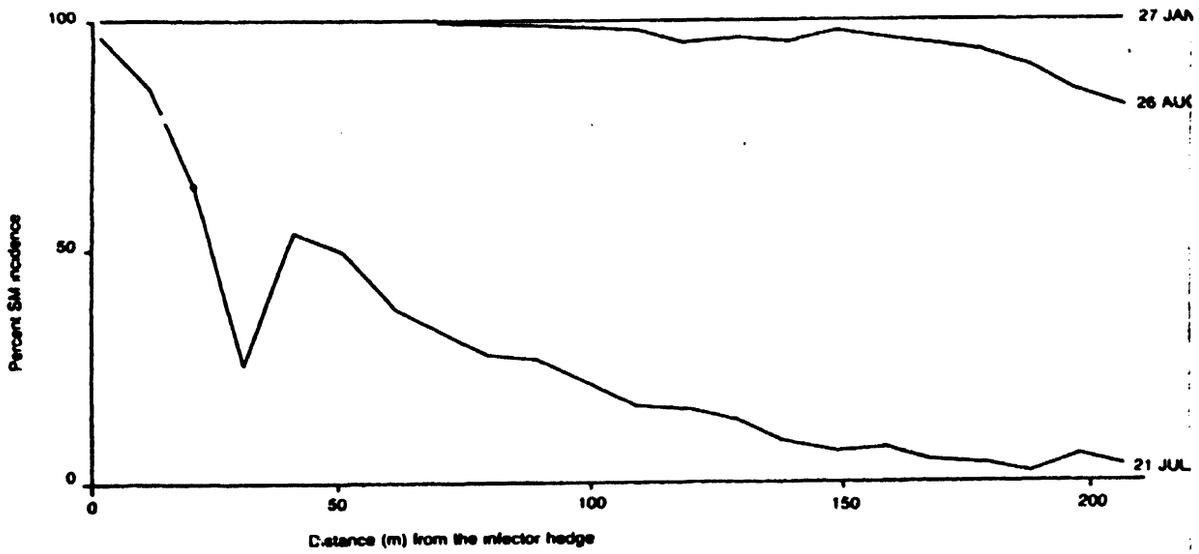

Fig. 1. Incidence of pigeonpea sterility mosaic in a susceptible cultivar at different distances from the infector hedge at different dates during the 1982-83 season at ICRISAT Center.

confirming that the infector hedge was a primary source of inoculum. During the second month, there was a sudden spurt in SM incidence and even the last row (206 m distance) showed 82% SM incidence as compared to 4% in the first month. This sudden increase in SM spread after a month suggested that either the spread of primary inoculum was greatly enhanced due to efficient dispersal of the vector favoured by weather conditions or that the secondary sources of inoculum were responsible. However, it was observed that in other seasons also, the sudden increase in disease incidence on the more distant rows usually takes place a month after sowing, confirming the possible role of secondary spread of inoculum.

Long distance spread of SM in relation to wind direction

The wind direction at ICRISAT Center during June-September is west-southwest. Further experiments were conducted to find out the maximum distance to which the mite could spread the disease in different directions from the inoculum source. Healthy potted plants of the cultivar BDN 1 were used for studying the spread of the disease. The maximum distance of disease spread during the two year study is presented in Table 5. The disease spread up to 2000 m in eastern (downwind) direction in 54 to 77 days. In the western direction, the disease spread up to 200 m at a low frequency (13.2%). The disease spread to 400 m in the northern and 300 m in the southern directions at a very low frequency (2.1%) (Table 5). There was considerable variation in the extent of disease spread between the two years.

Table 5

Spread of pigeonpea SM in different wind directions from source of inoculum, at ICRISAT Center, 1981–83

Year	Direction from source	Maximum distance monitored(m)	Intervals(m) at which monitoring pots were kept	Maximum distance of spread from source (m)	Days for spread	Per cent SM
1981-82	East	1000	100	1000	54	3.2
	West	200	100	200	54	13.2
	North	500	100	400	54	1.3
	South	500	100	300	54	2.1
1982-83	East	2000	100	2000	72	5.7
	West	100	25	25	77	2.7
	North	500	100	*	77	0.0
	South	500	100	*	77	0.0

*No incidence was recorded up to 100m which was the minimum distance tested.

The studies thus indicated more spread in the downwind direction than in other directions from the vector source. The spread of SM up to 200 m in the direction of the downwind was usually very high, reaching a level of 100%, while in the other directions, it was negligible. These results confirm the role of wind in the dispersal of the eriophyid mite vector and consequently in the spread of SM disease.

Effect of distance from the source on the eriophyid mite populations

During October 1981, we examined BDN 1 (susceptible check) plants at three different distances from the infector hedge in the SM screening nursery at ICRISAT. At each distance, six random plants were sampled and the total number of leaves at top, middle and bottom strata were counted. From each stratum two leaves were taken at random, and the number of mites on them was counted.

The results revealed that the number of eriophyid mites as well as the population per plant were significantly different between plants of the same genotype at different distances from the