

On the Impietratura of Grapefruit

IN A RECENT NOTE (8), I reported that I found trees of grapefruit (*C. paradisi* Macf.) in Sicily with fruit having symptoms identical to those designated in Florida as lumpy rind (6). In Rhodesia (4), as well as in Florida (1, 2), lumpy rind is attributed to boron deficiency; but in Sicily the disorder, which we call impietratura, occurs on trees with leaves having a normal content of boron (40-65 ppm). In orange [*C. sinensis* (L.) Osbeck], impietratura has been shown experimentally to be of a virus nature (8). It might seem that leaf analyses for boron could discriminate between lumpy rind caused by boron deficiency and impietratura resulting from infection (9), but there are trees in Florida that continue to produce fruit with lumpy rind even when the boron content of leaves is 60-70 ppm (personal letter from P. F. Smith). Thus a proper diagnosis may be possible only if a transmission test is made; the results of such tests can be obtained within a few months.

Influence of Rootstock

In 1928, several hundred grapefruit trees budded on rough lemon (*C. jambhiri* Lushington) were imported into Sicily from Florida. No fruit with symptoms of impietratura have been seen on these trees, but a number of trees propagated by budding with buds from the original trees into sour orange (*C. aurantium* L.) seedlings have had fruit with typical symptoms of impietratura.

In Cyprus, there is a grapefruit plantation on rough lemon that was established with plants introduced from South Africa in 1930; no fruit from these trees has shown symptoms of impietratura (letter from Dr.

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Papazolomontos). Buds were subsequently taken from these trees and grafted into sour orange seedlings. In many of the latter, which had a boron content greater than 70 ppm (5), I observed symptoms of impietratura during a visit to Cyprus in November, 1962; in some orchards, more than 50 per cent of the fruit was affected.

Use of sour orange as a rootstock in Sicily and other Mediterranean countries may explain the more frequent occurrence of impietratura in these areas (3) than in South Africa and Florida, where rough lemon is the most frequently used rootstock. Rough lemon is undoubtedly more able than sour orange to absorb boron from soil (9) and this may be part of the explanation for the higher incidence of impietratura in Mediterranean countries.

When a bud of the femminello Santa Teresa variety of lemon [*C. limon* (L.) Burm. f.] is grafted into a sweet orange plant with symptoms of impietratura, the lemon fruits produced subsequently show no sign of the disease. This led me to think that lemon is a tolerant species (8). It was recently observed, however, that top-working and rebudding such a lemon, at a distance of 10-15 cm above the sour orange rootstock, with Moro orange did not result in fruit of the new plant having impietratura, which suggests that lemon is more than tolerant and actually inhibits the virus of impietratura. Perhaps the behavior of rough lemon is analogous, and thus it will be of interest to see whether inarching rough lemon into the sour orange rootstock of the tree affected by impietratura will mask the symptoms of this disease.

Transmission Tests

Very young plants of sweet orange budded on sour orange, and having symptoms of impietratura, have been topworked and rebudded with Marsh seedless grapefruit buds obtained from a tree without impietratura. Fruit from the grapefruit shoots produced on these plants had impietratura.

Very young trees of grapefruit on sour orange rootstock, which were healthy, were inoculated by Dr. Papazolomontos in Cyprus in October, 1961, by budding small shields of bark from grapefruit plants with impietratura into one- or two-year-old twigs. The fruit produced in 1962 on the inoculated twigs had symptoms of impietratura.

I carried out similar inoculations on orange in 1953 (7) but failed to obtain quick positive results, probably because I worked on adult trees with large old branches which may be less susceptible.

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The results of the transmission experiments reported here suggest that very young grapefruit trees on sour orange rootstock can be used as test plants in indexing for impietratura.

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