

Original Research Article

<https://doi.org/10.20546/ijcmas.2017.608.448>

Transmission of Pigeon Pea Sterility Mosaic Virus and Management of Sterility Mosaic Disease of Pigeonpea by Different Acaricides under Middle IGP of Bihar

Rahul Kumar Maurya^{1*}, Birendra Kumar¹, Rahul Kumar^{2*} and Mukesh Singh³

¹Department of Plant Pathology, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar, India

²Division of Crop Research, ICAR-Research Complex for Eastern Region Patna, Bihar, India

³Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, U.P., India

*Corresponding author

ABSTRACT

Keywords

Pigeon pea,
Sterility mosaic
virus,
Transmission and
acaricides.

Article Info

Accepted:

29 June 2017

Available Online:

10 August 2017

Pigeonpea (*Cajanus cajan* L. Millsp.) is one of the most important pulse in India. It is known to be affected by several pests and diseases however among these sterility mosaic disease is one of the most destructive disease and has become a major limiting factor for pigeonpea cultivation. Virus was not seed born in nature. None of the plants emerged from seed collected from diseased plants produced symptoms even though up to 45 days after emergence. Sterility mosaic virus was not transmitted by dodder from Pigeonpea to Pigeonpea, as none of the plants inoculated by fully parasitized dodder developed any symptoms up to 45 days. Mite (*Aceria cajani*) transmitted sterility mosaic virus disease to Pigeonpea and 90 per cent of the inoculated plants developed sterility mosaic disease symptoms 35 days after inoculation. Among these acaricides, T₅ (Propargite @ 0.1% Two spray (1st spray at 25 DAS and 2nd spray 15 days after first spray) recorded significantly lowest sterility mosaic disease incidence of 7.72% with highest yield of 875 kg/ha.

Introduction

Pigeonpea is one of the most important pulse crop grown in Asia. In India, Pigeonpea was grown on 3.88 million ha, with annual production of 3.17 million tonnes and average productivity of 812 kg/ha during the year 2013-14. Pigeonpea, sterility mosaic disease (PSMD) is the most damaging disease of pigeon pea (*Cajanus cajan*) in the Indian subcontinent. PPSMV is transmitted by the eriophyid mite, *Aceria cajani* Channabasavanna (Acari: Arthropoda) (Ghanekaret *al.*, 1992; Seth, 1962).

Analysis of mite populations obtained from SMD affected plants from several locations in India, Nepal, and Myanmar has indicated that *A. cajani* transmits PPSMV at all of these locations (Kumar *et al.*, 2001). It is transmitted by Eriophyid mite (*Aceria cajani*) and is now considered as one of the most serious disease of Pigeonpea. An early infection can reduce grain yield up to 100 per cent. The disease has been reported in all states wherever the Pigeonpea is grown. In the absence of resistance varieties, the

available control measures are not adequate to manage the disease. In present investigation methods of transmission and use of acaricides, four methods used for the transmission of sterility mosaic disease namely seed, sap, dodder and mite (*Aceria cajani*) transmission. The virus was readily transmissible by mites but not by sap, seed or through dodder.

Materials and Methods

Mechanical transmission

Maintenance of Pigeonpea sterility mosaic disease nursery

A field was selected to ensure that it is isolated from other Pigeonpea field to avoid spread of the viral inoculum from this plot to other for survival of Eriophyid mites. The plot was maintained adequate shadow, a highly susceptible genotype (ICP 8863) was sown two month earlier than the normal planting schedule of Pigeonpea, the plants were inoculated using leaf stapling technique at the 2-3 leaf stage, irrigation was given frequently to insure the optimum temperature required for survival of mite transmission of the disease. The plant showed 100 per cent sterility mosaic infection 60 days after sowing. The virus and mites multiply on these nursery plants and serve as source of inoculum for the transmission studies.

