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Citrus Diseases Exotic to Florida: Citrus Tristeza Virus–Stem Pitting (CTV-SP)[1]

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Citrus is susceptible to a large number of diseases caused by plant pathogens. Economic losses due to plant diseases can be severe, but fortunately, not all pathogens attacking citrus are present in Florida. Major citrus diseases currently present in Florida include: Alternaria brown spot, blight, citrus canker, greasy spot, melanose, Phytophthora-induced diseases (foot and root rot, brown rot), postbloom fruit drop (PFD), scab, and *tristeza*. An exotic, destructive disease called citrus greening (Huanglongbing) has recently been found in Florida. Efforts to suppress citrus canker and greening are ongoing in Florida. Any exotic diseases, if introduced, will increase production costs and decrease profitability for Florida growers. Exotic diseases affect the viability of the industry or the varieties that could be profitably grown. Background information for each exotic citrus disease will be presented in a series of fact sheets to: 1) provide a basis for evaluating exotic pathogens that may pose potential risks to Florida citrus; and 2) create a decision-making framework to prevent their introduction and spread. This paper will discuss *Citrus tristeza virus*-Stem Pitting (CTV-SP) disease.

Why Are We Concerned About CTV-SP?

Florida growers are familiar with the *Citrus tristeza virus* (CTV)-induced decline of trees on sour orange and bitter sweet rootstocks, a disease that is continuing to destroy the remaining trees on susceptible rootstocks in Florida. Growers are less familiar with the stem pitting disease caused by certain CTV isolates. Unlike decline, CTV-SP is not a bud union disorder and can affect sensitive scion varieties regardless of the rootstock used. CTV-SP is a debilitating disease on grapefruit and sweet orange, and may take years after infection before trees show obvious loss of vigor and yield. However, once infected the effect is continuous and long-term economic effects to the grower may be worse than those from other CTV declines. Trees if lost to decline can be replaced by trees on tolerant rootstocks and production is restored in a few years. Currently, there are no CTV-SP tolerant grapefruit and sweet orange. Once CTV-SP is endemic in an area, replants will soon become infected and the debilitation cycle is repeated. Mild and decline-inducing isolates of

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CTV are already widespread in Florida, but isolates that induce CTV-SP in grapefruit and sweet orange are relatively rare. However, CTV-SP isolates are widespread in Asia, Australia, South Africa, Brazil, Columbia, and other areas. Florida also has the brown citrus aphid vector capable of transmitting CTV-SP. There is clearly a potential for the introduction and natural spread of CTV-SP in Florida.

The Causal Agent of CTV-SP Disease

CTV-SP is only caused by some isolates of CTV. CTV is a member of the closterovirus group of plant viruses with long flexuous rod-shaped particles. CTV is the largest plant RNA virus that has been characterized. There is extensive genetic diversity among various isolates of CTV and many genetic groups of the virus have been found. Variability also exists within each group. The specific regions of the virus genome that are associated with the induction of stem pitting have not yet been identified.

Which Cultivars Are Affected by CTV-SP?

Citrus cultivars and relatives, even within the same group, tend to exhibit variable reactions to CTV infection. Limes, grapefruit, and Alemow (*Citrus macrophylla*) are highly susceptible to CTV-SP. Sweet oranges and rough lemon are tolerant to many CTV isolates, but show strong stem pitting when infected by CTV-SP. Mandarins are considered tolerant, but may show stem pitting under some conditions. Trifoliate orange and trifoliate hybrids carrying the CTV-resistance gene are resistant to CTV infection and CTV-SP, but hybrids without this gene may show strong pitting. Some pummelos show selective resistance specific to some severe CTV-SP isolates, but are highly susceptible to others. It appears that several independent virus factors cause stem pitting in different hosts. *Tristeza*-induced stem pitting and decline are also apparently under separate genetic control. Decline isolates often do not cause stem pitting and some CTV-SP isolates do not cause decline or seedling yellows (another symptom associated with decline isolates of CTV).

What Are the Typical Symptoms Caused by CTV-SP?

