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Data Sheets on Quarantine Pests

Citrus tatter leaf capillovirus

IDENTITY

Name: Citrus tatter leaf capillovirus
Synonyms: Citrange stunt virus (Roistacher, 1988)
Taxonomic position: Viruses: *Capillovirus*
Common names: CiTLV (acronym)
Bud-union crease (Japan; Miyakawa & Tsuji, 1988), yellow ring (China; Zhang *et al*., 1988) (English)
Notes on taxonomy and nomenclature: The virus is a capillovirus (Nishio *et al*., 1989; Namba, 1995) which is serologically related to apple stem grooving capillovirus and to a virus isolated from stunted and chlorotic lily (*Lilium longiflorum*) widespread in western parts of Japan (Inoue *et al*., 1979). It has been suggested that, due to homologies in nucleotide sequences, it is now probably best considered to be a strain of apple stem grooving capillovirus rather than a distinct virus (Ohira *et al*., 1994). This suggestion, however, has yet to be confirmed.
EPPO computer code: CSTLXX
EPPO A1 list: No. 191
EU Annex designation: II/A1

HOSTS

Almost all citrus plants can be symptomless hosts. *Poncirus trifoliata* is immune or highly resistant, but its hybrids can show symptoms after infection (Wallace & Drake, 1963). All citrus are potential hosts in the EPPO region.

The following plants are infected by the virus when inoculated mechanically (Nishio et al., 1982): *Amaranthus tricolor*, *Catharanthus roseus*, *Chenopodium amaranticolor*, *C. quinoa*, *Cucurbita pepo*, *Dianthus barbatus*, *D. chinensis*, faba beans, *Gomphrena globosa*, *Nicotiana clevelandii*, *N. debneyi*, *N. glutinosa*, peas, *Petunia hybrida*, soyabeans,, *Tetragonia tetragonioides*, tomatoes, *Vigna unguiculata*.

GEOGRAPHICAL DISTRIBUTION

CiTLV was first found in *Citrus meyeri* in 1962 at Riverside, California, USA. The original tree was brought from China in 1908 (Wallace & Drake, 1962) and it is clear that the virus originates in China. Old budlines of *C. meyeri* which were imported from China into the USA and subsequently delivered to other countries were probably symptomless carriers (Wallace & Drake, 1962; Schwarz, 1966), so the virus may have a wider distribution than specified below.
EPPO region: Absent.
Asia: China (widespread, including Guangdong, Guangxi, Zhejiang; Zhang *et al*., 1988), Japan and Korea Republic (imported citrus cultivars from China and some budlines of

Citrus reticulata and *C. maxima*; Miyakawa, 1980b; Koizumi, 1989), Taiwan (Su & Cheon, 1984).
Africa: South Africa (Shamouti oranges; Marais & Lee, 1986).
North America: USA (California, Florida, Texas; imported cultivars from China; Wallace & Drake, 1962).
Oceania: Australia (New South Wales, Queensland).
EU: Absent.

BIOLOGY

The major method of transmission from citrus to citrus is by grafting. Mechanical transmission by knife slashes and leaf-abrasion is easily achieved from infected *Nicotiana clevelandii* to citron (Garnsey, 1974) and from citron to citron (Roistacher *et al.*, 1980). However, a field trial which attempted to transmit the virus to 8-year-old mandarin trees by slashing their bark with a knife or sawing the branches gave a very low rate of infection (Isoda, personal communication).

Seed transmission has been observed in *Chenopodium quinoa*, cowpeas and soyabeans but not in *Fortunella japonica* (Nishio *et al.*, 1982). No natural vector is known. These results suggest that natural transmission occurs only at a very low rate.

DETECTION AND IDENTIFICATION

Symptoms

The virus is often symptomless in citrus plants. Chlorotic leaf symptoms are produced in *Citrus excelsa*, Rusk and Troyer citranges (*Poncirus trifoliata* x *Citrus sinensis*), Swingle citrumelos (*P. trifoliata* x *C. paradisi*) and other *P. trifoliata* hybrids. Leaves of *C. excelsa* may be deformed (so-called tatter leaf), but infected plants often recover after the initial reaction. Stems of citrange plants may be deformed and have a zigzag growth pattern associated with chlorotic areas on the stem. Citranges and citrange hybrids are often pitted on their stem.

When infected latent hosts are grafted on rootstocks of *P. trifoliata* or its hybrids, a bud-union crease, showing a yellow to brown line, can be observed 1 year after grafting when the bark is removed. Affected plants become stunted, chlorotic and overblooming, have early-maturing of fruit, and often die. Suckers often develop.

