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STUDIES ON SOME WHITE FLY TRANSMITTED PLANT VIRUS DISEASES FROM KERALA*

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The role of weed hosts in the incidence and spread of some virus diseases affecting economic plants has been well established. Eventhough a number of weeds are affected by virus diseases in different parts of Kerala State, there is no precise knowledge of the viruses carried by these plants. The present investigation was therefore undertaken to study the symptomatology and mode of transmission of the virus diseases of weed plants in Kerala and to establish their relationship if any with the diseases of cultivated plants.

Material and Methods

The diseases included in the present studies were yellow vein mosaic of *Ageratum conyzoides* L., *Croton sparsi florus* L., *Emilia sonchifolia* DC. and *Sida cordifolia* L. and leaf curl of *Synedrella nodi flora* Gaertin. Transmission trials were conducted inside an insect-proof house. Sap inoculation was done by the leaf-rubbing method using carborundum powder as an abrasive. Graft transmission was tested by inarching. The white fly *Bemisia tabaci* Gen. and the aphids *Aphis craccivora* Koch and *A. nerii* B. were used as vectors in insect transmission tests. The insects were given an acquisition feeding period of 24 hours. They were then released on one-month-old healthy plants and allowed to feed for 24 hours. Ten to fifteen insects were released on each plant. At the end of infection-feeding, the insects were killed by spraying 0.05 per cent parathion. For testing seed transmission, 100 seeds collected from severely infected plants were sown in 15 cm earthen pots. To study the host range of the viruses, the host plants were inoculated using viruliferous white flies. The inoculated plants were kept under observation for a period of 45 days. The plant species which did not show any visible symptoms after this period were indexed on the original host of the respective viruses in order to detect the symptomless carriers.

Filed symptoms on weeds

Ageratum conyzoides. The symptoms first appear as yellow vein clearing in the newly opened leaves. In some leaves the yellowing diffuses and spreads to the interveinal areas giving a mottled appearance to the infected leaves. Curling and cupping of leaves with thickening of veins and production of enations are also seen in some plants. The disease does not generally affect flowering and seed production (Fig. 1).

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Croton sparsiflorus. Vein clearing and mottling are the typical symptoms of the disease. The plants may become completely yellow, except the stem and branches, Slight curling and reduction in the size of ieaves may also be noticed. Severely infected plants become stunted in growth (Fig. 2).

Emilia sonchifolia. The disease is characterised by pronounced vein-clearing in the leaves. In severe cases of infection the yellowing extends to the mesophyll tissues and may develop into a general chlorosis of the young leaves. Reduction in leaf size, slight distortion and marginal curling of the leaf lamina are also noticed (Fig. 3).

Sida cordifolia. The symptoms on this host appear first as circular, chlorotic spots on the leaves. The leaves later show typical yellow vein mosaic, often followed by a general chlorosis of the leaves. Thickening of veins and production of enations are also noticed. Plants with only one branch showing symptoms of the disease ara frequently observed. Cupping and marginal drying of the leaves are the other symptoms noticed (Fig. 4).

Synedrella nodiflora. Initial symptoms of the virus infection is mild vein clearing in the newly produced leaves. The diseased leaves become reduced in size while the plants become stunted. Inward curling, chlorosis of leaf margins and harsh and brittle nature of the leaves are the other symptoms noticed (Fig. 5).

Experimental Results

Transmission trials revealed that none of the diseases could be transmitted by sap inoculation or through the seeds of infected plants. However, all of them could be transmitted by inarch grafting. Symptoms in the grafted healthy plants appeared within 7-11 days in *A. conyzoides*, 15-20 days in *C. sparsiflorus*, 10-13 days in *E. sonchifolia*, 20-22 days in *S. cordifolia* and 18-20 days in *S. nodiflora.*

All the five viruses could be transmitted by viruliferous *B. tabaci.* In ageratum the symptoms were produced within 8-15 days after inoculation. The newly emerging leaves showed vein clearing, followed by curling and crinkling. Disease symptoms consisting of vein clearing and curling of leaves were produced on croton plants within 15–20 days after inoculation. Inoculated emilia plants showed yellow vein mosaic after a period of 7-12 days. In sida, the initial symptoms consisting of circular chlorotic spots on the young leaves were noted 15-20 days after inoculation. This was followed by vein mosaic, curling and cupping of the leaves. The newly formed leaves of inoculated synedrella plants exhibited disease symptoms within 15-20 days after inoculation. These consisted of irregular, chlorotic patches and mild vein clearing followed by curling and slight distortion of the leaf laminae.

