

Citrus tristeza virus: Symptoms and control

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INTRODUCTION

Tristeza virus is assumed to have originated in China quite a long time ago. Tristeza, known

as ‘quick decline’ in the United States, is the most destructive disease of citrus in the western hemisphere and has a worldwide distribution. Less than two decades after tristeza was



Fig. 1. Stem pitting disease of Hassaku tree, showing dieback and poor fruit-set



Fig. 2. Severely affected grapefruit tree, showing stunting and yellowing

introduced from Africa into South America in the 1920s, the disease had practically wiped out the citrus industries of Argentina, Brazil, and Uruguay. The virus is also the cause of Hassaku dwarf in Japan. Failure of sweet orange, or grapefruit budded onto sour orange stock, is diagnostic for tristeza virus. The virus commonly latently infects tolerant combinations of scions and rootstock varieties, such as mandarin and trifoliate orange.

SYMPTOMS

Citrus tristeza virus (CTV) causes different symptoms on citrus plants depending on the virus strain, the variety of citrus, and the scion-rootstock combination. In Asia, various strains of CTV, generally referred to as seedling yellows (CTV-SY), tristeza (CTV-T), stem pitting (CTV-SP), and a mild type, have been widespread for many years. Any of these strains may exist in a citrus plant, or they may occur together, as a complex.

Quick decline, or tristeza disease

The following cultivars are affected by this disease when grown on sour orange, pumelo, or lemon rootstock (but not rough lemon rootstock): sweet orange, mandarin (including Satsuma and Ponkan), Tankan, Iyo, Tangor, many varieties of tangelo, and grapefruit. The causal virus is either CTV-SY or CTV-T. When the adult tree of such a combination is affected, it turns yellow and wilts rapidly, and dies within a few years. If the tree is grafted onto resistant rootstock, such as trifoliate orange or mandarin, it recovers immediately after grafting.

Seedling yellows

Self-rooted trees of sour orange, Natsudaidai, lemon and buntan are affected by this disease after being infected with CTV-SY. These trees become yellow and die back. If the affected trees are grafted onto a resistant rootstock, they soon recover.

Stem pitting disease

Most varieties of citrus are affected by stem pitting disease, even if they are grafted onto a

rootstock resistant to tristeza. Grapefruit, buntan and its relatives, tangelo, tangor, sweet orange, Iyo, Yuzu, and natsudaidai are all susceptible, although many varieties of mandarin are resistant, including Satsuma and Ponkan.

Susceptible plants develop a large number of pits on both their trunks and their stems. Affected trees become dwarfed and show less vigor, and occasionally die back. As a result, although there is profuse flowering, the trees bear only poor crops of small sized or irregularly shaped fruit. Some cultivars develop rind-oil spots, or brown spots with gumming on the fruit. The causal virus is a severe strain of CTV-SP.

THE PATHOGEN AND ITS VECTOR

The causal virus is a flexuous and thread-like rod, 2,000 nm in length and 15 nm in width. The virus particles are located in the phloem of the host plant, and disturb its transportation systems. The optimum temperatures for virus infection and multiplication are 20°C - 25°C.

CTV is transmitted by some species of aphids found on citrus plants.

Of these, citrus brown aphid, *Toxoptera citricida* Kirkaldy, is the most effective vector. The probability that the virus will be transmitted by the aphid after feeding on an affected plant is 5, 50, and 70%, when the trial is made using one, five, and 15 aphids, respectively, per receptor plant.

Melon aphid (*Aphis gossypii* Glover) is also an important vector, especially in Spain, Israel, California, and Florida where *T. citricida* is not established. However, the level of transmission from the melon aphid is low in Japan, probably because of a difference in the virus strain.

Aphis citricola Van der Goot and *Toxoptera aurantii* Boyer de Fonscolombe have also been shown to be potential vectors of CTV in some countries, but their efficiency is very low.

INDEXING

Mexican lime (*Citrus aurantifolia*), also known as West Indian lime or Key lime, is the best indicator of tristeza virus infection. Leaves of this lime develop distinctive clear veins which become corky, followed by chlorosis and

cupping of the entire leaf and stunting, when they are infected with severe virus strains. Stem pitting commonly develops, varying in extent with different virus strains. Eureka lemon (*C. limon*), sour orange (*C. aurantium*) and grape fruit (*C. paradisi*) can also be used to demonstrate the presence of tristeza virus. The main symptoms of seedling yellows in Eureka lemon seedlings are retarded growth, chlorotic leaves, and smaller terminal leaves.

