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# MOSAIC DISEASE OF *Stachytarpheta indica* VAHL., A SOURCE OF VIRUS INFECTION TO CROP PLANTS

A.V. MATHEW[1] and S. BALAKRISHNAN [2]

ABSTRACT

*Stachytarpheta indica* Vahl., a common verbenaceous weed in Kerala, was observed to be infected with a severe mosaic disease. The virus was easily transmitted by wedge grafting, sap inoculation and by the aphids, *Aphis craccivora* Koch.and *Aphis gossypii* Glov. The virus had a dilution end point (DEP) of 1 : 750 - 1 : 1000, thermal inactivation point (TIP) of 70-75°C end longevity *in vitro* (LIV) at room temperature (27-32°C) 48-72 h. and at refrigerated condition (5-10°C) 96-120 h. In the host range studies the virus infected seven test plants *viz., Benincasa hispida, Cucumis sativus, Cucurbita maxima, Trichosanthes anguina* (Cucurbitaceae), *Nicotiana tabacum* var. White Burley, *Nicotiana tabacum* var. Samsun (Solanaceae) and *Stachytarpheta indica* var. *jamaicensis* (Verbenaceae). Results of the studies on transmission, physical properties and host range of the virus indicated that this might possibly be a strain of Cucumis virus I.

KEY WORDS : Mosaic disease, Virus infection, Host plants.

Several weeds showing symptoms of infection have been reported to be sources of the virus diseases on cultivated plants (Tomlinson *et al.*, 1970; Deighton, 1938; Anderson, 1959; and Mariappan and Narayanaswamy, 1977). During a survey of virus diseases of plants in Kerala, *Stachytarpheta indica* Vahl., a common verbenaceous gardenland weed, was found showing severe mosaic symptoms. The results of the studies conducted on the symptomatology, transmission, physical properties and host range of the virus are presented.

## MATERIALS AND METHODS

Periodical surveys were conducted and the weed plants showing obvious virus symptoms were collected and established in the glass house for further studies. Transmissions were attempted by grafting, sap inoculation and by the aphids, *Aphis craccivora and A. gossypii.* Sap transmission was carried out by extracting the sap in 0.1 M phosphate buffer, pH 7.4. Carborundum powder (600 mesh) was used as the abrasive.

Cultures of healthy colonies of *A. craccivora* and *A. gossypii* were maintained on cowpea and brinjal seedlings respectively. In all the transmission trials five adults were used per plant for inoculation. The insects were given 24 h each acquisition and inoculation access feeding periods. After inoculation, the aphids were killed by spraying 0.025% quinalphos and the seedlings were kept in an insect-proof glass house for expression of symptoms.

Seed transmission of the virus was tested by collecting seeds from diseased plants and then sowing. Properties *in vitro* of the virus were studied by expressing the sap from diseased *S. indica* plants and then inoculating on to healthy seedlings of *M. tabacum* var. White Burley after necessary treatments (dilution, heating and aging). The host range of the virus was tested by sap inoculation of 47 plant species belonging to 11 different

1. Assistant Professor, Regional Agrl. Research Station, Kumarakom, Kottayam - 686 566, Kerala.
2. Professor of Plant Pathology, College of Agriculture, Vellayani, Trivandrum-695 522, Kerala.

families. The test plants which did not show any visible symptom even after two months of inoculation were back inoculated to healthy *S. indica* to identify symptomless carriers, if any. The host plants which were susceptible to sap inoculation were also inoculated by both the species of aphids.

## RESULTS AND DISCUSSION

The symptoms developed first as chlorotic patches with light and dark green shades on the young leaves. Later, the chlorotic patches faded and characteristic mosaic symptoms appeared with raised blisters on the adaxial surface of the leaves. In severe cases of infection, the leaves were considerably malformed, reduced in size and filiform in shape. The virus was found to be transmissible by grafting, sap inoculation and by both the species of aphids tried, viz., *Aphis craccivora* and A. gossypii. When the virus was transmitted by grafting, the symptoms developed 12-14 days after grafting. The symptoms of sap transmission developed 9-12 days after inoculation. The symptoms of aphid transmission appeared 12-14 and 13-15 days respectively after inoculation with *A. craccivora and A. gossypii.*

The dilution end point (DEP) and thermal inactivation point (TIP) of the virus were 1 : 750 - 1 : 1000 and 70-75°C respectively. The longevity *in vitro* of the virus at room temperature (27-32°C) was between 48 and 72 h and that at refrigerated condition (5-10°C) was between 96 and 120 h (Table 1).

