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Studies on Virus Diseases of Cucurbits*

by

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Introduction: Cucurbits are cultivated throughout India as popular vegetables. They are affected by a fairly large number of fungal, bacterial and virus diseases causing considerable losses in yield. The occurrence of five cucurbit viruses *viz.*, bottlegourd mosaic virus (Vasudeva and Lal, 1943), *Cucumis* virus 2 B (Capoor and Varma, 1948), *Cucumis* virus 2 C Vasudeva *et al.* 1949), watermelon mosaic virus (Bhargava and Joshi, 1960) and cucumber mosaic virus (Reddy and Nariani, 1963) have been so far reported from India. This paper deals with the identity and mode of spread of two virus isolates on muskmelon (*Cucumis melo* L.) and pumpkin (*Cucurbita moschata* Duch.) in Tamil Nadu.

Materials and Methods: The virus isolates on muskmelon and pumpkin were collected from Valankulam lake and Thudiyalur area of Coimbatore district respectively and maintained on their respective host plants by periodical sap inoculation in an insect protected glass house. For insect transmission studies, virusfree colonies of the apterous forms of the aphids, *Aphis gossypii* Glov., *A. craccivora* Koch., *Myzus persicae* Sulz., and *Toxoptera citricidus* Kirk. obtained by the multiplication of single viviparous wingless females were used.

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Results: 1. *Symptoms:* (a) *Muskmelon isolate:* The diseased vines of muskmelon in the field were stunted and conspicuous in that the tips of the runners and proliferated shoots from the crowns protruded markedly above the ground level. The internodes were shorter and the leaves smaller and malformed. Older leaves exhibited conspicuous mottling and dark green raised blisters of varying sizes and shapes. The diseased vines produced only a few fruits which were normal in appearance.

On sap inoculation to healthy muskmelon plants the first symptoms of infection appeared on the second leaf produced after inoculation in the form of dark green vein-banding along the main veins of the leaf. The subsequent leaves had characteristic mosaic mottling and dark green, raised, circular blisters. Most of the infected leaves were reduced in size and disfigured in shape. (Fig. 1)

(b) *Pumpkin isolate:* Symptoms on naturally infected pumpkin plants consisted of different types of leaf mottling and malformations. A few leaves exhibited dark green vein-banding along the midrib and lateral veins. The plants infected early in the season remained dwarfed and flowered sparingly with sparse fruit setting.

On sap inoculation to the test pumpkin plants initial symptoms of the disease appeared on the second leaf produced after inoculation in the form of mild vein-clearing. Typical mosaic mottling with dark green and light green patches was evident in all the subsequent leaves. However, in the older leaves the mottling was less pronounced and only chlorotic areas were seen. A few leaves had prominent vein-banding along the main vein and occasionally dark green blisters. The growth of the vines subsequent to infection was much reduced, the internodes being shortened and leaves reduced in size and disfigured in shape. (Fig. 2)

2. *Transmission:* Both the isolates were easily transmitted by sap. Muskmelon isolate produced symptoms within 8 to 9 days in summer and 11 to 12 days in winter. The pumpkin isolate induced the symptoms within 11 to 13 days in both summer and winter.

Insect transmission: Among the four species of aphids tested (*vide* Materials and Methods), *Myzus persicae* alone was able to transmit muskmelon isolate while *M. persicae* and *Aphis gossypii* were able to transmit the pumpkin isolate.

Vector-virus relationships: These studies were carried out using the vector, *M. persicae* on muskmelon and pumpkin. Minimum number of aphids required for transmission of the isolates was determined by allowing the aphids to feed on the source plant for 30 minutes and on the test plant for

one hour. The results indicated that a minimum number of five aphids were required to transmit the two isolates and that maximum transmission could be obtained by using 10 aphids per plant. Hence an uniform number of 10 aphids was used in the subsequent studies.

To test the efficacy of pre-acquisition starvation of insects in improving the transmission of the virus the aphids were starved for different periods and allowed to feed on the source plant for 10 minutes and on the test plant for one hour. To test the effect of post-acquisition starvation the aphids were fed on the source plant for 10 minutes and starved for various periods before transfering them to the test plants. The results are presented in Table 1.

TABLE 1. *Effect of pre-and post-acquisition starvation of M. persicae on the transmission of the virus isolates*

Pre-acquisition starvation (minutes)	No. of plants infected out of 10 inoculated		Post-acquisition starvation (minutes)	No. of plants infected out of 10 inoculated	
	Musk melon isolate	Pumpkin isolate		Musk melon isolate	Pumpkin isolate
0	2	2	0	9	8
5	3	4	5	7	8
15	6	5	15	4	5
30	7	8	30	1	2
60	9	8	60	0	0
120	8	7	120	0	0

The results revealed that starving of aphids prior to acquisition feeding increased the percentage of transmission of both the isolates. Maximum transmission was observed when the aphids were starved for 60 minutes. Starving of aphids after acquiring the virus resulted in reduced transmission of both muskmelon and pumpkin isolates and the viruliferous nature of the vector was lost 60 minutes after starvation.

