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Data Sheets on Quarantine Pests

Citrus tristeza closterovirus

IDENTITY

Name: Citrus tristeza closterovirus
Synonyms: Citrus quick decline virus (Fawcett & Wallace, 1946)
Citrus seedling yellows virus (Fraser, 1952)
Grapefruit stem pitting virus (Oberholzer et *al.*, 1949)
Lime die-back virus (Hughes & Lister, 1949)
Taxonomic position: Viruses: *Closterovirus*, tentative species (Candresse & Martelli, 1995)
Common names: CTV (acronym)
Tristeza, seedling yellows, quick decline (English)
Tristeza (French, Spanish)
EPPO computer code: CSTXXX
EPPO A2 list: No. 93
EU Annex designation: II/A1 for non-European strains and II/A2 for European strains

HOSTS

CTV infects all species, cultivars and hybrids of citrus. It also infects some citrus relatives such as *Aeglopsis*, *Afraegle*, *Fortunella* and *Pamburus* and some intergeneric hybrids. Species of *Passiflora* have been infected experimentally (but not naturally) and are the only non-rutaceous experimental hosts.

In the EPPO region, citrus and citrus relatives are the hosts of concern throughout the Mediterranean area.

GEOGRAPHICAL DISTRIBUTION

CTV is widespread throughout tropical citrus-growing areas. Individual countries where the disease have been found are cited in Bové & Vogel (1981).
EPPO region: Recorded in Israel, Spain, Turkey. France (found in 1940s in Corsica but not established; a previously noted record for the mainland is erroneous). Scattered infected trees have been found in Algeria, Cyprus, Egypt, Italy (including Sardinia and Sicily), Morocco and Tunisia. Such trees have been destroyed, but it is not clear to what extent others remain. An unconfirmed report from Libya is probably confusion with stubborn disease (EPPO Reporting Service 504/02).
Asia: Brunei, China (Fujian, Guangdong, Guangxi, Sichuan), Cyprus, Georgia, India (widespread), Indonesia (Java), Iran, Japan, Jordan (unconfirmed), Korea Democratic People's Republic, Korea Republic, Malaysia (Pensinsular, Sabah), Nepal, Pakistan, Philippines, Saudi Arabia, Sri Lanka, Taiwan, Thailand, Turkey, Viet Nam, Yemen.
Africa: Algeria, Cameroon, Central African Republic, Chad, Egypt, Ethiopia, Gabon, Ghana, Kenya, Libya (unconfirmed), Mauritius, Morocco, Mozambique, Nigeria, Réunion, South Africa, Tanzania, Tunisia, Zaire, Zambia, Zimbabwe.

North America: Bermuda, Mexico, USA - main citrus areas (Arizona, California, Florida, Hawaii, Louisiana, Texas).
Central America and Caribbean: Antigua and Barbuda, Bahamas, Belize, Costa Rica, Dominica (unconfirmed), Dominican Republic, El Salvador, Guatemala, Honduras, Jamaica, Netherlands Antilles, Nicaragua, Panama, Puerto Rico, St. Lucia, Trinidad and Tobago.
South America: Argentina, Bolivia, Brazil, Chile (found but not established), Colombia, Ecuador, Guyana, Peru, Paraguay, Suriname, Uruguay.
Oceania: American Samoa, Australia, Fiji, French Polynesia, New Caledonia, New Zealand (strains present do not include orange stem pitting isolates), Samoa.
EU: Present.
Distribution map: See CMI (1978, No. 289).

BIOLOGY

CTV is transmitted in nature by several aphid species in a semipersistent manner (Bar-Joseph *et al.*, 1983). *Toxoptera citricidus* is the most efficient vector. It is not present in the EPPO countries (EPPO A1 list; EPPO/CABI, 1996a) and North America, although it is moving northwards in Central American countries. *Aphis gossypii* though generally not abundant in citrus is also an efficient vector of many isolates. *Aphis citricola* and *Toxoptera aurantii* are less efficient vectors, but are more abundant on citrus.

Several strains have been described, differing in symptoms induced in several hosts (Bové & Vogel, 1981), aphid transmissibility (Bar-Joseph *et al.*, 1983), dsRNA patterns (Dodds *et al.*, 1987), peptide maps (Guerri *et al.*, 1990) and serological reaction with monoclonal antibodies (Permar *et al.*, 1990).

DETECTION AND IDENTIFICATION

Symptoms

Trees grafted on sour orange rootstocks usually show dieback and defoliation, stunting and in many cases complete decline. This symptomatology is caused by the starvation of the roots as a consequence of sieve-tube necrosis induced by the virus below the bud union. Cells of the medullary rays of the wood become lignified in this area and produce the symptom called inverse pitting, honey combing or pinholing. However, this symptom is not specific to tristeza and can also be induced by *Spiroplasma citri* (stubborn disease) (EPPO/CABI, 1996b).

CTV may also induce stem pitting, stunting and low yields on susceptible cultivars (mainly limes, grapefruits and some sweet oranges) even if they are grafted on tristeza-tolerant rootstocks. The cultivars affected and the intensity of the symptoms depend on the virus strain. Some severe strains may induce stem pitting in most citrus cultivars.