**Table 1. Physical properties of the mosaic virus of *Stachytarpheta indica* Dilution end point Thermal inactivation Longevity in vitro**

| Dilution end point | | Thermal inactivation | | Longevity in vitro | | |
|---|---|---|---|---|---|---|
| | | | | | Per cent transmission | |
| Dilution | Per cent transmission | Temperature °C | Per cent transmission | Age of the sap in hours | At room temp. (27-32°C) | At 5-10°C |
| Control | 100 | Control | 100 | Control | 100 | - |
| 1 : 10 | 80 | 40 | 80 | 4 | 100 | 100 |
| 1 : 100 | 50 | 45 | 70 | 8 | 80 | 100 |
| 1 : 500 | 30 | 50 | 50 | 16 | 60 | 80 |
| 1 ; 750 | 20 | 55 | 40 | 24 | 40 | 60 |
| 1 : 1000 | 0 | 60 | 20 | 32 | 40 | 50 |
| 1 : 1500 | 0 | 65 | 10 | 48 | 20 | 40 |
| 1 : 2000 | 0 | 70 | 8 | 72 | 0 | 20 |
| 1 : 2500 | 0 | 75 | 0 | 96 | 0 | 10 |
| 1 : 5000 | 0 | 80 | 0 | 120 | 0 | 0 |
| | | 85 | 0 | 144 | 0 | 0 |
| | | 90 | 0 | 168 | 0 | 0 |

Forty seven plant species, *viz.*, *Amaranthus caudatus L., A. viridis L., Celosia cristata L., Gomphrena globosa L. (Amaranthaceae); Hemidesmus indicus L. (Asclepiadaceae); Ageratum conizoides L., Dahlia pinnata Cav., Synedrella nodiflora Gaertn., Zinnia elegans* Jacq. (Asteraceae); *Impatiens balsamina L.* (Balsaminaceae); *Benincasa hispida* Cogn., *Citrullus vulgaris* Schrad., *Cucurbita maxima L., Cucurbita pepo L.* var. condensa, *Cucumis sativus L., Luffa acutangula Roxb., Trichosanthes anguina L.*, (Cucurbitaceae); *Manihot esculenta* Crantz., *Micrococca mercurialis* Benth., *Sebastania chamelea* Muell. (Euphorbiaceae); *Canavalia ensiformis* D.C., *Cyamopsis tetragonoloba* (L.) Taub., *Dolichos biflorus L., Glycine max (L.) Merr., Phaseolus aureus (L.) Roxb., P. mungo (L.) Roxb., Vigna unguiculata* L. (Fabaceae); *Abelmoschus esculentus (L.)* Moench., *Hibiscus rosasinensis L., Sida carpinifolia L., S. cordifolia* L. (Malvaceae); *Sesamum indicum* L. (Pedaliaceae); *Capsicum annum* L., *Datura metal* D.C., *D. stramonium* L., *Lycopersicon esculentum* Mill., *Nicotiana tabacum* L. White Burley, N. tabacum L. Samsun, *N. glutinosa L., Petunia hybrida* Vilm., *Physalis minima* L., *Solanum melongena* L., *S. nigrum* L., *S. torvum* L. (Solanaceae), *Lantana camara* L., *Stachytarpheta indica* Vahl. and *S. indica* Vahl. var. *Jamaicensis* (Verbenaceae) respectively were tested for host range. Among the plants tested seven *viz., B. hispida, C. sativus, C. maxima, T. anguina, N. tabacum* White Burley, *N. tabacum* Samsun and *S. indica Var. jamaicensis* were susceptible to infection by the virus (Table 2).

**Table 2. Transmission of the mosaic virus of Stachytarpheta indica**

| Plants susceptible to the the mosaic virus isolate | Sap transmission * | | Insect transmission | | | |
|---|---|---|---|---|---|---|
| | | | Aphis craccivora | | Aphis gossypii | |
| | Incubation period in days | Per cent transmission | Incubation period in days | Per cent transmission | Incubation period in days | Per cent transmission |
| **Benincasa hispida** | 7-10 | 30 | 11-13 | 50 | Nil | Nil |
| **Cucumis sativus** | 8-10 | 60 | 11-13 | 60 | 13-15 | 50 |
| **Cucurbita maxima** | 8-10 | 60 | 12-15 | 80 | 10-14 | 40 |
| **Nicotiana tabacum** Var. White Burley | 6-8 | 100 | 12-14 | 80 | 12-14 | 60 |
| **Nicotiana tabacum** var. Samsum | 7-9 | 100 | 12-14 | 70 | 13-15 | 60 |
| **Stachytarpheta indica** | 8-10 | 90 | 12-14 | 60 | 13-15 | 40 |
| **Stachytarpheta indica** var. **jamaicensis** | 10-12 | 50 | 12-14 | 60 | 13-15 | 40 |
| **Trichosanthes anguina** | 8-10 | 60 | 11-13 | 50 | 12-14 | 50 |

