

STUDIES ON CUCURBIT VIRUSES IN MADRAS STATE*

I. A New Virus Disease on Bittergourd (*Momordica charantia* L.)

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Received February 16, 1970

ABSTRACT

A virus disease of bittergourd (*Momordica charantia* L.) was observed around Coimbatore. The virus was transmitted by five species of aphid vectors, viz., *Myzus persicae*, *Aphis gossypii*, *A. malvae*, *A. nerii* and *Brevicoryne brassicae* but not by sap or seed. The virus did not pass on to *Solanum tuberosum* L. and *Citrus aurantifolia*. The host range of the virus was confined to members of Cucurbitaceae. The virus was tentatively designated as Bittergourd Mosaic Virus.

INTRODUCTION

IN addition to many fungal and bacterial diseases, a number of virus diseases have been reported on cultivated cucurbits in recent years. A perusal of the literature indicates that as many as 22 different viruses occur naturally on cucurbits while 17 others have been reported to infect them on artificial inoculation. Among these viruses, cucumber mosaic virus, and its strains, squash mosaic virus, melon mosaic virus, watermelon mosaic virus and bottlegourd mosaic virus are important because of their wide distribution, severity of symptoms and heavy loss caused to cultivated cucurbits. Much of the work on cucurbit viruses has been from the United States of America and some European countries. As far as India is concerned, very little information is available on the various diseases of this important group of vegetables.

In India, virus diseases on cultivated cucurbits like *Lagenaria vulgaris* (Vasudeva and Lal, 1943; Capoor and Varma, 1948), *L. leucantha* (Vasudeva *et al.*, 1949), *Cucurbita pepo* (Bhargava and Joshi, 1960; Reddy and Nariani, 1963; Hariharasubramanian and Badami, 1964) and *Luffa acutangula*

* Submitted by the senior author as part of his Ph.D. Thesis to the Madras University.

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(Mitra and Nariani, 1965) have been reported. In Madras state, very little work has been carried out on cucurbit virus diseases. Jaganathan (1965) studied the virus diseases of *Cucurbita moschata*, *Cucumis melo*, *Citrullus vulgaris*, *Lagenaria vulgaris* and *Luffa acutangula*.

A virus disease on bittergourd (*Momordica charantia* L.) was commonly observed wherever it was grown and particularly in the vegetable section of the Agricultural College and Research Institute, Coimbatore, and also a Telungupalayam, near Coimbatore. The results of investigations carried out on this virus disease are given in the following paragraphs.

RESULTS

A. Symptomatology

Symptoms on the naturally infected bittergourd plants were confined mostly to leaves. Infected plants were somewhat difficult to locate in the field because no severe damage was caused to the vines. The leaves in the secondary branches produced at the apical end of the plant showed symptoms of the disease. Symptoms on the leaves consisted of scattered small irregular yellowish patches. Some leaves showed vein-clearing in one or two lobes of the leaf. Severely infected leaves showed reduction in their size and elongation and/or suppression of one or two lobes. The plant as a whole was not severely affected and produced normal flowers and fruits. No symptoms were observed on the fruits.

On the artificially inoculated bittergourd plants, the first symptom was fine vein-clearing which usually started from the top end of the lobes and progressed inwards. Leaves produced subsequent to primary infection showed filiformity and yellowing. Young developing leaves were completely distorted and malformed with considerable reduction in their size. The number of lobes in a severely diseased leaf was reduced. Some of the leaves showed marked reduction in the development of lamina resulting in a shoe-string effect. Flower production was normal but flowers were shed early. Very few fruits were produced which were normal without any virus symptoms on them.

B. Transmission

(i) *Sap transmission*.—The virus was not sap transmissible. Virus inoculum in 0.1 M phosphate buffer of pH 4.0, 4.5, 5.0, 6.0, 7.0 and 7.5 and also with antioxidants like 0.1 M glycine, magnesium chloride, cysteine hydrochloride, sodium nitrate and potassium cyanide failed to give infection.

