

Vein Enation in Citrus Leaves

virus found to be responsible for vein swelling and protuberances in citrus leaves

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A virus—not related to any of the previously known citrus viruses—was found to induce vein swelling and protuberances on citrus leaves.

Several plant viruses are known to stimulate certain tissues of affected hosts resulting in vein swelling and the production of protuberances of papillae-like growths from veins on the under sides of leaves. Usually such symptoms are associated with other effects such as vein-clearing or leaf distortion.

On plants affected by the new virus some of the veins of certain leaves appear slightly swollen and the under sides of the leaves reveal small elevations or wart-like projections. The outgrowths, or papillae, may sometimes extend as much as one millimeter— $1/25''$ —from the leaf surface. On some leaves they are numerous and conspicuous but on others they may be few and small or absent. When the projections have attained sufficient size to make them easily detected there are usually slight depressions on the upper surface of the leaves directly coinciding with the overgrowths on the under sides.

Causal Agent Transferable

These abnormalities were first observed on leaves of sour orange sprouts that had grown from roots left in the ground when quick-decline affected orange trees had been removed. There was a possibility that they were induced by the quick decline virus. Graft-transmission studies showed that the causal agent could be transferred from sour orange to sour orange. Additional transfers have been made to other citrus species and the vein enation symptoms have appeared on inoculated seedlings of bittersweet and sweet orange, and on grapefruit, tangerine, lime, rough lemon, and lemon. The most pronounced effects have been observed on sour orange and Mexican lime.

From experimental studies it is concluded that the virus causing these effects is not related to the virus of quick decline although the two viruses are frequently obtained from the same tree. However, the quick decline virus is known to occur in nature without being mixed with the vein-enation virus. Numerous sources—cultures—of the quick decline virus obtained by graft-inoculation from quick

decline trees or by means of aphid transmission have never induced the vein-enation symptoms. Also, the vein-enation virus has been obtained from citrus trees that do not carry quick decline virus. When the virus from such sources is inoculated into lime seedlings it induces the vein enations, without the typical quick decline vein clearing of leaves and pitting of the woody stems.

In some current studies to determine the extent to which quick decline virus is present in orchard lemon trees, the vein-enation virus has been recovered from a rather high percentage of trees in

certain plantings and to a lesser extent in others. While it has been determined experimentally also that lemon seedlings can be infected with the vein-enation virus, only very rarely have symptoms been observed on inoculated lemon seedlings even though the virus can be recovered from them.

The occasional discovery of vein-enation symptoms on young citrus seedlings that have been grown outside or under lath has suggested that the virus is insect-transmitted. Preliminary insect vector studies suggest that the virus is transmitted by at least one species of aphid but additional data are needed before conclusions can be made. In these preliminary studies *Aphis gossypii*, the vector of the quick-decline virus, has not transmitted the vein-enation virus.

In limited tests, attempts to transmit the vein-enation virus from citrus to citrus by means of inoculation with extracted juice have failed to reproduce the vein-enation symptom.

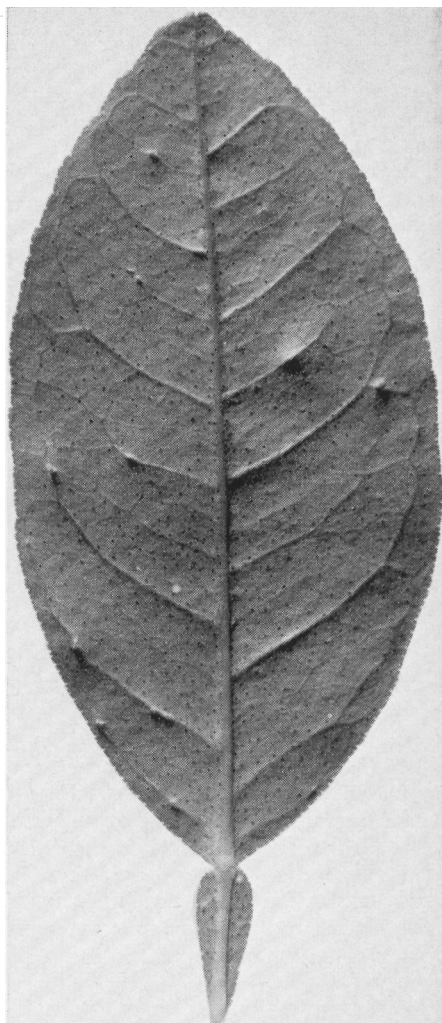
Full Effects Unknown

At present it is not known whether the vein-enation virus has any effects on citrus other than the observed vein abnormalities. Studies are in progress to determine if this virus causes any other detectable injury to its hosts. Particular attention is being given to the possible causal relationship of this virus to such diseases as lemon decline and collapse or other disorders that are suggestive of virus diseases but for which the causes have not yet been discovered. Certain of these studies will necessitate inoculation of budded trees of various combinations of top and rootstock varieties. Some will require long-time investigation to determine if the vein-enation virus is the cause of any one of several disorders of citrus of unknown cause. Special study will be made of those disorders that do not become apparent on young trees but which seem to be responsible for various types of deterioration at some time after citrus trees become productive.

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The above progress report is based on Research Project No. 1383.



Outgrowths from veins on lower surface of leaf from Mexican lime seedling experimentally infected with the vein-enation virus. (Enlarged about four times normal.)