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STUDIES ON THE MOSAIC DISEASE OF SNAKE GOURD (*TRICHOSANTHES ANGUINA* L.)*

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Occurrence of mosaic diseases of snake gourd has been reported by several workers (Verma *et al.*, 1970, Nagarajan and Ramakrishnan, 1971., and Dubey *et t,l* 1974) and hence investigations were undertaken to identify and characterise the virus causing mosaic disease of snake gourd in Kerala.

Materials and Methods

The culture of the virus, isolated from naturally infected plants, was maintained on young sanke gourd plants (local cultivar) by frequent sap transmission with concentrated sap extracted from infective tissues. The insect transmission was studied with *Aphis gossypii* Glov., and *Aphis craccivora* Koch. Healthy aphids were reared on their respective hosts and used for the studies. The vector-virus relationships and the physical properties of the virus were investigated following standard procedures. In order to determine the minimum acquisition feeding period, 20 aphids were used in each case and the pre-acquistion starvation and infection feeding periods were fixed as 2 hrs., and 24 hrs. respectively. In all the other experiments, the number of insects and the duration of different treatments ware the same as above but the acquisition feeding time was fixed as 30 minutes. The host range was determined by noting the reaction of different plant species to infection by the vims.

Results and Discussion

The symptoms of the disease developed as mosaic with irregular chlorotic patches and formation of dark green blisters on the leaves of infected plants (Fig.1). The size of the leaves is reduced considerably and the leaves are variously crinkled and deformed. The internodes are shortened and the growth of the plant is retarded. The infected plants blossom sparingly and set only few fruits.

The virus is sap transmissible and the symptoms appeared within 6 to 8 days after inoculation. The virus is transmissible with *Aphis gossypii* and *A, craccivora,* the former being more efficient and the symptoms appeared earlier (Table 1)

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Table 1

Transmission of snake gourd mosaic virus by aphid vectors

Vector species	No. of aphids	Pre-acquisition fasting time (Hr)	Acquisition feeding time (Hr)	Pre-infection fasting time (Hr)	Infection feeding time (Hr)	No. of plants inoculated	Number/ per cent of plants infected.	Time taken for appearance of symptoms (days)
Aphis gossypii	30	2	24	2	24	15	5/33.3	8—9
A. craccivora	30	2	24	2	24	20	6/30.0	10—12

The vector-virus relationships were studied using *A. craccivora* and the results are given in Table 2. The aphid acquired the virus with a minimum feeding time ot 5 minutes and the etticiency ot transmission increased when the acquisition feeding time increased upto 30 minutes Jaganathan and Ramakrishnan (1971) found that the aphid vector of Melon mosaic virus could pick up the virus with an acquisition feeding time of less than 30 seconds. Watson and Roberts (1939) reported that the efficiency of transmission of non-persistent viruses by aphid was reduced after longer acquisition feeding time. Bradley (1954) reported that the formation of salivary sheath during longer feeding intervals prevented the aphids from becoming infective.

The virus was transmitted with an infection feeding of 5 minutes, increase of the time upto 2 hours increased the per cent of infected plants, but further increase reduced the per cent of infection. it was reported by Jaganathan and Ramakrishnan (1971) that the aphid of Melon mosaic virus can transmit it wtih an infection feeding of less than 30 seconds. It is assumed that the aphids that can cause infection do so within the first hour and further increase of infection feeding reduced the ability of the vector (Nariani and Sastry, 1962).

A minimum of 5 aphids are required for successful transmission. Use of 20 aphids gave maximum per cent of infection. Earlier workers have reported that a single aphid can transmit CMV (Hoggan, 1933; Kaiser and Danesh, 1944), but in the present study the failure to transmit the virus by lesser number of aphids may be due to the fact that the virus concentration was low to be infective.

Pre-acquisition fasting of aphid for a period of 2 hours increased its efficiency to acquire and transmit the virus. Similar results were reported by Reddy and Nariani (1963) in the case of mosaic disease of vegetable-marrow caused by CMV. Post-acquisitional fasting of aphids for 30 minutes was optimum for effective transmission of the virus. The efficiency was when they

Table 2

Transmission of snake gourd mosaic virus by *Aphis craccivora* Koch

Acquisition feeding period		No. of aphids used for transmission		Infection feeding period		Pre-acquisition starvation period		Post-infection starvation period		Persistence of the virus in the vector					
Time	Per cent transmission	No. of aphids used	Per cent transmission	Time	Per cent transmission	Time	Per cent transmission	Time	Per cent transmission	Infection feeding time (Days)	No. of plant infected 1	2	3	4	5
5 min	26.6	3	0	5 min	80.0	30 min	100.0	30 min	80.0	1 hr	+	—	—	—	—
10 ,,	26.6	5	40.0	10 ,,	80.0	1 hr	100.0	1 hr	70.0	1 hr	+	—	—	—	—
15 ,,	53.3	10	80.0	15 ,,	80.0	2 hrs	100.0	2 hrs	40.0	1 ,,	+	—	—	—	—
30 ,,	53.3	15	82.0	30 ,,	80.0	3 ,,	100.0	3 ,,	40.0	1 s	+	—	—	—	—
1 hr	00	20	100.0	1 hr	80.0	4 ,,	100.0	4 ,,	0	1 ,,	+	—	—	—	—
2 hrs	00	25	80.0	2 hrs	100.0	5 ,,	100.0	5 ,,	0	1 s	+	—	—	—	—
4 ,,	00	30	30.0	4 ,,	80.0										
8 ,,	0			8 ,,	80.0										
16 ,,	0			16 ,,	80.0										
24 ,,	0			22 ,,	80.0										
				24 ,,	80.0										