CONTROL OF CTV

The certification of bud-stock, and the use of resistant rootstock, are the primary counter-measures in controlling the disease. Because CTV-SY is well established in Asia, resistant rootstock of e.g. trifoliate orange, Sunki, and Shiikuwasha (*C. depressa* Hayata) have been used for many years. Some hybrids, such as Troyer citrange or Swingle citromelo, show promise as resistant root-stock.

Bud-stock trees should be periodically examined and indexed. Severely stem-pitted

trees, or those which are dwarfed or show reduced vigor, are not suitable for propagation.

The production of virus-free trees by shoot-tip grafting or heat treatment is very important. If it is possible to keep the field permanently free of CTV, the planting of virus-free trees is practical. In areas where it is difficult to find a virus-free field, preinoculation with a mild CTV strain protects trees against infection with a severe strain of CTV.

Bud-stock trees should be inoculated with a mild CTV strain at least four to six months prior to propagation. They should then be kept in a screenhouse, under aphid-free conditions. It is also recommended that nurseries of young plants grown for propagation should be kept vector-free. Top-grafting with pre-inoculated buds onto interstock trees infested with severe CTV is not effective, because the tree has little protection against the disease.

It is necessary to spray nursery plants and young trees with insecticide occasionally, to control aphids. This should retard any re-infection with the virus.

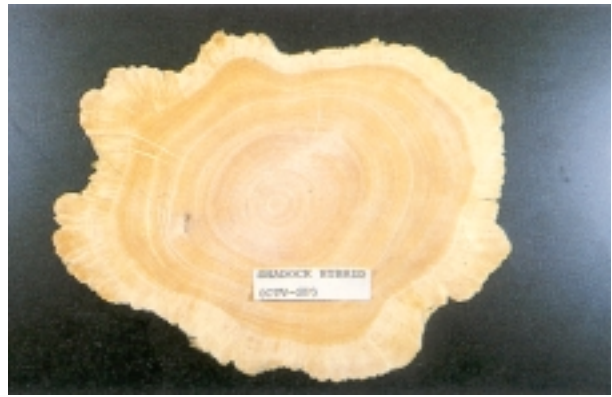


Fig. 3. and Fig. 4. Severe stem-pits on the trunk of 20-year-old tree of buntan. Note the normal growth of annual rings until the tree is 10 years old, and the very slow and irregular growth afterwards



Fig. 5. Yellow spots on lyo, one of the symptoms of stem pitting disease



Fig. 6. Citrus brown aphid, *Toxoptera citricida* Kirkaldy, the primary vector for CTV

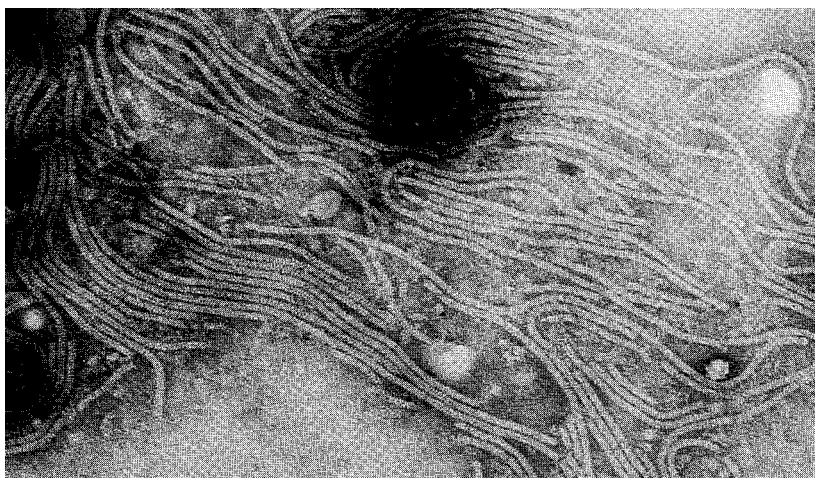


Fig. 7. Causal virus, flexuous and thread-like particles 2,000 nm in length