Morphology

Filaments and usually flexible rod particles are 650 nm long and 12 nm wide, with a helical construction of 3.4 nm pitch. The virus has a single RNA species of molecular weight 2.83 x 10^6 Da and produces a single protein band of molecular weight 27 x 10^3 Da in SDS-PAGE (Nishio *et al.*, 1989).

Detection and inspection methods

Seedlings of Rusk citranges are recommended as indicators for CiTLV. Rusk citrange is budded on virus-free seedlings of rough lemon rootstock and the citrus tissues to be tested are also budded below the citrange bud. The rootstock is cut back 10-14 days later to force development of new sprouts from the Rusk citrange. Optimum temperatures for symptom development are 20-24°C (Miyakawa, 1978). Leaf-abrasion inoculation to *Chenopodium quinoa* is also recommended. *C. quinoa* develops chlorotic or necrotic spots on the inoculated leaves, and its upper leaves show vein clearing, twisting and stunting. *Vigna unguiculata* is also used, but symptoms vary markedly depending on virus isolate (Iwanami *et al.*, 1991). Optimum temperatures for symptom development in these herbaceous plants are 30°C/25°C (day/night) (T. Iwanami, unpublished data). ELISA using CiTLV antiserum

has been utilized (Kawai & Nishio, 1990). By using PAGE, two typical dsRNA bands can be observed. See also Frison & Taher (1991).

MEANS OF MOVEMENT AND DISPERSAL

With no means of natural transmission, CiTLV is moved and dispersed only in infected budwood.

PEST SIGNIFICANCE

Economic impact

Almost all citrus plants are symptomless if grown on their own roots or on a CiTLV-tolerant rootstock. *Poncirus trifoliata* is immune or highly resistant to CiTLV. However, when infected latent hosts are grafted on rootstock of *P. trifoliata* or its hybrids, a bud-union crease occurs and the tree becomes stunted or often dies (Calavan *et al*., 1963). Yields of affected mandarins (*Citrus reticulata*) on *P. trifoliata* rootstock are 75% those of CiTLV-free trees (Takahara *et al*., 1988). Accordingly, *P. trifoliata* and its hybrids cannot be used in practice as rootstocks where CiTLV is indigenous.

Inserting a healthy interstock between the infected latent bud and the *P. trifoliata* rootstock only delays the problem. The scions grow normally for 1-2 years, but then become overblooming and yellow gradually and finally die within 5-6 years. These trees develop a crease at the bud-union between interstock and rootstock, and are occasionally dislocated at this point by strong winds.

Control

CiTLV-free budlines must be used for propagation. If latently infected scions are used for propagation without any therapy, *Poncirus trifoliata* or its hybrids cannot be used as the rootstock. *Citrus depressa* or *C. reshni* provide good results when used as rootstocks for CiTLV-infected mandarins (*C. reticulata*) (Takahara *et al*., 1988).

CiTLV cannot be eliminated by shoot-tip grafting alone (Roistacher & Kitto, 1977). Heat treatment for 30 days at 35-40°C/30°C (day/night) followed by shoot-tip grafting can be an effective therapy (Koizumi, 1984). Incubation of budsticks on medium *in vitro* for 10-14 days at 32°C, followed by shoot-tip grafting can also produce CiTLV-free plants with 30-50% success (Navarro *et al*., 1989). Long-term heat treatment of affected plants for 90 or more days at 40°C/30°C (day/night) can eliminate CiTLV (Miyakawa, 1980a).

Mechanical transmission from citron to citron by knife-slashing is completely prevented by dipping the contaminated knife-blades into 1.05% sodium hypochlorite solution or 2% sodium hydroxide plus 5% formaldehyde solution, or merely by washing the blades with tap-water and drying, prior to slashing the receptor (Roistacher *et al*., 1980).

Phytosanitary risk

CiTLV was recently added to the EPPO A1 list of quarantine pests, but is not listed as a quarantine pest by any other regional plant protection organization. EPPO had not previously assessed most non-European citrus pests because importation from non-European countries was in any case prohibited because of the most important ones (citrus greening bacterium, *Xanthomonas axonopodis* pv. *citri* etc.; EPPO/CABI, 1996). CiTLV certainly presents a very significant risk to citrus-growing areas in the EPPO region. The addition to the EPPO list harmonizes it with EU Directive Annex II/A1.

PHYTOSANITARY MEASURES

CiTLV is another non-European citrus virus which justifies citrus-growing countries in prohibiting the import of citrus from infested countries.

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