

A MOSAIC DISEASE OF HIBISCUS MANIHOT IN PAPUA AND NEW GUINEA.

R. J. VAN VELSEN.*

ABSTRACT.

Hibiscus manihot, in most areas of Papua and New Guinea, exhibits mosaic leaf symptoms induced by a virus. The virus is transmitted mechanically to *H. esculentus*, *H. sabdariffa*, *H. tuberculatus*, *H. pungens*, and *H. cannabinus*. The virus could not be transmitted by *Planococcus citri*, *Freesiana* sp., an aleurodid (*Bemisia tabaci*), nor nymphs and adults of *Aphis gossypii* and *Myzus persicae*.

From the host range and insect vector studies, the virus does not appear to be related to any previously described viruses affecting *Hibiscus* spp.

INTRODUCTION.

THE fleshy young leaves of *Hibiscus manihot* L. (locally named 'aibika') are eaten as a staple green vegetable by the indigenous people in many coastal regions of Papua and New Guinea. In 1954, Magee noted green mottle symptoms on the leaves of *H. manihot* and Shaw (1963) noted suspected virus symptoms on *H. esculentus* L. and *H. rosa-sinensis* L., in Papua and New Guinea. Throughout the Gazelle Peninsula of New Britain, crops of *H. manihot* are usually affected with mosaic symptoms of the leaves.

A yellow vein mosaic disease of *Hibiscus esculentus* in India was first described by Uppal *et al.* in 1940. This virus disease is restricted to Malvaceae (Capoor and Varma 1950), and is transmitted by grafting and *Bemisia tabaci* (Capoor and Varma 1950, Varma 1952, 1955). Stone (1954) reported that a virus of *H. cannabinus* L. could be transmitted mechanically, and that it appears to be confined to *Hibiscus* spp. Anthocyanosis virus of cotton is reported by Costa (1956) to be transmitted by grafting and *Aphis gossypii* to *H. cannabinus* and *H. esculentus*, but is not transmissible by sap inoculation. Abutilon mosaic virus which is transmitted by *Bemisia tabaci* and sap inoculation produces mosaic symptoms in *H. esculentus* and *H. cannabinus* (Costa 1955, Costa and Carvalho 1960). Tobacco streak virus, for which no insect vector has been recorded, was transmitted by sap inocu-

lation to *H. esculentus* and *H. cannabinus* by Costa and Carvalho (1961).

Costa *et al.* (1959) investigating malva yellows virus recorded *H. esculentus* to be a symptomless carrier of this virus, which is transmitted by *Myzus persicae*, *Aphis gossypii* and *Myzus ornatus* and by grafting, but not mechanically. Cotton leaf curl virus is readily transmitted by *Bemisia tabaci* to *Hibiscus* spp., but the virus is not mechanically transmissible (Tarr 1951). Hibiscus leaf curl (Anon. 1954), and Malva virus (Hein 1956) have also been recorded as infecting *Hibiscus* spp.

The mosaic disease of *Hibiscus manihot* in Papua and New Guinea was investigated to determine whether the symptoms were induced by a virus and if so, to determine its host range and mode of transmission. This paper gives the experimental details and the results of the investigations.

INVESTIGATIONS.

The mosaic symptoms on the leaves of *H. manihot* were found not to be attributable to fungi, nematodes, bacteria, insects or environmental factors.

Symptoms.

Field infected plants of *H. manihot* exhibit pale mosaic symptoms of the young leaves with clearing of the veins. As the leaves mature, the mosaic symptoms become indistinct. The plants are not stunted and the yield of leaf matter compared with healthy plants is not reduced. The disease does not appear to affect the palatability of the leaves, as they are readily eaten.

* Formerly Senior Plant Pathologist, Lowlands Agricultural Experiment Station, Keravat, New Britain.

Hibiscus esculentus.

Severe mosaic symptoms on the leaves appear 7 to 10 days following the inoculation with sap on the first true leaves with cut sections of infected leaves of *H. manihot*. The symptoms are persistent and systemic and the plants are severely stunted.

Hibiscus sabdariffa L., *H. tuberculatus*, *H. pungens*, and *H. cannabinus*.