The host range and incubation period of the viruses are presented in Table 1. It may be observed that the virus from *A. conyzoides* infected *S. nodiflora* and *vice versa.* The viruses from *C. sparsiflorus* and *S. cordifolia* could cross infect each other's host plant. In addition to croton, the sida virus could infect tomato, *Lycopersicon esculentum* (Fig. 6).

Table 1

Host range and incubation period of different viruses in their host plants after inoculation with viruliferous white flies

Host plant	Incubation period (in days) of the virus from				
	Ageratum	*Croton*	*Emilia*	*Sida*	*Synedrella*
Ageratum conyzoides	8–15	...	...	...	10-15
Croton sparsiflorus	...	15-20	...	20-25	...
Emilia sonchifolia	...	...	7-12	...	...
Lycopersicon esculentum	...	...	...	20-25	...
Sida cordifolia	...	18-22	...	15-20	...
Synedrella nodiflora	10-15	...	...	...	15-20

The infection on tomato started as mild vein clearing in the youngest leaves within 20-25 days after inoculation with the white flies. Later on, curling of leaflets, thickening of veins and reduction in the size of leaves were noticed. The internodes were shortened and the plants became stunted. Flowering and fruiting of infected plants were badly affected.

Back transmission of the viruses to their original hosts produced typical disease symptoms as that observed on them in nature. None of the plant species tested was found to act as symptomless carrier of the viruses under study.

Discussion

The yellow vein mosaic of *A. conyzoides* and leaf curl in *S. nodiflora*, appear to be caused by one and the same virus. In India *A. conyzoides* has been reported to act as a collateral host of the viruses causing mosaic of sandal, leaf curl of tobacco and yellow vein mosaic of bhindi (Rao 1933, Vasudeva 1957). Attempts to transmit the ageratum virus to 18 species of plants including tobacco and bhindi yielded negative results in the present studies. The leaf curl of *S. nodiflora* is reported for the first time from India.

The viruses causing yellow vein mosaic of *C. sparsiflorus* and *S. cordifolia* could infect each other's host plant. In addition to croton, the sida virus could infect tomato causing leaf curl symptoms. The croton virus, however, could not infect tomato. Pruthi and Samuel (1942) obtained vein clearing symptoms on *Sida rhombifolia* by inoculating the tobacco leaf curl virus, with the aid of white flies. Vasudeva and SamRaj (1948) reported a white fly transmitted leaf curl of tomato from Delhi. They noted that the disease could be transmitted to *Datura stramonium, Nicotiana glutinosa, N. sylvestris, N. tabacum* and *Solanum tuberosum* by grafting. Presumably, white fly transmission was not tried on these hosts. In the present investigation, the virus causing yellow vein mosaic *of Sida cordifolia* could be transmitted to tomato and croton but not to datura, potato and tobacco by the agency of white flies.