Preparation of inoculum

The virus inoculum was prepared from freshly collected young diseased leaves of Pigeonpea. These were washed with tap water followed by distilled water. The adhering water was removed by placing the leaves in between two folds of blotting paper. The diseased leaves were ground in 0.1 M phosphate buffer having pH 7.0 by pestle and mortar. In the leaf tissues phosphate buffer

was added in ratio of 1:1 (W/V). The sap are extracted through two layer of muslin cloth and collected in a beaker. The sap thus obtained was centrifuged at 5,000 rpm for 20 min. The supernatant was used as inoculum. Hence forth this inoculum is called as "standard inoculum". Before inoculation a pinch of celite powder (200 mesh) which acts as abrasive was either added in the inoculum mixed thoroughly or dusted over the leaf surface which was to be inoculated.

Preparation of phosphate buffer

Stock solution

0.2 M solution of monobasic potassium phosphate (KH_2PO_4 . 2.720 g in 100 ml Distilled water).

0.2 M solution of dibasic sodium phosphate (Na_2HPO_4 . $7\text{H}_2\text{O}$. 5.360 g in 100 ml distilled water).

39 ml of (a) and 61 ml of (b) were mixed and diluted to 200 ml with distilled water to prepare 0.1 M solution at pH 7.0.

Mechanical transmission through sap inoculation

Attempts were made to transmit the virus by mechanical inoculation through sap inoculation to Pigeonpea. In all the experiments wherever sap inoculation was to be done, plants were inoculated with freshly prepared standard inoculum. Absorbent cotton was soaked in the inoculum and three leaves of apparently healthy looking plant were inoculated. A high susceptible variety ICP 8863 was used for inoculation. The plants were inoculated at first trifoliate stage. Too old and too young leaves were discarded. A small quantity of celite powder was dusted on leaves before inoculation. Prior to inoculation the plants were kept in darkness for 12 hour to

make them susceptible to infection. At the time of inoculation leaves were supported from below with the help of a piece of card board and then the cotton soaked in the inoculum was gently rubbed on the upper surface. The plants were immediately washed with tap water to remove excess of inoculum and inhibitors over there. Inoculated plants were then kept in the glasshouse and observed daily for production of symptoms.

Transmission through seed

100 seeds collected from diseased plants and 100 seeds from healthy plants of Pigeonpea Variety ICP 8863, highly susceptible were sown in pot maintaining five plants in each pot. After recording germination percentage, the seedlings were kept in insect proof condition for symptom production.

Transmission through dodder (*Casuarina flexa* Roxb.)

The growing ends of the dodder (*Casuarina flexa* Roxb.) Collected from healthy weeds (*Lantana camara*, *Eichornia crassipes* etc.) were twined to young growing shoots of sterility mosaic disease infected Pigeonpea plants and the growing end of dodder, established on diseased plant was twined on the young shoots of healthy test plants. The dodder so established was allowed to grow as bridge between donor and recipient plants for 30 days and then removed. The test plants were kept in insect proof net house for symptom production.

Transmission through Eriophyid mites (*Aceria cajani*)

Leaf collected from diseased plants carrying a number of Eriophyid mite *Aceria cajani* (confirmed under stereoscopic binocular microscope) were stapled to the healthy test plants of Pigeonpea. The inoculated (stapled) plants of Pigeonpea were kept in insect proof

net house for symptoms development. An experiment was conducted during *Kharif* season 2014-15 at research area Tirhut College of Agriculture, Dholi, Muzaffarpur (Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar), to evaluate the efficiency of various management practices in controlling sterility mosaic disease with the following treatments.