*Sap extracted in 0.1 m phosphate buffer pH 7.4

The virus produced disease symptoms on *B. hispida* within 7-10 days and on *C. sativus, C. maxima* and *T. anguina* within 8-10 days after inoculating with the sap. It produced chlorosis, mosaic mottling and distortion of leaves. More severe infection was noted on *T. anguina* on which raised blisters developed on the leaves. On white Burley and Samsun tobacco plants the symptoms developed 6-8 and 7-9 days/respectively after inoculation. All the inoculated plants developed the symptoms of mosaic and the symptoms were identical on both varieties of tobacco plants. On *S. indica* var. *Jamaicensis* symptoms of severe mosaic and leaf distortion developed 10-12 days after inoculation.

The above findings on the host range of the mosaic virus of *S.indica* was confirmed by aphid transmission of the virus to all the hosts. In *B. hispida*, only *Aphis craccivora* could transmit the virus. It has been found that in general *A. craccivora* was more efficient than *A. gossypii* in transmitting the virus (Table 2).

The virus was transmitted by sap inoculation and by the aphids. The percentage of sap transmission increased from 60 to 90 when the sap extracted in phosphate buffer was used for inoculation when compared to concentrated sap (Table 3). Similar reports were also reported by earlier workers like Thornberry (1935) and Costa (1944).

The physical properties of the virus resembled that of the cucumber mosaic virus (CMV) and its strains. Chamberlain (1939) described the physical properties of a strain on CMV as having a DEP of 1 : 1000, TIP 62-66°C and LIV 96 h at room temperature. Dubey *et al.*, (1974) described the physical properties of *Cucumis virus* I as having a DEP of 1:1000 - 1:5000, TIP 65-70°C and LIV in phosphate buffer 16-18 h at room temperature and 192 h at 8°C. Joseph and Menon (1978) reported a mosaic disease of snakegourd caused by a strain of Cucumis virus I and the virus had a DEP of 1:5000 - 1:10000, TIP 70-75°C and LIV 72-96 h at room temperature and 144-168 h at refrigerated condition. The above details show that there can be variations in the physical properties of strains of CMV.

Host range studies of the virus showed that it was transmitted to seven host plants belonging to the family Cucurbitaceae, Solanaceae and Verbenaceae and that the virus had similarities with some strains of Cucumis virus I.

A perusal of literature showed that Deighton (1938) reported *Stachytarpheta* sp. as the collateral host of tobacco leaf curl virus. Van Der Laan (1940) reported

**Table 3. Sap transmission of the mosaic virus of *Stachytarpheta indica***

| Inoculum | Incubation period in days | Per cent transmission |
|---|---|---|
| Concentrated sap | 8-10 | 60 |
| Standard sap | 9-12 | 40 |
| Sap extracted in deionized water | 10-12 | 50 |
| Sap extracted in 0.1 M phosphate buffer pH 7.4 | 8-10 | 90 |

*S. dichotoma* among the collateral hosts of pseudo-mosaic disease of tobacco. Wilson and Sathiarajan (1965) reported a leaf distorting virus of *S. indica* which was transmitted by grafting. There is no earlier report of any sap transmitted or aphid transmitted virus disease of *S. Indica* and hence, this forms the first record of a mosaic disease of this plant.

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# FIELD SCREENING OF SHORT DURATION PIGEONPEA LINES FOR RESISTANCE TO BACTERIAL LEAF SPOT AND STEM CANKER *(Xanthomonas campestris pv. cajani)*

G. ARJUNAN, R. SAMIYAPPAN and K. THIYAGARAJAN
National Pulses Research Centre, Vamban, Pudukkottai District.

### ABSTRACT

Thirty five determinate and non-determinate pigeonpea types of early duration were screened against bacterial leaf spot and stem canker (*Xanthomonas campestris pv. cajani).* ICPL 87 and ICPL 85017 in determinate and ICPL Nos. 84048, 85048, 85049 and ICPH.22 in non-determinate types were resistant to bacterial leaf spot. Among these lines, the non-determinate line ICPL 85049 showed resistant reaction to stem canker also. The other five lines showed moderate resistance to stem canker. In general, red-flowered types, whether determinate or non-determinate, were found more susceptible than yellow-flowered types.

KEY WORDS : Pigeon pea, Varietal screening, Bacterial leafspot, Stem canker.

Bacterial leaf spot and stem canker of pigeonpea were reported to occur in different parts of India (Kulkarni *et al.*, 1950, 1952; Gaikward and Kote, 1981; Reddy *et al.*, 1987) and Sudan and Panama (Nene *et al.*, 1984). The disease usually appears between July and