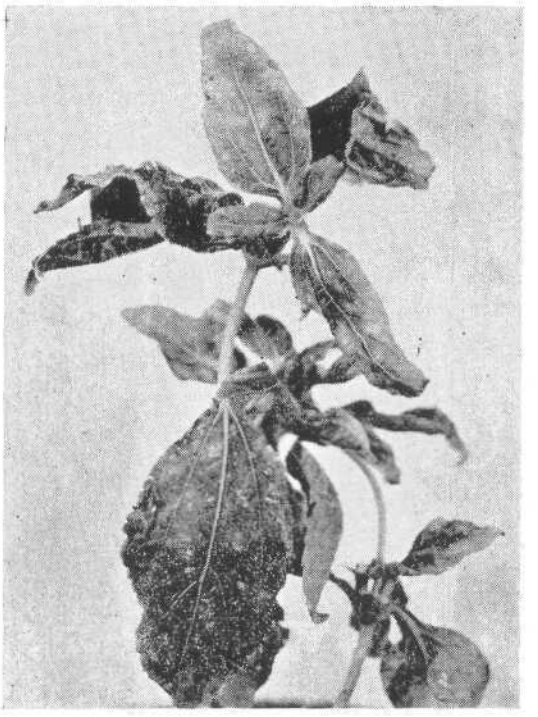

Fig. 5. Leaf curl of *Synedrella nodiflora*

Fig. 6. Leaf curl of tomato

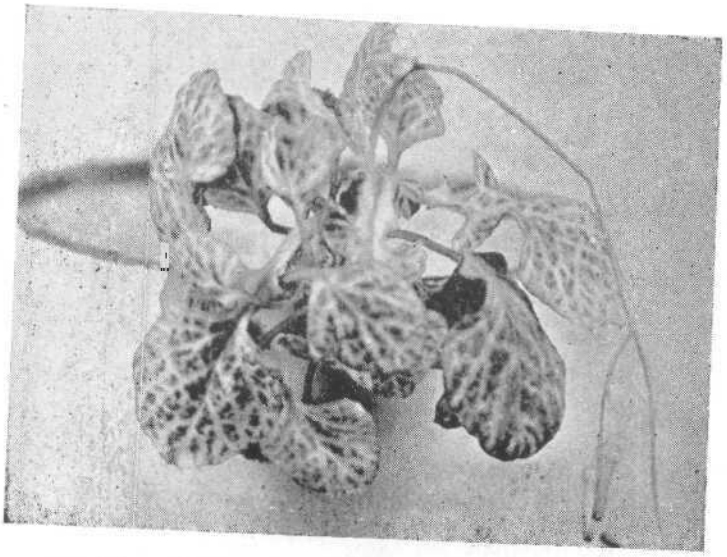

Fig. 3. **Yellow vein** mosaic of *Emilia sonchifolia*

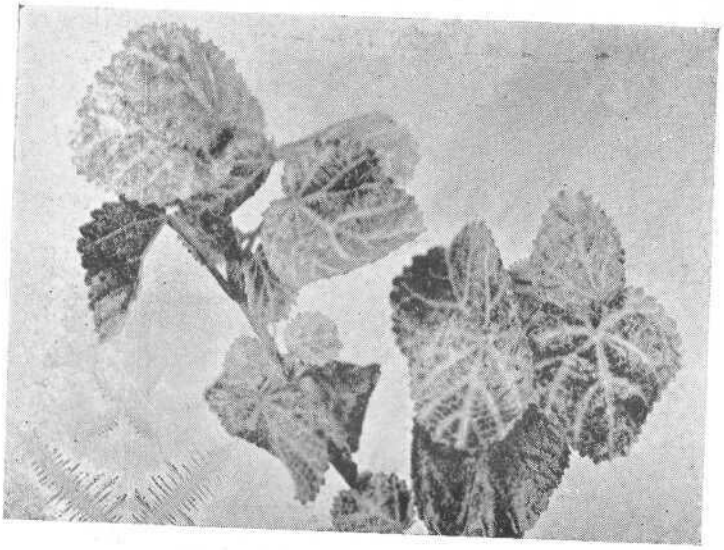

Fig. 4. **Yellow** vein mosaic of *Sida cordifolia*

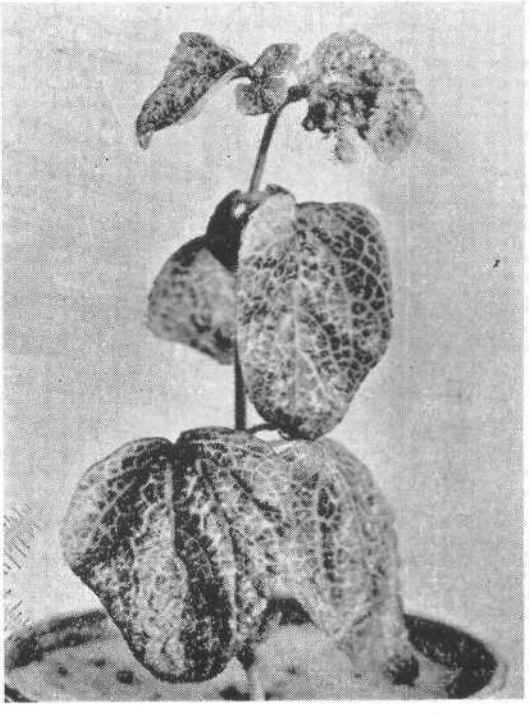

Fig. 1. Yellow vein mosaic of *Ageratum conyzoides*

Fig, 2. Yellow vein mosaic of *Croton sparsiflonis*

The virus causing yellow vein mosaic of *E. sonchifolia* could not infect any of the 20 species of plants tested, except its original host. This disease has not been reported from India so far.

Summary

The yellow vein mosaic of *Ageratum conyzoides, Croton sparsiflorus, Emilia sonchifolia* and *Sida cordifolia* and leaf curl of *Synedrella nodiflora* were found to be transmissible by inarch grafting as well as by the agency of the white fly, *Bemisia tabaci*.