Treatments

T₁ - Neem oil @ 3% - two spray (1st spray 25 DAS and 2nd spray after 15 days of 1st spray)

T₂ - NSKE (Neem Seed Kernel Extract) @ 5% - two spray (1st spray 25 DAS and 2nd spray after 15 days of 1st spray)

T₃ - Fenazaquin @ 0.1% - two spray (1st spray 25 DAS and 2nd spray after 15 days of 1st spray)

T₄ - Dicofol @ 0.2% - two spray (1st spray 25 DAS and 2nd spray after 15 days of 1st spray)

T₅ - Propargite @ 0.1% - two spray (1st spray 25 DAS and 2nd spray after 15 days of 1st spray)

T₆ - Wettable sulphur @ 0.25% - two spray (1st spray 25 DAS and 2nd spray after 15 days of 1st spray)

T₇ - Control (No spray)

Results and Discussion

Mode of transmission

Mechanical transmission through sap

Sap inoculation of virus causing sterility mosaic virus disease was carried out on Pigeonpea variety ICP 8863. The results showed that the virus was not sap transmissible. None of the plant produced

symptoms even upto 45 days after inoculation (Tables 1 and 5).

Seed transmission

A study on seed transmission on sterility mosaic virus disease was carried out as described in materials and methods. The result revealed that virus was not seed born in nature. None of the plants emerged from seed collected from diseased plants produced symptoms even though up to 45 days after emergence (Tables 2 and 5).

Dodder transmission

Studies on dodder transmission of the virus were carried out as described in “Materials and Methods”. The results indicated that sterility mosaic virus was not transmitted by

dodder from Pigeonpea to Pigeonpea, as none of the plants inoculated by fully parasitized dodder developed any symptoms up to 45 days (Tables 3 and 5).

Mite transmission

Mites (*Aceria cajani*) were used for transmission of sterility mosaic virus as described under “Materials and Methods”. Mite (*Aceria cajani*) transmitted sterility mosaic virus disease to Pigeonpea and 90 per cent of the inoculated plants developed sterility mosaic disease symptoms 35 days after inoculation (Table 4 and 5). One study suggested that PPSMV was not transmitted transovarially by *A. cajani* but was transmitted in a persistent manner provided mites continue to feed on susceptible plants (Reddy *et al.*, 1989).

Table.1 Transmission through sap inoculation

| Date of inoculation | No. of plant inoculated | No. of infected plant | Date of disease appearance | Incubation period (Days) |
|---------------------|-------------------------|-----------------------|----------------------------|--------------------------|
| 06.08.2014 | 10 | 0 | 0 | 0 |
| 11.08.2014 | 10 | 0 | 0 | 0 |
| 16.08.2014 | 10 | 0 | 0 | 0 |
| 20.08.2014 | 10 | 0 | 0 | 0 |
| 25.08.2014 | 10 | 0 | 0 | 0 |

Table.2 Transmission through seed

| Pigeonpea seed collected from | No. of seeds sown | No. of seeds germinated | No. of plant showing symptoms/healthy | Percent seed transmission |
|-------------------------------|-------------------|-------------------------|---------------------------------------|---------------------------|
| Disease plants | 100 | 90 | 0/90 | 0.00 |
| Healthy plants | 100 | 95 | 0/95 | 0.00 |

Table.3 Transmission through Dodder

| Date of Inoculation | No. of plant inoculated with Parasitized Dodder | No. of infected plant |
|---------------------|---|-----------------------|
| 01.09.2014 | 5 | 0/5 |
| 06.09.2014 | 5 | 0/5 |
| 10.09.2014 | 5 | 0/5 |
| 15.09.2014 | 5 | 0/5 |

Table.4 Transmission through mite

| Mite | Total no. of plant | | Infection (%) |
|---|--------------------|----------|---------------|
| | Inoculated | Infected | |
| Eriophyid mite (<i>Aceria cajani</i>) | 200 | 180 | 90 |

Table.5 Transmission studies on sterility mosaic disease

| Sl. No. | Method of inoculation | Total No. of plants infected Total No. of plants inoculated | Disease (%) | Period taken for symptoms expression (Days) |
|---------|---|--|-------------|---|
| 1. | Mechanical | 0/50 | - | - |
| 2. | Seed | 0/200 | - | - |
| 3. | Dodder | 0/20 | - | - |
| 4. | Eriophyid mite (<i>Aceria cajani</i>) | 180/200 | 90.0 | 35 |