(ii) *Seed transmission*.—The virus was not transmitted through seeds.

(iii) *Insect transmission*.—Out of eight species of aphids tested, five species, viz., *Myzus persicae* Sulz., *Aphis gossypii* Glov., *A. malvae* Koch., *A. nerii* and *Brevicoryne brassicae* L. successfully transmitted the virus. The other three species of aphids, viz., *Aphis craccivora* Koch., *A. maidis* F. and *Toxoptera citricidus* Kirk., two species of beetles, viz. *Aulacophora intermedia* Jacoby and *A. foveicollis* Lucas and the whitefly, *Bemisia tabaci* failed to transmit the virus.

C. *Host Range*

The host range of the virus was tested by using *Myzus persicae* as the vector. The results indicated that out of 53 species of plants tested, the virus infected only certain members of the family Cucurbitaceae. No symptomless carriers were noticed.

The following cucurbits were infected by the virus :

(1) *Cucurbita moschata* Duch.—Vein-clearing of the young developing leaves, mild mosaic with prominent yellowing of the interveinal areas and reduction in the size of the young infected leaves were the prominent symptoms.

(2) *Cucurbita maxima* Duch.—Symptoms of irregular vein-clearing followed by mild mosaic mottling were noticed.

(3) *Cucurbita pepo* L.—Four varieties of *C. pepo* were infected by the virus under study. In the case of “early white bush” variety, the symptom of vein-clearing of the first true leaf appeared 5 days after inoculation followed by secondary symptoms like production of dark-green raised blisters, reduction in leaf size and severe malformations leading to filiformity and shoe-string formation. The plant as a whole was stunted and infected plants failed to produce flowers.

Symptoms of virus infection on the variety “caserta” were seen 8 days after inoculation and were more or less similar to those observed on the variety “early white bush”. Severe malformation of the young developing leaves leading to complete reduction in the size of the lamina and elongation of the petiole were the symptoms.

The symptoms on the variety “zucchini” were mild, the symptoms being banding of the midrib and secondary veins, slight dark-green blistering and very little malformation.

Prominent vein-clearing followed by mosaic mottling and blistering, reduction in the leaf size were the symptoms seen on the variety “golden delicious”.

(4) *Cucumis melo*. L.—Typical mosaic with very little mottling and blistering were seen 14 days after inoculation.

(5) *Trichosanthes anguina* L.—Symptoms of vein-banding and mosaic patches were noticed on young developing leaves.

(6) *Citrullus vulgaris* Schrad.—Mild mosaic was observed on the young leaves 14 days after inoculation.

(7) *Lagenaria vulgaris* Ser.—Prominent symptom of mosaic with mottling and vein-banding were seen 12 days after inoculation on the young developing leaves.

The following plants were not infected by the virus :

Cucumis sativus L., *Luffa acutangula* Roxb., *L. cylindrica* Roem., *Benincasa hispida* Cogn., *Nicotiana tabacum* L., *N. glutinosa* L., *Solanum melongena* L., *S. nigrum* L., *Lycopersicon esculentum* L., *Capsicum annum* L., *C. frutescens* L., *Datura stramonium* L., *D. ferox* L., *D. metel* L., *Nieandra physaloides* (L.) Pers., *Petunia hybrida* Mort., *Physalis minima* L., *P. peruviana*, *P. ixocarpa*, *Vigna sinensis* Endl., *Phaseolus mungo* L., *Cajanus cajan* L., *Lathyrus odoratus* L., *Pisum sativum* L., *Melilotus alba* Desr., *Cyamopsis psoraloides* Dc., *Apium graveolens* L., *Coriandrum sativum* L., *Chenopodium amaranticolor*, *C. murale* L., *Zinnia elegans*, *Z. linearis*, *Calendula officinalis* L., *Callistephus chinensis* Near., *Hibiscus esculentus* L., *Gossypium hirsutum* L., *Althaea rosea* L., *Gomphrena globosa* L., *Fagopyrum esculentum*, *Tropaeolum majus* L., *Allium cepa* L., and *Zea mays* L.