The minimum acquisition feeding period for the aphid to become viruliferous (acquisition threshold) was determined by allowing different periods of acquisition feeding ranging from five seconds to one hour. The results furnished in Table 2 indicated that the acquisition threshold of muskmelon isolate was 5 seconds while that of pumpkin isolate was 10 seconds.

The transmission threshold of *M persicae* which is the minimum transmission feeding period required by the viruliferous aphid for successful infection of healthy test plant was found to be five seconds for both the isolates (Table 2).

TABLE 2. *Acquisition threshold and transmission threshold of M. persicae*
(Pre-acquisition starvation: 1 hour)

Acquisition feeding	No. of plants infected		Transmission feeding	No. of plants infected	
	Muskmelon isolate (10)	Pumpkin isolate (6)		Muskmelon isolate (10)	Pumpkin isolate (6)
5 seconds	2	0	5 seconds	3	1
10 ,,	5	1	10 ,,	4	3
15 ,,	7	3	15 ,,	6	4
30 ,,	6	4	30 ,,	7	4
45 ,,	7	4	45 ,,	6	5
60 ,,	7	4	60 ,,	8	4
5 minutes	8	5	5 minutes	7	5
15 ,,	6	4	15 ,,	7	5
30 ,,	5	5	30 ,,	7	6
60 ,,	6	4	60 ,,	7	5

NOTE: Figures in parenthesis indicate the number of plants inoculated

Seed transmission: The transmission of muskmelon isolate through the seed was tested by sowing all the seeds obtained from an infected fruit. Among the 25 seeds germinated four seeds produced stunted plants exhibiting typical mosaic symptoms indicating the seed transmission of the virus.

3. *Physical Properties:* The physical properties of the two virus isolates were studied using *Cucurbita pepo* as the test plant for muskmelon isolate and *C.moschata* for pumkin isolate. The results are presented in Table 3.

TABLE 3. *Physical properties of the virus isolates*

Property	Muskmelon isolate	Pumpkin isolate
Dilution end point	1:5000 to 1:7500	1:2500 to 1:5000
Thermal inactivation point	60° – 63°C	50° – 53°C
Longevity *in vitro* at 25° – 28°C	2 – 4 days	4 – 6 days
Longevity *in vitro* at 5°C	8 – 10 days	8 – 10 days
Longevity in desiccated leaves	8 – 10 days	6 – 8 days
Resistance to 95% alcohol	< 1 hour	< 1 hour

4. *Host range:* To determine the host relationships of the isolate under investigation 57 species of plants belonging to 47 genera representing 19 families were tested by sap inoculation. The plants which did not produce visible symptoms after 4 weeks were indexed on healthy test plants to determine whether they were symptomless carriers. The plants included in the study were: *Cucumis sativus* L., *C.melo* L., *Cucurbita maxima* Duch., *C.moschata*

Duch., *C pepo* L., *Citrullus vulgaris* Schrad., *Luffa cylindrica* Roem., *L.acutangula* Roxb., *Lagenaria vulgaris* Ser., *Trichosanthes anguina* L., *Momordica charantia* L., *Benincasa hispida* Cogn., *Vigna sinensis* Endl., *Lathyrus odoratus* L., *Pisum sativum* L., *Lupinus angustifolius* L., *Trifolium incarnatum* L., *Trigonella foenum-graecum* L., *Melilotus alba* Desr., *Cyamopsis psoraloides* Dc., *Nicotiana tabacum* L. (varieties Local and White Burley), *N.glutinosa* L., *Solanum melongena* L., *S.nigrum* L., *Lycopersicon esculentum* Mill., *Capsicum annum* L., *Datura stramonium* L., *D.ferox* L., *D.metel* L., *Nicandra physaloides* (L.) Pers., *Petunia hybrida* Mort., *Apium graveolens* L., *Coriandrum sativum* L., *Foeniculum vulgare* Hill., *Anethum sowa* Roxb., *Zinnia elegans* Jacq., *Z linearis*, *Calendula officinalis* L., *Callistephus chinensis* Near., *Chenopodium amaranticolor* Coste & Reyn., *C.murale* L., *Beta vulgaris* L., *Hibiscus esculentus* L., *Gomphrena globosa* L., *Fagopyron esculentum* Gaertn., *Tropaeolum majus* L., *Rosa odorata* Sweet., *Delphinium consolida* L., *Primula obconica* Hauce, *Lobelia cardinalis* L., *Pentstemon* sp., *Buddleia* sp., *Ligustrum coralifolium* Hassk., *Lilium philippinense* Baker, *Allium cepa* L. and *Zea mays* L.