+ = Infected — = Not infected

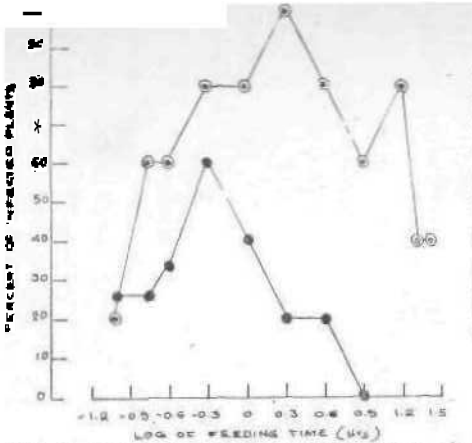


FIG 2 EFFECT OF ACQUISITION FEEDING (-●-) AND INFECTION FEEDING (-●-) ON THE PERCENT OF INFECTED PLANTS

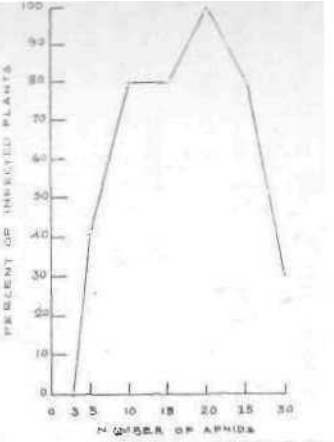


FIG 3 EFFECT OF NUMBER OF APHIDS ON THE PERCENT OF INFECTED PLANTS

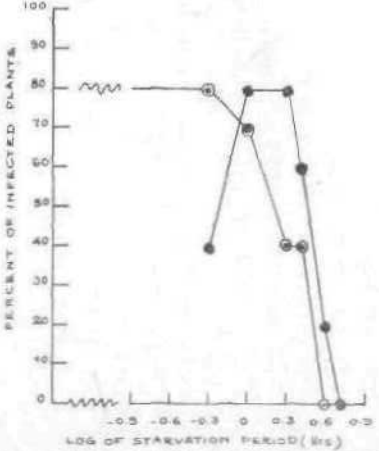
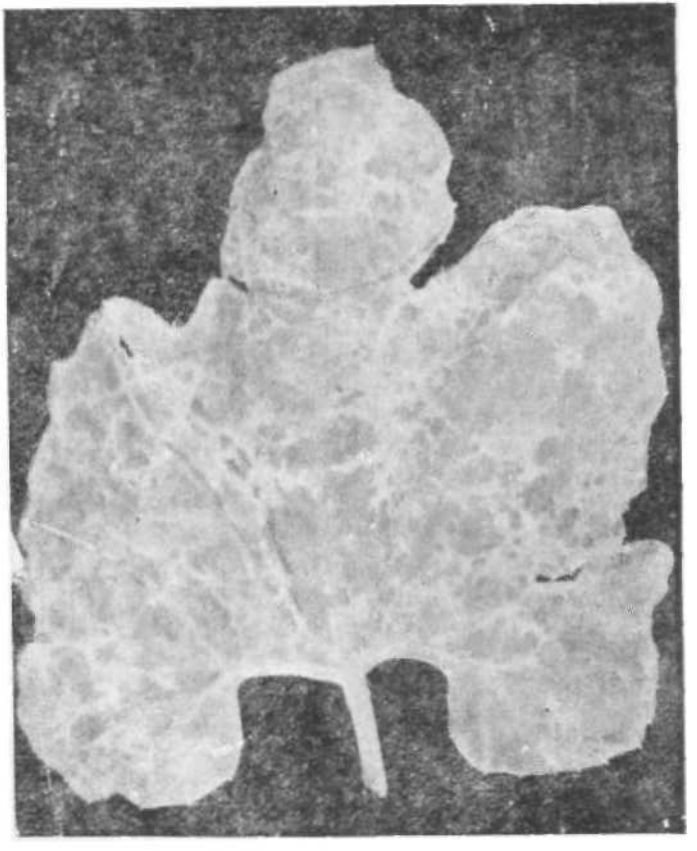


FIG 4. EFFECT OF PRE-ACQUISITION STARVATION (-●-) AND PRE-INFECTION STARVATION (-●-) OF APHIDS ON THE PERCENT OF INFECTION



were starved for 4 hours. Such an effect was reported by Nariani and Sastry (1962) in the case of Chilli mosaic virus. Jaganathan and Ramakrishnan (1971) also reported that post-acquisitional fasting of aphids for more than 5 minutes reduced the infectivity of Melon mosaic virus and after one hour starvation, the aphids ceased to transmit the virus. The virus was not retained by the vector for long periods and it persisted only for a period of one hour. Nariani and Sastry (1962) observed that single viruliferous aphid lost its infectivity after feeding on a test plant for 10 minutes and could not transmit Chilli mosaic virus to the subsequent test plants.