The two primary leaves were inoculated with sap from diseased cut leaf sections of *H. manihot* with the aid of 500 grit carborundum powder. Mosaic symptoms appeared five to seven days later on the true leaves, but not on subsequent leaves unless the plants were pruned. The new leaves emerging immediately after pruning had characteristic mosaic symptoms, but subsequent growth was again symptomless. However, *H. esculentus* plants inoculated with sap from symptomless leaves became infected, showing the typical mosaic symptoms. Thus these three *Hibiscus* spp. are systemically infected, but after the initial symptoms appear symptomless.

Host range studies.

Hibiscus esculentus, *H. manihot*, *H. sabdariffa*, *H. cannabinus* and *H. pungens* were all found to be systemically infected with Hibiscus mosaic virus. The following plants were found to be resistant to the virus:—

Cucumis sativus L.
Pisum sativum L.
Vicia faba L.
Physalis floridana Rydb.
Capsicum annuum L.
Chenopodium amaranticolor Coste et Reyn.
C. quinoa Willd.
Solanum dulcamara L.
Zinnia elegans Jacq.
Glycine max Merr.
Arachis hypogaea L.
Lycopersicon esculentum Mill.
Nicotiana tabacum L.
N. rustica L.
N. glutinosa L.
Gossypium hirsutum L.
Sida rhombifolia L.
Althaea rosea Gav.
Stizolobium deeringianum Bort.
Crotalaria juncea L.
C. anagyroides H.B.K.

Thus the host range of the virus appears to be restricted to *Hibiscus* spp.

Transmission.

Due to the inherent viscous nature of the expressed sap from Hibiscus leaves, inoculation experiments were carried out using rolled leaf sections. Diseased leaves were tightly rolled, then a cut was made across the roll and the exposed surface rubbed over the leaves to be inoculated. In this manner, 100 per cent. infection was obtained with the *Hibiscus* spp. tested.

Attempts to transmit the virus by seed collected from infected plants of *H. sabdariffa* and *H. esculentus* were unsuccessful. The virus also was not transmitted through the soil from infected to healthy plants of *H. esculentus* in a series of 40 pots in the glasshouse. However, the virus was readily transmitted from infected to healthy plants of *H. manihot*, *H. esculentus* and *H. sabdariffa* by both budding and grafting.

Insect transmission.

Experiments were carried out to determine whether white flies (*Bemisia tabaci*) were capable of transmitting the virus with acquisition and test feeding periods ranging from five minutes to 24 hours. The time intervals were five minutes, one, three, six, 12 and 24 hours with 30 plants in each test. However, as no transmission was recorded, it is concluded that the white fly (*Bemisia tabaci*) is not a vector. *Planococcus citri* and *Freesia* spp. nymphs also were unable to transmit the virus from infected *H. esculentus* plants to healthy *H. esculentus* test plants.

Attempted aphid transmission.

Nymphs and adults of *Aphis gossypii* and *Myzus persicae*, which were found feeding on young *H. manihot* leaves in the field, were found unable to transmit the virus using acquisition and test feeding times of several minutes to 72 hours.

Attempted field transmission.

Healthy *H. esculentus* plants and infected *H. esculentus* plants were planted alternately in the field alongside an established plot of infected *H. manihot* in a search for insect vectors and possible transmission in the field. However, of the 50 healthy *H. esculentus* plants, none became

infected at the end of ten months observation, as determined from the absence of symptoms and periodic inoculations onto test seedlings of *H. esculentus* in the greenhouse.

Vegetative propagation.

As no vector could be located transmitting the virus, it is probable that the widespread distribution of the disease in the Gazelle Peninsula has resulted from the practice of the local farmers in establishing plants of *H. manihot* from cuttings. Cuttings of *H. manihot* readily root in the pumice soils of the Gazelle Peninsula and provide a quick supply of leaf material.

CONCLUSIONS.

The host range of the virus studied at Keravat appears to be restricted to *Hibiscus* spp. and is readily transmitted mechanically to other *Hibiscus* spp. However, it could not be transmitted by the white fly (*Bemisia tabaci*), *Planococcus citri*, *Freesiana* sp., nor by *Aphis gossypii* and *Myzus persicae*. Thus the virus is not likely to be related to the yellow vein mosaic disease of *H. esculentus* in India, Anthocyanosis virus of cotton tobacco streak virus, nor malva yellows virus.

From field trials, it appears that the disease is more likely to be spread in the Gazelle Peninsula from the planting of infected cuttings. As the virus does not reduce yield, nor affect the palatability of the leaves, the virus is of little importance in the cultivation of *H. manihot*.

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