It was observed that both the isolates were confined to the family Cucurbitaceae and the virus could not be recovered from the other species by back inoculation to the test plants. Among the different species of cucurbits tested, *Cucumis melo*, *C.sativus*, *Cucurbita moschata*, *C.pepo*, *Citrullus vulgaris*, *Lagenaria vulgaris* and *Luffa acutangula* were infected by both the isolates. In addition to these hosts, *Trichosnthes anguina* and *Memordica charantia* were also infected by muskmelon isolate and *Cucurbita maxima* and *Benincasa hispida* by the pumpkin isolate. *Luffa cylindrica* was not infected by both the isolates.

Discussion: Close similarities existed between the muskmelon and pumpkin virus isolates in most of the characters studied. The host range studies revealed that both the isolates were confined to the family Cucurbitaceae. Vector-virus relationship studies indicated striking similarities between the two isolates. Starving of aphids prior to acquisition feeding improved the transmission of both the isolates and this is in consonance with the results of Sylvester (1961) and other workers. The acquisition threshold and transmission threshold of *M.persicae* for the present isolates were similar and indicated the non-persistent nature of the virus. There was a close similarity in the physical properties also and hence the two isolates are considered as strains of a single virus.

Among the several viruses infecting pumpkin and muskmelon and having restricted host range only melon mosaic virus (Lindberg *et al*, 1956), watermelon mosaic virus (Anderson, 1954) and squirting cucumber mosaic virus (Cohen and Nitzany, 1963) were reported to be transmitted by aphids while

number of other viruses such as *Cucumis* virus 2 (Ainsworth, 1935) and *Cucumis* virus 3 (Vasudeva *et al.*, 1949; Mitra and Nariani, 1965) were not transmitted by aphids. The present strains differed markedly from squirting cucumber mosaic virus in their physical properties. Though the isolates resembled watermelon mosaic virus in their transmissibility by *M. persicae* in a typical non-persistent manner (Toba, 1963) and physical properties, they differed markedly from watermelon mosaic virus in host reactions and transmissibility through seed. On the other hand, the present isolates closely resembled melon mosaic virus (Lindberg *et al.*, 1956) and its strains (Komuro, 1956, 1957; Van Velson, 1960) in all major respects. Further it is known that melon mosaic virus is seed transmitted (Lindberg *et al.*, 1956; Komuro, 1956). Hence the present virus isolates on muskmelon and pumpkin are considered as strains of melon mosaic virus and the occurrence of this virus in India is reported for the first time.

Summary: Two sap transmissible virus isolates were collected from naturally infected muskmelon *(Cucumis melo)* and pumpkin *(Cucurbita moschata)* plants. Both the isolates were transmitted by *Myzus persicae* in a typical non-persistent manner with an acquisition threshold of 5 to 10 seconds and transmission threshold of 5 seconds. The virus isolate from muskmelon was transmitted through seeds also. The two virus isolates had similar physical properties and infected only the members of the family Cucurbitaceae. These two isolates were identified as strains of melon mosaic virus. The occurrence of this virus in India is reported for the first time.

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Plant Introduction in Tamil Nadu - *Stenotaphrum dimidiatum* Brogn. Syn : *S. glabrum* Trin - a new colourful grass from the wild, for lawns and soil erosion control

by

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Introduction : *Stenotaphrum* Trin is a tropical genus with 2 or 3 species. *S. dimidiatum* Brogn (Fig. 1) is reported to be distributed in the tropical plains of India (Hooker, 1897; Fischer, 1956). Among the other species *S secundatum* (St. Augustine grass), a native to West Indies, Guinea, South Africa and the Pacific areas from Mexico to Australia is extensively cultivated in the Southern States of U.S.A. in lawns and on fairways of golf courses (Hoover, Hein, Dayton and Erlanson, 1948). A leaf-variegated form of this species is a well known garden plant.

Methods of Material : Sprigs of *S. dimidiatum* were introduced from Kerala State in the year 1956 at the Government Botanic Gardens, Coimbatore. These were planted first in a bed and growth habits studied. Subsequently, the species was tried in 1966 for its usefulness in soil conservation for covering the bottom and sides of drainage channels. In 1967, it was planted under the canopy of trees at the Botanic Gardens, and in 1968 in an open lawn for evaluating its suitability as a lawn grass.

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