DISCUSSION

Among the several viruses infecting cucurbits, most are transmitted by sap as well as insect vectors. None of the cucurbit viruses are exclusively transmitted by aphid vectors. All the known cucurbit viruses are sap transmissible and some are transmitted by aphids also.

Among the several plant viruses recorded it was observed that viruses transmitted by aphid vectors would generally be transmitted through sap inoculation. However, a few exceptions like potato leaf-roll virus (PLRV) and citrus tristeza virus are transmitted by aphid vectors and not through sap. In the case of PLRV, *Myzus persicae*, *M. ascolonicus*, *M. circumflexus*, *Macro-*

Trialeurodes solanifolia, *Aphis rhamni* and others were considered as aphid vectors (Smith, 1957). The virus is persistent in *M. persicae* and is retained for many days even after feeding on immune hosts (Smith, 1931; Kassanis, 1952; MacGillivray, 1954). In the case of tristeza virus, the aphid vector was *Toxoptera citricida*. In the present study, attempts were made to transmit the bittergourd isolate of bittergourd to potato (*Solanum tuberosum* L.) plants by means of *M. persicae* and to citrus plants by means of *T. citricida* and *A. gossypii*. Neither potato nor citrus plants, however, showed visible symptoms of virus infection. Subindexing the virus back to *Momordica charantia* and *Cucurbita pepo* failed to show evidence of masked infection. In another experiment, *M. persicae* was starved for two hours and then fed on diseased *M. charantia* plants for four to six hours. After the acquisition feeding the viruliferous aphids were rested two days after which they were transferred to healthy potato and bittergourd plants. In another set, the viruliferous aphids were immediately transferred to healthy potato and bittergourd plants. The purpose of this experiment was to determine whether any latent period in the vector was involved. Neither potato nor bittergourd plants were infected when the viruliferous aphids were given a period of two days after acquisition. In the second test, where viruliferous aphids were used without any time lag, only bittergourd plants were infected and not potato plants. Further, *Myzus persicae* acquired the bittergourd virus isolate in five seconds, transmitted the same to healthy plants in 60 seconds, retained the virus up to four hours during fasting and up to 35 to 40 minutes during continuous feeding. No latent period was observed in the vector. These results indicated the present virus isolate in question did not resemble potato leaf-roll virus. Another important consideration was the differential host ranges of the two viruses. The present virus isolate was transmitted to members of Cucurbitaceae only. Smith (1957) reported that PLRV is transmitted to solanaceous hosts like *Lycopersicon esculentum* L., *Datura stramonium* L., *Physalis floridana* and non-solanaceous hosts like *Amaranthus spinosus* L., *A. retrofractus*, *Comphrena globosa* but no cucurbits are reported to be susceptible to PLRV.

It has been reported that three aphid vectors, viz., *Toxoptera citricida*, *Trialeurodes* and *A. spinicola* transmitted the citrus tristeza virus. However, *Trialeurodes* was considered to be an efficient vector (Knorr *et al.*, 1957). In the present investigations, transmission of the bittergourd virus isolate was tried using *T. citricida* and *A. gossypii*. Inoculated citrus plants failed to show any symptoms even after four months. Back inoculation to bittergourd and squashes (*Cucurbita pepo*) plants failed to show symptoms. Hence, it is considered that the bittergourd virus isolate is not related to citrus tristeza

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Based on the above observations, it is concluded that the virus causing mosaic disease on bittergourd (*Momordica charantia* L.) is a new virus and is tentatively designated as Bittergourd Mosaic Virus.

ACKNOWLEDGEMENTS

The authors express their sincere thanks to the University of Madras for having permitted the publication of this research work.

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