Table.6 Evaluation of different Acaricides for control of mite (*Aceria cajani*)

| Sl. No. | Treatments | Incidence (%) | Yield (Kg/ha) |
|----------------|---|---------------|---------------|
| T ₁ | Neem oil @3% Two spray (1 st spray at 25 DAS and 2 nd spray 15 days after first spray) | 27.22 (31.43) | 270.00 |
| T ₂ | N.S.K.E. @ 5% Two spray (1 st spray at 25 DAS and 2 nd spray 15 days after first spray) | 33.10 (35.10) | 201.25 |
| T ₃ | Fenzaquin @ 0.1% Two spray (1 st spray at 25 DAS and 2 nd spray 15 days after first spray) | 15.27 (22.98) | 642.50 |
| T ₄ | Dicofol @ 0.2% Two spray (1 st spray at 25 DAS and 2 nd spray 15 days after first spray) | 10.42 (18.81) | 727.50 |
| T ₅ | Propargite @ 0.1% Two spray (1 st spray at 25 DAS and 2 nd spray 15 days after first spray) | 7.72 (16.10) | 875.00 |
| T ₆ | W. S. @ 0.25% Two spray (1 st spray at 25 DAS and 2 nd spray 15 days after first spray) | 40.91 (39.74) | 142.50 |
| T ₇ | Control | 71.85 (57.94) | 95.00 |
| | LSD at 5 % | 2.54 | 82.00 |
| | SE(m) | 0.85 | 27.38 |
| | C.V. | 5.77 | 12.98 |

Among these, T₅ (Propargite @ 0.1% Two spray (1st spray at 25 DAS and 2nd spray 15 days after first spray) recorded significantly lowest sterility mosaic disease incidence of 7.72% with highest yield of 875 kg/ha followed by T₄ (Dicofol @ 0.2% Two spray (1st spray at 25 DAS and 2nd spray 15 days after first spray) 10.42 per cent (yield of 727.5 kg/ha) and T₃ (Fenzaquin @ 0.1% Two spray (1st spray at 25 DAS and 2nd spray 15 days after first spray) incidence 15.27% (642.5

kg/ha) (Table 6). While untreated control showed highest sterility mosaic disease incidence of 71.85% with lowest yield of 95 kg/ha. All the treatments have shown significant among themselves. Some studies have been conducted earlier (Rathi 1983, Reddy *et al.*, 1990), seed dressing with 25% Carbofuran or 10% Aldicarb @ 3g/kg seed in helpful in protecting the crop at early stage up to 45 days after sowing.

In conclusion, Virus was not seed born in nature. None of the plants emerged from seed collected from diseased plants produced symptoms even though up to 45 days after emergence. Sterility mosaic virus was not transmitted by dodder from Pigeonpea to Pigeonpea, as none of the plants inoculated by fully parasitized dodder developed any symptoms up to 45 days. Mite (*Aceria cajani*) transmitted sterility mosaic virus disease to pigeonpea and 90 per cent of the inoculated plants developed sterility mosaic disease symptoms 35 days after inoculation. Among these acaricides, T₅ (Propargite @ 0.1% Two spray (1st spray at 25 DAS and 2nd spray 15 days after first spray) recorded significantly lowest sterility mosaic disease incidence of 7.72% with highest yield of 875 kg/ha.

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How to cite this article:

Rahul Kumar Maurya, Birendra Kumar, Rahul Kumar and Mukesh Singh. 2017. Transmission of Pigeon Pea Sterility Mosaic Virus and Management of Sterility Mosaic Disease of Pigeonpea by Different Acaricides under Middle IGP of Bihar. *Int.J.Curr.Microbiol.App.Sci.* 6(8): 3711-3716. doi: <https://doi.org/10.20546/ijemas.2017.608.448>