Fruits from affected trees (declining trees grafted on sour orange or trees with severe stem pitting) are usually small and of poor quality.

Morphology

CTV is a closterovirus with long flexuous particles 2000 nm long and 12 nm wide. The capsid protein has a molecular weight of 27 000-28 000. The particle contains a single-stranded RNA with a size of aproximately 6.5×10^6 (Bar-Joseph *et al.*, 1989).

Detection and inspection methods

Lime seedlings are used as indicators for biological testing of CTV (USDA, 1968). Indicator plants are graft-inoculated with buds or bark patches from candidate trees and incubated in a temperature-controlled glasshouse at 18-25°C. Infected plants show specific

vein-clearing and stem-pitting symptoms within 2-6 months. The method is very sensitive and specific, although it is expensive and time-consuming.

CTV can also be detected by ELISA. Specific monoclonal antibodies are commercially available and the technique is routinely used for large-scale testing in several countries.

MEANS OF MOVEMENT AND DISPERSAL

Aphid vectors will spread tristeza locally, or internationally if they are carried on citrus plants or fruits. However, propagation of citrus with infected budwood is the most important means of tristeza spread, both locally and from country to country. This applies to ornamental citrus as well as to plants for fruit production. In Europe, the growing of ornamental citrus in pots is becoming popular and plants from tristeza-infected areas are being imported into non-citrus-producing countries. Recently, plants of *Citrus madurensis* from the Netherlands were found in Spain, infected by severe strains of CTV.

PEST SIGNIFICANCE

Economic impact

Citrus tristeza is the most destructive virus disease of citrus. It causes the death of infected trees of most citrus cultivars (except lemons) grafted on the highly susceptible sour orange rootstock, which was widely used in the past due to its excellent horticultural behaviour. Tens of millions of trees have been destroyed by the disease, mainly in North and South America and some Mediterranean countries.

Control

CTV is controlled by the use of tristeza-tolerant rootstocks. However, there are many severe strains that also produce stem pitting, stunting, low yields, and poor fruit quality in certain cultivars, even when grafted on tolerant rootstocks. In these cases, disease damage can be controlled only by cross protection with mild virus strains. However, this method has many difficulties and in practice it is only being used efficiently on a large scale in Brazil (Costa & Müller, 1980).

Phytosanitary risk

CTV appears on the A2 quarantine list of EPPO (OEPP/EPPO, 1978) and is also of quarantine significance for CPPC and IAPSC. Tristeza is a very important threat for the citrus-growing countries of the EPPO region. In this area the highly susceptible sour orange rootstock is extensively used and the potential introduction and quick spread of the virus could completely destroy the citrus industry of many countries. Spain and Israel are the most affected countries in the region. In Spain alone, the disease has caused the death of close to 15 million trees grafted on sour orange. Despite this damage, the CTV strains present in the area are relatively mild and can be controlled by the use of tristeza-tolerant rootstocks. As an example, in Spain, propagation of citrus (except lemons) on sour orange has been forbidden and close to 50 million trees grafted on tristeza-tolerant rootstocks have been planted in the field during the last 15 years. These trees have not, so far, shown any damage due to tristeza. The introduction of much more damaging strains from other parts of the world is another major risk to be considered.

In addition, *Toxoptera citricidus*, the most efficient vector of CTV, is not present in EPPO countries. Its introduction is a very important threat, because it could accelerate the spread of the virus throughout the region (EPPO/CABI, 1996a).

PHYTOSANITARY MEASURES

Strict quarantine measures are necessary to avoid the introduction of CTV into countries where the virus is not present or the introduction of severe strains in areas with only relatively mild strains (Navarro *et al.*, 1984; Frison & Taher, 1991). EPPO recommends (OEPP/EPPO, 1990) citrus-growing countries to prohibit importation of host plants from countries where CTV occurs, and to require origin from an official virus-free certification programme for countries where CTV does not occur (i.e. in particular within the EPPO region). In addition, plants for planting should be fumigated against vectors. Fruits from infested countries should be either free from peduncles and leaves, washed and waxed, or fumigated. EPPO recommends countries within the region which do not grow citrus as a commercial crop not to re-export citrus plants to citrus-growing countries.

Large-scale surveys using the ELISA technique with monoclonal antibodies should be carried out to detect outbreaks of CTV in countries where the virus is not present, or severe strains in areas with only mild strains of CTV as early as possible. Any new outbreak should be eradicated quickly to avoid virus spread.

Certification programmes should be established in all citrus-growing countries to guarantee that CTV is not spread with budwood used for commercial propagation (Navarro *et al.*, 1988). In countries where CTV is already widespread, the certification programmes should avoid the spread of severe CTV strains in new plantings. In some cases it may be necessary to propagate cultivars deliberately infected by mild CTV strains to protect the trees against natural challenge infections by more severe isolates. EPPO is considering a certification scheme for citrus.

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