

SHORT NOTES:

MARDI Res. Bull. Vol. 5, 2: (148 - 152)

A WHITEFLY-BORNE VIRUS DISEASE OF
AGERATUM CONYZOIDES (LINN.) IN MALAYSIA

ONG CHING ANG, TING WEN POH, and LIM YAU CHUAN

Accepted for publication on 16 August, 1977

RINGKASAN

Satu penyakit virus yang menyebabkan tanda penyakit yellow vein-banding dan daun kerinting pada pokok *Ageratum conyzoides* telah disahkan melalui kajian transmissi. Virus itu bolih menjangkit melalui cantuman tetapi ia tidak bolih menjangkit melalui suntikan cecair atau benih-benih. Pembawanya ialah lalat putih, *Bemisia tabaci*. Lalat putih bolih membawa penyakit virus ini selepas menghisap daun yang berpenyakit selama 24 jam. Virus ini didapati bolih menjangkit *A. conyzoides* sahaja. Nama yang dicadangkan untuk virus ini ialah *Ageratum* yellow vein-banding virus.

INTRODUCTION

Ageratum conyzoides is a common weed in waste and cultivated land throughout Malaysia. Leaf symptoms such as pronounced yellow vein-banding and leaf-criinkling are frequently observed on *A. conyzoides*. Similar symptoms have been reported on virus-infected *A. conyzoides* in other tropical region (GADD and LOSS, 1941; THUNG and HADIWIDJAJA, 1950), although the aetiology of this disease has not been studied in Malaysia. The present investigations were conducted to characterize the causal agent of this disease and to establish its identity.

MATERIALS AND METHODS

Infected *A. conyzoides* plant with conspicuous yellow vein-banding and leaf-criinkling symptoms was collected from the Department of Agriculture, Kuala Lumpur, Selangor. The isolate was initially maintained by regular transfers using single leaf-graft technique (NATTRASS, 1944). Subsequently the isolate was maintained by periodical transfers to healthy *A. conyzoides* at 4-6 leaf stage using the vector *Bemisia tabaci* Genn.

Sap transmission was carried out by grinding infected *A. conyzoides* leaves in 0.05 M phosphate buffer at pH 7. Carborundum (mesh 600) was added to the inoculum which was then rubbed over the leaves of healthy *A. conyzoides* and other test plants.

In seed transmission study, more than 3,000 seeds collected from diseased *A. conyzoides* plants were immediately sown in boxes containing sterilized soil. Germinated seedlings were observed for disease symptoms, namely yellow vein-banding. Plants which failed to show this symptom two months after germination were considered healthy.

Non-viruliferous colonies of *Aphis gossypii* Glover and *Myzus persicae* (Sulz.) maintained on *A. conyzoides* and *Nicotiana tabacum* respectively were used in the aphid transmission studies. After a 30 min. pre-acquisition fasting, the aphids were allowed to feed on infected *A. conyzoides* leaves for one minute. They were then transferred to healthy 4-6 leaf stage *A. conyzoides* at the rate of five aphids per plant for an inoculation access period of 24 hours.

In the field, *B. tabaci* were often observed to colonise healthy *A. conyzoides* as well as those showing yellow vein-banding symptom. White-flies were collected from the vicinity of naturally infected *A. conyzoides* and then caged, five per plant, onto healthy *A. conyzoides* for 24 hours to determine whether they are vectors of the disease. Transmission studies were also carried out with *B. tabaci* from virus-free colony, maintained on healthy *A. conyzoides*. Non-viruliferous whiteflies were given a 24 hour acquisition access period on infected *A. conyzoides*. They were then transferred to healthy *A. conyzoides* and other test plants for another 24 hour inoculation access period. Twenty to thirty whiteflies were caged on each test plant.

Recovery tests for the above studies were done 1½ months after each transmission experiment. The method used was similar to that described above for the transmission studies with non-viruliferous whiteflies.

RESULTS

GRAFT TRANSMISSION

The disease was found to be readily graft transmissible. Grafted *A. conyzoides* developed systemic vein-chlorosis followed by yellowing of the leaves. Continual serial graft transfers of the disease agent from infected to healthy *A. conyzoides* were consistently successful without any change in symptom severity.

SAP TRANSMISSION

Repeated attempts to transmit the disease using crude leaf sap of infected *A. conyzoides* to healthy *A. conyzoides*, *Cassia occidentalis*, *Chenopodium amaranticolor*, *Datura stramonium*, *Gomphrena globosa*, *N. glutinosa*, *N. tabacum*, and *N. xanthi* were unsuccessful.

SEED TRANSMISSION

The disease was not transmitted through seeds of infected *A. conyzoides*. Of more than 3000 seeds studied, all the germinated seedlings remained healthy throughout the observation period.

INSECT TRANSMISSION

The whitefly, *B. tabaci*, was found to be the vector of the disease whereas the two aphid species, *A. gossypii* and *M. persicae*, failed to transmit it. Some of the whiteflies collected from the vicinity of field-infected *A. conyzoides* were found to be viruliferous. Non-viruliferous *B. tabaci* could acquire and then transmit the pathogen after a 24 hour acquisition access period (Table 1).

HOST RANGE AND SYMPTOMATOLOGY

Since the disease was not sap-transmissible, whiteflies were used in the host range study.

