

PRESENT STATUS OF TRISTEZA IN FLORIDA

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The presence of tristeza in Florida was announced before this Society last year by Dr. T. J. Grant of the U.S. Department of Agriculture. The disease had been identified by its effect on sweet orange trees on sour orange root, by a characteristic histological picture at the bud union of such trees, and by graft transmissions from infected trees to Key lime seedlings in which are produced the typical discontinuous vein-clearing pattern and the pitting of stems that indicate presence of the causal virus.

During the past year, several State and Federal agencies have been active in gathering facts about tristeza, including information on its recognition, distribution, importance, and behavior under Florida conditions. From the preliminary findings reported here, it is already evident that there are significant differences between tristeza in Florida and tristeza in other areas. These differences are important for they mean that solutions to the Florida problem will have to be worked out independently rather than to rely on information that is valid elsewhere.

Symptomatology

It is illustrative of the range in differences between tristeza to compare symptoms as they occur in Argentina and in Florida. In the Argentine Litoral, most affected trees pass through a rather definite sequence of symptoms, beginning with a bronzing of the foliage, followed by a reduction in shoot growth and a dropping of leaves, and terminating in an appearance similar to that of trees in the last stages of water damage. Generally speaking, infected trees decline to the point of unproductiveness within the first year, and usually pass into oblivion by the end of the second. In Florida, on the other hand, tristeza appears in a variety of forms. A common type consists of a gradual retardation in the growth of trees, affecting most notably the volume of the tops and the diameter of the trunks. This dwarfing may or may not be accompanied by die-back.

Judging from the length of time that must be required to produce the degree of stunting generally observed, tristeza has been present in affected trees for over 15 years, yet such trees continue to live.

Florida tristeza also finds expression in a much more rapid kind of decline. This type appears at present to be restricted to a few counties including Volusia, Seminole, Orange, Lake, and Marion. Here mature trees first show a slight wilting and rolling of the foliage followed by considerable defoliation. Three to six months later affected trees may be dead. In some respects this type is similar to the fulminant form of tristeza that is predominant in the irrigated Andean groves of Argentina and to some extent in California. Florida rapid decline differs from the fulminant form, however, in that leaves drop rather than remain attached in a papery-brown and dead condition.

A further symptomatological difference between tristeza in Florida and elsewhere is in the matter of stem pitting. In South Africa, South America, and Australia, grapefruit trees are subject to considerable damage from the stem-pitting phase of tristeza. This is a reaction involving grapefruit tissue itself and is independent of any effects related to rootstocks, whether susceptible or tolerant. Symptoms are expressed as an external channelling and an internal pitting of the trunk, a pitting of the wood under the cortex of twigs, and a slow but progressive decrease in the size of fruits. In Florida, despite the evidence that the tristeza virus has been present for perhaps 15 years, stem pitting has been encountered in but a single grapefruit tree, and the pitting here is restricted to the twigs. On the other hand, in Key and Tahiti limes and in limequats, stem pitting does occur in Florida, but appears not to alter the healthy aspect of the trees infected.

Another difference in the symptoms on grapefruit becomes evident when the decline of trees on susceptible rootstocks is considered. In California no effects on this combination in the field have yet been observed despite the presence there of tristeza for at least 16 years. In contrast in Florida grapefruit on sour orange shows the same type of decline as is the case with sweet oranges on sour orange roots.

Dissemination

Florida tristeza differs also in the speed with which it spreads. In Argentina, as pointed out by DuCharme and Knorr (1) the average rate measured in five Entre Rios groves amounted to approximately 3 per cent involvement of a grove the first year, 15 per cent the second year, 50 per cent the third year, and 70 per cent the fourth year; by the end of the fifth year, nearly all trees were affected. In Florida, on the other hand, it is common to find single tristeza-positive trees standing in the middle of healthy sour-orange-rooted groves despite the fact that, judging from the stunted appearance of positive trees, the disease has been present for perhaps 15 years or more.

In only a few Florida groves, all of which are in the Volusia-Seminole-Orange-Lake-Marion district, does the rate of spread approximate that described for areas abroad. In the rest of the State, field spread, if any, is much less rapid despite the fact that tristeza is now known definitely to be established in at least 27 counties, which include all the major citrus areas.

Credit for ascertaining the distribution of tristeza in Florida belongs to the inspectors of the State Plant Board who during the past year have surveyed the State's citrus-growing counties for this disease. The survey was conducted on the basis of inspecting groves in one area, and as soon as tristeza was encountered, to move on to other areas. This procedure was intended originally to determine whether the zone of infection first discovered might have been restricted and prevented from spreading to other parts of the State. However, the survey soon made it clear that tristeza already occurred throughout Florida and that, consequently, nothing could be accomplished through the establishment of internal quarantines.