The results of the studies on physical properties of the virus are presented in Table 3. The thermal inactivation point of the vrius is between 70 and

Table 3

Physical properties of the snake gourd mosaic virus

Temperature inactivation point		Dilution end point		Longevity *in vitro*			
				At room temperature		Ar 10°C	
Temperature (°C)	Number of plants infected[a]	Dilution	Number of plants infected[a]	Age of the sap (Hr)	No. of plants infected[b]	Age of the sap (Hs)	No. of plants infectedb
50	10	!:100	10	Fresh sap	5	Fresh sap	5
55	8	1:500	10	24	5	24	5
60	9	1:1000	3	48	4	48	4
61	6	1:5000	6	72	2	72	3
70	2	1:10000	0	96	0	96	2
75	0	1:50000	0	120	0	120	1
80	0	1:100000	0	144	0	144	1
85	0					168	0

a = Out of 10 plants inoculated b = Out of 5 plants inoculated

75 C, dilution end point between 1 :5000 snd 1 :10000 and longevity in vitro at room temperature and at 10°C between 72 & 96 hours and 144 & 168 hours respectively. The results show that the physical properties of the virus resemble more or lese *Cucumis virus* 1 (Dubey *et al.*, 1974), Melon mosaic virus (Jaganathan and Ramakrishnan, 1971) and the strain of CMV (Pillai, 1971).

Table 4

Host range of the snake gourd mosaic virus

Test plant	Symptoms produced
Cucurbitaceae :	
Cucumis sativum L.	Small greenish yellow areas with characteristic yellow mottle . distortion and crinkling of lamina.
Cucurbita maxima L.	Yellowish green chlorotic patches with blistering.
Cucurbita pepo var. *condensa* Bailey.	Development of chlorotic spots into yellowish green patches with distortion and crinkling of lamina.
Solanaceae	
Nicotiana tabacum L.	Vein clearing and pale green areas on the lamina.
N. glutinosa L.	Mosaic mottling with blistering of leaf lamina.
Capsicum annuum L.	Light green mottling and curling of leaf lamina.
Petunia hybrida Vilm.	Pale green mosaic areas with blistering symptoms.
Compositae	
Zinnia elegans Jacq.	Vein clearing with blistering symptoms.

* Only eight species of plants were susceptible to infection.

Out of 33 plant species belonging to 10 families, 8 species in 3 families were found to be susceptible to the virus under study (Table 4). The members of Solanaceae were reported to be susceptible only to *Cucumis virus* 1 (Smith, 1937), and other cucurbit viruses were not reported to infect Solanaceae plants systemically. The virus failed to produce local lesions on *Chenopodium amaranticolor* and *Vigna sinensis* although they were reported to be local lesion hosts of CMV.

The esults of the studies on symptoms, transmission, and physical properties of the virus indicate that the virus infe:ting snake gourd is a strain of *Cucumis virus* 1. This view is further strengthened by the fact that the virus can infect plants belonging to Solanaceae and compositae. The findings of Dubev and Nariani (1975) that snake gourd mosaic virus and melon mosaic virus are serologically related and formed one group, i.e. *Cucumis virus* 1, also strongly support the view that the virus is a strain of *Cucumis virus* 1.

Summary

The symptom of snake gourd mosaic disease manifested as mosaic pattern with dark green raised blisters on the leaf lamina. The size of leaves

severely reduced ; internodes shortened and the growth of the plant is retarded. The infected plants blossom sparingly and set few fruits. The virus is sap and insect transmissible; both *Aphis gossypii* and *A cracdvora* transmitted the virus. Studies on the vector-virus relationships with *A. cracdvora* showed that the vector could acquire the virus with 5 minutes acquisiton feeding and transmit it with 5 minutes feeding on a healthy test plant. A minimum of 5 aphids are required for transmission and pre-acquisition starvation increased the efficiency whereas pre-infection starvation beyond 30 minutes reduced it. The vector could not retain the virus for long periods and the relationship was of non-persistent nature. The physical properties of the virus are: T.!. P. of 70 -75°C, D.E.P. ,of 1 :5000-1 :1 0000, longevity in vitro of 72-96 hours at room temperature and 144—168 hours at 10°C. Eight species of plants in 3 families are susceptible to infection by the virus. Based on the above characteristics, the virus causing mosaic disease of snake gourd in Kerala is identified as a strain of *cucumis virus* 1 .

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