"Little Leaf", a Virus Disease of Ipomoea Batatas in Papua and New Guinea.

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ABSTRACT.

A virus disease producing little leaves and vein-clearing symptoms of sweet potato (Ipomoea batatas *L.*) *has been recorded in the Keravat area of New Britain, and Dogura, Goodenough Bay in Eastern Papua. The condition is readily transmitted by stem grafting to* I. batatas, I. setosa *ker.*, I. purpurea *Lam.*, I. purpurea *variety "Crimson Rambler", and* I. nibro-coenilia *Roth., and by core grafting to* I. batatas. *Attempts to transmit the virus mechanically, by white flies* (Bemesia tabaci), Myzus persicae (*Sulzer*), *and* Planococcus citri (*Rossi*) *were unsuccessful. However, it was found to be transmitted by* Halticus tibialis, *and by vegetative propagation, and also to be soil borne. Diseased plants show a marked reduction in yield when infected in the early stages of growth, and rogueing of infected plants in the field has little effect as a control measure.*

INTRODUCTION.

VIRUS diseases of sweet potato (*Ipomoea batatas*) have been reported from many parts of the world. Magee (1954) recorded sweet potato in the Territory of Papua and New Guinea to be free of virus diseases, mentioning that conditions termed 'rosette' or leaf 'curl' to be probably caused by insect attack. His visit however, was only cursory. During the Japanese occupation of the Gazelle Peninsula from 1941 to 1945, many food crop plants were introduced and it is suspected that sweet potato plants may have been introduced. In 1961, Rast reported a complex virus disease of sweet potato in New Guinea (West Irian) suggesting the feathery mottle virus complex as the agent.

Summers (1951) recorded a dwarfing ('Ishuku-Byo') of sweet potato in the Ryuku Islands which resulted in no edible tubers being produced on diseased vines. The visible symptoms consisted of excess proliferation of the young shoots from the leaf axils and a dwarfing of subsequent growth. The latex content of the diseased plants and roots was markedly reduced.

In Ghana, Clerk (1960) reported an investigation on a vein-clearing virus of sweet potato, which he confirmed to be due to a virus disease. The virus was transmitted by grafting, tuber core-grafting and by *Bemesia tabaci*. There are other virus diseases of sweet potato reported from Israel (Loebenstein and Harpaz 1960), U.S.A. (Webb and Larson 1954), and elsewhere.

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In 1956, sweet potato plants showing little leaves and vein-clearing symptoms were observed in the variety trials at the Lowlands Agricultural Experiment Station, Keravat, New Britain. Attempts to eradicate the disease by rogueing were unsuccessful. Investigations were commenced in 1958 to determine the cause and possible control measures, for the condition.

INVESTIGATIONS.

Field Symptoms.

Diseased sweet potato (*I. batatas*) plants are conspicuous due to the erect habit of the tips of vines which are usually reduced in length compared with healthy plants. The leaves are a quarter to an eighth the size of healthy leaves and the veins are a yellowish green (vein-clearing) compared with the darker green interveinal tissue. The internodes between leaves on the diseased vine rarely exceed 1 in. compared with 2 to 6 in. on normal vines. The latex content of the vines and roots is greatly reduced.

Plants affected when nearing maturity exhibit vein-clearing symptoms with a slight reduction in leaf area. Plants infected in the early growing stages yield poorly, giving no edible tubers. In a yield trial of 16 diseased and 16 healthy plants, yields per plant at maturity were 28 and 618 grammes respectively.

Symptoms following inoculation.

Ipomoea setosa.

Following the establishment of stem grafts between infected *I. batatas* and healthy *I. setosa* plants, severe chlorotic spotting appears 28 to

40 days later. The spots are irregular in shape and a pale yellowish green. As the leaves mature, the chlorotic spots enlarge and coalesce giving the leaves a mottled appearance. The symptoms are systemic. The vigour of the plants is not reduced.

Ipomoea purpurea.

Pale, rather indistinct mosaic symptoms appear 30 to 60 days after the establishment of successful stem grafts with *I. batatas*. The plants are reduced in vigour with smaller leaves and reduced vine lengths. The symptoms are systemic.

Ipomoea purpurea variety "Crimson Rambler".

Pronounced mosaic leaf symptoms appear 25 to 30 days following stem grafting, which are persistent. The plants are not reduced in vigour.

Ipomoea nibro-coenilia.

Pale, indistinct mosaic symptoms on the leaves appear 30 to 40 days after stem grafting, and are persistent and systemic. The leaf size and vine length are slightly reduced compared with healthy plants.

TRANSMISSION.

Mechanical.

Attempts made to mechanically transmit the virus to indicator plants of *Ipomoea batatas*, *I. setosa*, *I. purpurea*, *I. nibro-coenilia*, *Nicotiana tabacum*, *N. glutinosa*, *Datura stramonium*, *Phaseolus vulgaris*, *Capsicum anuum* and *Convolvulus* sp. using various buffers were unsuccessful.