In this survey no attempt was made to examine all citrus properties in the State. Such an aim, even if deemed desirable, was not pursued due to insufficient manpower. Nevertheless, in the course of the year, well over 500 infected properties were discovered. These were located in the following 27 counties: Alachua, Brevard, Citrus, Dade, DeSoto, Hardee, Hendry, Hernando, Highlands, Hillsborough, Indian River, Lake, Lee, Manatee, Marion, Orange, Osceola, Pasco, Pinellas, Polk,

Putnam, Sarasota, Seminole, St. Johns, St. Lucie, Sumter, and Volusia.

To date the injurious effects of tristeza have shown up only on trees with sour orange rootstocks. In these cases the scion varieties have been sweet orange, grapefruit, and tangerine. The virus has also been found in these and additional scion varieties on rootstocks other than sour orange, but in these combinations no harmful effects have been detected.

The determination of whether a tree was infected was based on the Schneider histological test in which a patch of bark at the bud union is removed, fixed, sectioned, stained, and examined microscopically for the anatomical symptoms of tristeza. In many instances the histological test was confirmed by transmission of the virus from suspected trees into Key lime test plants. The confirmatory testing was done through the courtesy of Dr. T. J. Grant at the Orlando Station.

Importance

Another difference between tristeza in Florida and elsewhere lies in the matter of importance. In South Africa 60 per cent of the grapefruit trees have been reported to exhibit symptoms of stem pitting and approximately 40 per cent are so severely affected as to render them practically worthless (2). Stem pitting in Florida has been observed only once on grapefruit and there have not been any reports of difficulty with progressively decreasing fruit sizes in grapefruit.

A further difference in relative importance may be found in the effect of tristeza on limes. On the Gold Coast of Africa, West Indian (Key) lime production has been seriously crippled. Affected trees develop stem pitting, vein clearing, and eventually die (3). In Florida, infected West Indian limes and (as Dr. J. F. L. Childs has recently shown) Tahiti limes exhibit the same symptoms of stem pitting and vein clearing, yet none of the diseased trees suffers from decline. It appears, however, based on recent commercial experience on the Gold Coast, that the destructiveness of tristeza in limes is restricted to seedling trees (the form in which limes have traditionally been grown there), and that trees budded on resistant stocks are tolerant.

The importance of tristeza in relation to sweet orange and tangerine trees is also different in Florida as compared to effects elsewhere.

In Argentina over 7,000,000 trees were killed in the twenty years after the first symptoms of tristeza were observed. In Florida losses to date have not been spectacular despite the fact that the disease is present in every citrus-growing county, and that tristeza has apparently existed in the State for the last 15 or 20 years. In some areas, however, losses have been greater than elsewhere. For example, in one 75-acre grove in Orange County, approximately 17 per cent of the trees show signs of the disease, and the number of dying trees is growing continually. Other groves in this and adjacent counties seem to be following the same trend. Elsewhere in the State there appears to be an entirely different pattern, with only scattered trees infected and with no evidence of spread.

Suscept Range

Several other differences apparently exist between tristeza in Florida and elsewhere. These relate to the behavior of the virus under experimental conditions. One involves the citrus relative *Aeglopsis Chevalieri*. In Argentina this species produced early and very conspicuous symptoms when infected with tristeza; in fact its reactions were so outstanding as to make it superior to Key lime as a test plant (4). In Florida, however, this same species fails to show any distinct symptoms of infection whenever it is included in Key lime test series.

Another experimental difference relates to the presence of the virus in lemon. According to evidence reported from South America, it was not found possible to retrieve the virus after inoculation into lemon plants. In contrast, our tests show that in Florida the tristeza virus can be transmitted from lemon to Key lime with the subsequent production of vein

clearing symptoms. The same has also been accomplished with sour orange as source of the virus.

Conclusions

The differences pointed out above may be explained in many cases by what seems obvious. For example, variations in the rate of spread may be correlated with the presence or absence of vectors. Similarly the extent of damage, once the virus is in the tree, may be explained in terms of virulent and mild strains. Present-day lack of importance may only be illusory; if all tristeza-diseased trees pulled in years past because of stunting were totaled, the amount of damage might actually be considerable. It may also be that sufficient time has not yet elapsed for the disease to appear as a snowballing force.

At the present time, however, such answers are purely inferential, and much work remains to be done before any of these theories can be proved valid. Future research on tristeza will attempt not only to substantiate or reject the various theories but will seek also to establish whether the above-mentioned differences are real or merely apparent. Not until this has been done can any authoritative assurances be given concerning the importance of tristeza to Florida.

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ROOT DISTRIBUTION OF CHLOROTIC AND IRON-CHELATE-TREATED CITRUS TREES

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Iron chlorosis has been one of the important nutritional problems in growing citrus in Flor-

ida. The symptoms can not be alleviated effectively with iron from ordinary sources such as iron sulfate. In 1951, studies by Stewart and Leonard (5) on acid sandy soils indicated that soil applications of iron chelated with ethylene-diamine tetracetic acid (EDTA) effectively controlled the foliage chlorosis within a few weeks after treatment. New shoot