The virus causing yellow vein mosaic of *A. conyzoides* and that causing leaf curl of *S. nodiflora* were found to infect each other's host plant. The virus causing yellow vein mosaic of *S. cordifolia* could cause vein clearing in *C. sparsiflorus* and leaf curl in *Lycopersicon esculentum*, whereas the one causing yellow vein mosaic of *C. sparsiflorus* was able to produce vein clearing in *S. cordifolia*; it could not infect L. *esculentum*.

The leaf curl of *S. nodiflora* and yellow vein mosaic of *E. sonchiflolia* were recorded for the first time in India.

Acknowledgement

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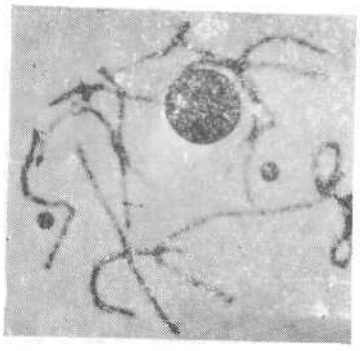

Fig. 1

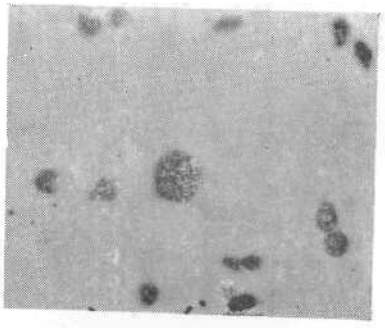

Fig. 2

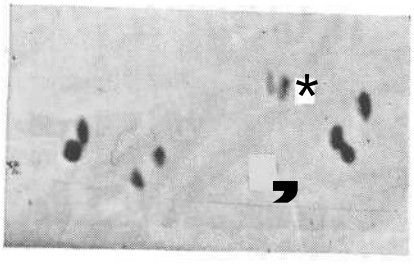

Fig. 3

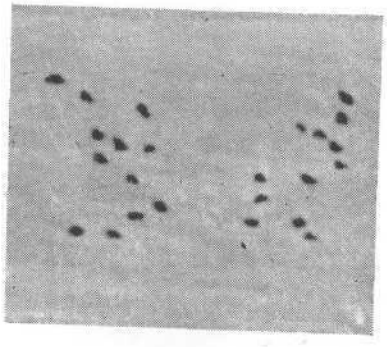

Fig. 4

Figs. 1 to 4. Microsporogenesis **in** Type 27-2, a mutant of PTB 10 rice.

1. Pacbytene - Complete pairing of the chromosome is noticed in all the twelve bivalents.
2. Diakinesis - All the twelve regularly formed bivalents can be counted.
3. Metaphase I - The twelve regularly formed bivalents form a normal metaphase plate.
4. Anaphase I - The chromosomes separate into two groups of twelve each.