Grafting.

Diseased tips of *Ipomoea batatas* were established in sterilized soil alongside healthy tips of *I. batatas*, *I. setosa*, *I. purpurea* and *I. nibro-coenilia* in insect-proof cages. The runner tips were carefully washed free of soil and when established regularly dusted with insecticide. When the plants were established, diseased and healthy vines were approached grafted. Twenty days later when the grafts had 'taken', the runners from the healthy plants were severed between the graft and the parent plant. Control cages were set up with the diseased and healthy plants growing intermingled. After 84 days, the results, as given in *Table* 1, were recorded. None of the control plants became infected.

Tuber core-grafting.

Cores, $\frac{1}{2}$ in. in diameter and 1 in. long were cut from tubers collected from diseased *I. batatas* plants and inserted into healthy sweet potato tubers. The wounds were covered with grafting mastic and the treated tubers planted out in sterilized soil. After 12 weeks growth, the results were recorded. Of the 20 cores inserted into 20 separate tubers, 18 tubers germinated, and 14 exhibited "little leaf" and vein-clearing symptoms. None of the 20 control tubers became infected.

Insect.

Attempts to transmit the virus from infected *I. batatas* to *I. purpurea* variety "Crimson Rambler" with *Planococcus citri*, *Myzus persicae* and white flies (*Bemesia tabaci*) using various acquisition and test feeding times were unsuccessful.

With *Halticus tibialis* adults, infected *I. batatas* runner was planted in sterilized soil with healthy runners of *I. purpurea* variety "Crimson Rambler". When the plants were established, the pots were caged and 20 adult *H. tibialis* were released, and maintained in the cages for eight days. At the end of this period, the cages were sprayed with 0.1 per cent. Dieldrin. Control pots were also set up. After 12 weeks the results were recorded. In two separate experiments each of 20 pots, the results were five and six infected plants respectively. None of the control plants became infected. Thus it is concluded that the virus can be transmitted by *H. tibialis*. During dry periods in the field, large populations of *H. tibialis* could be found feeding on sweet potato plants.

Soil.

Soil to a depth of 6 in. was collected from around field infected plants, sieved to remove large pieces of vegetable material and put into 12 in. pots. Healthy *I. batatas* runners from a single plant were planted in each pot. Control pots with sterilized soil were also set up in the greenhouse. The pots were placed in the greenhouse and sprayed regularly with 0.1 per cent. Dieldrin to kill any emerging insects from the soil. In the 20 pots of field soil, 16 plants exhibited little leaf and vein-clearing symptoms after 12 weeks. Runners in the sterilized soil remained disease-free.

The soil from the 16 infected pots was then sterilized and again planted with healthy runners from the control pots, and kept under observation for a further 12 weeks. None of these plants became infected. Since the " little leaf " and vein-clearing symptoms could not be removed by full fertilizer treatments, these experiments indicate that the virus is soil borne. No attempts have been made as yet to determine the vector in the soil.

CONCLUSION.

From the description of " Ishuki-Byo " of sweet potato in the Ryuku Islands by Summers (1951), the " little leaf " virus disease present at Keravat is possibly the same. Both diseases have a long incubation period in *Ipomoea batatas* with no edible tubers being produced. The field symptoms are also similar with respect to erectness of habit, leaf size reduction and the reduction of latex in runners and roots. At Keravat, attempts to eradicate the disease by rogueing were unsuccessful. Summers recorded no vein-clearing symptoms on sweet potato, and it is possible that the disease at Keravat is a virus complex consisting of " Ishuki-Byo " and a vein-clearing virus.

Loebenstein and Harpaz (1960) reported a vein clearing virus of sweet potato in Israel to be readily transmissible by stem and tuber core grafting, and by *Bemesia tabaci*, but not to be soil borne, nor transmitted by mechanical inoculation. Clerk (1960) reported a vein clearing disease of sweet potato in Ghana to be also transmitted by *Bemesia tabaci*. The feathery mottle virus described by Webb and Larson (1954) was reported to be transmitted by *Myzus persicae*. However, the " little leaf " and vein clearing virus at Keravat could not be transmitted by this aphid.

The field symptoms do not resemble those of internal cork disease of the U.S.A. (Hildebrandt 1956), and it is concluded that the " little leaf " disease of sweet potato at Keravat is similar to that reported by Summers.

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***Table* 1.—Infection of *Ipomoea* spp. following approach graftings to " little leaf " infected *I. batatas* plants.**

Test Plant.	No. of Infections/ No. of grafts.
Ipomoea purpurea variety " Crimson Rambler "	12/20
I. purpurea	12/20
I. nibro-coenilia	14/20
I. setosa	14/20
I. batatas	36/40