The pathogen appeared to have a limited host range. Only *A. conyzoides* was found to be susceptible. Infected *A. conyzoides* developed mild chlorotic vein-clearing on the young leaves 14 to 17 days following inoculation. As the leaves matured, the chlorotic vein-clearing

TABLE 1. TRANSMISSION OF AGERATUM YELLOW VEIN-BANDING DISEASE BY WHITEFLIES (*B. TABACI*)

	Source of whiteflies	No. infected
		No. Inoculated
1.	Whiteflies collected from vicinity of naturally infected <i>A. conyzoides</i>	$\frac{3}{5}$
2.	Whiteflies from virus-free colony maintained on healthy <i>A. conyzoides</i> and given 24 hour acquisition access period	$\frac{11}{25}$

intensified showing a conspicuous yellow net-work of veins (*Figure 1, centre*). This was then followed by severe veinal yellowing of the entire leaves (*Figure 1, left*). Diseased plants were also observed to be stunted.



Figure 1. Ageratum yellow vein-banding virus on A. conyzoides – healthy leaf (right); infected leaf showing conspicuous yellow net-work of veins (centre); infected leaf showing severe veinal yellowing (left).

The following plant species were found to be not susceptible to the disease: COMPOSITAE – *Zinnia elegans*; LEGUMINOSAE – *Arachis hypogaea*; MALVACEAE – *Hibiscus esculentus*; and SOLANACEAE – *Capsicum annum*, *D. stramonium*, *Lycopersicon esculentum*, *N. glutinosa*, *N. tabacum*, and *N. xanthi*.

DISCUSSION

The property of transmissibility is a fundamental characteristic of viruses. Thus, the findings that the yellow vein-banding disease of *A. conyzoides* can be transmitted through successive graft transfers with no diminution in severity of symptoms, and that it can be transmitted by a specific group of known vectors, namely *B. tabaci*, suggest that the disease agent is a virus.

B. tabaci, although common, have hitherto not been recorded as vectors of plant viruses in Malaysia. This is the first report of white-flies acting as vectors of a plant virus disease in the country. Elsewhere, whiteflies have been reported to transmit over 25 different virus diseases, mainly of tropical plants (COSTA, 1969). They are responsible for the natural spread of various economic important diseases viz. cotton leaf curl, tobacco leaf curl, cassava mosaic, tomato yellow leaf curl, cucumber vein yellow and bendi yellow vein-mosaic (MARAMOROSCH, 1967).

Most of the whitefly-borne viruses are incompletely characterized. As most of them are not sap transmissible, the use of viruliferous whiteflies would restrict the host range to plants which are hosts of the vectors. Furthermore, whitefly-borne viruses often induced diseases with strikingly similar symptoms in host plants, although the viruses might not be closely related (FLORES and SILBERSCHMIDT, 1963). Two other major reasons are that whitefly transmitted viruses have received little attention as to particle morphology and that successful serological testing of this group of viruses has not been reported (COSTA, 1969).

Two other yellow vein-banding diseases on *A. conyzoides* have previously been reported. In Ceylon, GADD and LOSS (1941) described a graft and whitefly transmissible yellow veinbanding disease on *A. conyzoides*. After further transmission tests they concluded that the disease was probably caused by at least two viruses transmissible by whiteflies to tobacco. In contrast, the virus in the present studies does not infect tobacco plants. In another study, THUNG and HADIWIDJAJA (1950) reported that the yellow vein-banding mosaic of *A. conyzoides* in Java was experimentally transmitted from diseased to healthy plants by means of dodder, *Cuscuta australis*. However, host range studies and vector identification had not been carried out. In view of the limited data available, it is therefore difficult to establish the relationship between these viruses. Since *A. conyzoides* develops characteristic yellow vein-banding symptom, we propose to name this virus *Ageratum* yellow vein-banding virus.

SUMMARY

The viral nature of a disease of *Ageratum conyzoides* showing yellow vein-banding and leaf crinkling was established by transmission studies. The virus was graft transmissible from infected to healthy *A. conyzoides*. However, it was neither sap nor seed transmissible. Whiteflies, *Bemisia tabaci*, were found to be the vectors of this virus. They readily acquired and transmitted the virus from diseased to healthy *A. conyzoides* after a 24-hour acquisition access period. In a host range study using viruliferous whiteflies, only *A. conyzoides* was found to be susceptible to the virus.

The name, *Ageratum* yellow vein-banding has been proposed for the virus.

REFERENCES

- COSTA, A.S. (1969). Whiteflies as virus vectors. In *Viruses, Vectors, and Vegetation*. Edited by Maramorosch K. Interscience Publishers. N. York pp. 95 – 119.
- FLORES, E. and SILBERSCHMIDT, K. (1963). Ability of single whitefly to transmit concomitantly a strain of infectious chlorosis of Malvaceae and of *Lenonurus* mosaic virus. *Phytopath* 53: 238.
- GADD, C.H. and LOSS, C.A. (1941). A virus disease of *Ageratum conyzoides* and tobacco. *Tropical Agriculturist* 46: 255 – 264.

- MARAMOROSCH, K. (1967). Virus-vector relationships: Vectors of circulative and propagative viruses. In *Plant Virology* edited by Corbett, M.K. and Sisler, H.D. University Florida Press, Gainesville. pp. 175 – 193.
- NATTRASS, R.M. (1944). The transmission of the virus of the 'woodiness' disease of passion fruit (*Passiflora edulis*) by single leaf grafts. *Ann. Appl. Biol.* 31: 310 – 311.
- THUNG, T.H. and HADWIDJAJA, T. (1950). Het overbrengen van viren met behulp van *Cuscuta australis* R. Br., 1. (English Summary). *Tijdschr. Plziekt* 56: 349 – 351. (In *Rev. appl. mycol.* 1951, Vol. 30: 261 – 262).