The severity of CTV-SP (Figure 1) in a specific host can vary markedly. Sometimes only a few scattered pits can be seen after removing the bark from affected plants and there is no detectable effect on plant vigor. Other isolates may cause extensive pits in the trunk and branches that can often be detected as depressed areas in the bark. When severe, the trunk and branches may have a ropy appearance. Trees may continue to grow fairly vigorously for extended periods with this type of pitting, but fruit size may be reduced (Figure 2). The most severe type of stem pitting causes extensive disruption in the normal differentiation of cambial cells into wood and bark. Twigs are brittle and the bark is abnormally thick and growth is markedly reduced. Fruit are frequently small and misshapen. Leaves are often chlorotic (Figure 3) and dieback may occur.

Figure 1. Stem-pitting of grapefruit caused by *Citrus tristeza virus*-Stem Pitting (CTV-SP) isolate.

Figure 2. Reduction of fruit size due to *Citrus tristeza virus*-Stem Pitting (CTV-SP) on right compared to the healthy fruit on left.

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Figure 3. Vein chlorosis caused by *Citrus tristeza virus*-Stem Pitting (CTV-SP).

How Is CTV-SP Transmitted?

As with decline isolates, CTV-SP isolates can be transmitted by budding and grafting. Long distance movement of CTV-SP to different countries or different areas within a region is usually via the movement of the infected budwood or nursery stock. CTV-SP is also transmitted by several species of aphids. The brown citrus aphid (*Toxoptera citricida*) is considered the most efficient vector, but the melon aphid (*Aphis gossypii*) and the spirea aphid (*A. spiraecola*) can also transmit the CTV-SP virus. The patterns of spread vary according to the type of aphids involved. CTV-SP problem often increases rapidly after the brown citrus aphid becomes established in a new area and it seems that CTV-SP isolates are transmitted more often by brown citrus aphid as compared to other aphids. CTV can be transmitted experimentally by stem slash inoculation of citrus plants, and thus transmission on contaminated tools in the field is likely.

How Can CTV-SP Be Detected?

CTV-SP can be readily identified by looking for pits in the trunk and branches in the field. For confirmation of infection, bioassay and molecular detection must be performed. CTV-SP isolates can be detected by inoculation of specific susceptible cultivars. For example: Duncan grapefruit seedlings are used to detect grapefruit CTV-SP and Madam Vinous is commonly used to detect sweet orange CTV-SP isolates. Most CTV-SP isolates react to the MCA13 monoclonal antibody used in Florida to detect severe CTV isolates. However, MCA13 can not separate decline isolates from CTV-SP isolates. Molecular techniques used to differentiate CTV-SP isolates from other CTV isolates are currently being evaluated and tested.

How Can CTV-SP Be Controlled?

The first lines of defense in areas where CTV-SP is not yet widespread are quarantine and budwood certification programs. Eradication may be an option under certain circumstances where the initial infection is limited and resources are immediately available to detect and remove infected trees. There are no commercial cultivars of limes, grapefruit and sweet orange with acceptable levels of tolerance to CTV-SP isolates. A resistance gene has been identified in trifoliate orange, but incorporation of this source of resistance by breeding or genetic engineering remains a long-term proposition, in part, because of the time required to verify horticultural characteristics of new germplasm. Mild strain cross protection against CTV has been used with some success in Brazil, South Africa, and Australia to alleviate losses, but protecting isolates have been difficult to find and may be useful only in select areas against specific genetic groups of the virus. The ability to engineer improved protection isolates tailored to specific requirements is still years away. Often the only practical option is to avoid growing cultivars sensitive to CTV stem pitting. Aphid control may be useful in certain situations such as nurseries, but is not regarded as a practical long-term strategy for commercial plantings.

What Can Growers Do?

CTV-SP is a vector-borne disease. Control of CTV-SP is difficult if inoculum sources are widespread and the aphid vectors are well established. Preventing CTV-SP from entering

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Florida is much easier than trying to eradicate or control it. It is important to avoid bringing propagation materials from CTV-SP-infected areas to Florida. Any citrus propagating materials must be introduced by proper procedures through the Florida Department of Agriculture and Consumer Services, Division of Plant Industry.

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