

Mini data sheet on *Citrus bark cracking viroid*

Citrus bark cracking viroid was added to the EPPO A2 List in 2017. A full datasheet will be prepared, in the meantime you can view here the data which was previously available from the EPPO Alert List (added to the EPPO Alert List in 2015 - deleted in 2017).

Citrus bark cracking viroid (Pospiviroid, CBCVd)

Why: an unknown and severe disease was observed in 2007 in hop gardens in Slovenia. The disease spread extremely rapidly and caused severe stunting and death of affected plants. Screening studies on all known pathogens of hop, revealed the presence of *Hop stunt viroid* (Pospiviroid, HSVd - hop stunt disease). However, the new disease observed in Slovenia presented some unusual characteristics for HSVd, such as shorter incubation period, higher aggressiveness, and unreliability of RT-PCR detection (limited to hop cone tissues). Further analysis of symptomatic plants using next generation sequencing (NGS) analysis revealed the presence of *Citrus bark cracking viroid* (Pospiviroid, CBCVd). Until this finding, CBCVd had been described only as a minor pathogen of citrus plants. Research studies confirmed that CBCVd was the causal agent of this new viroid disease of hop, which was called 'severe hop stunt disease'. Hop is a new and highly susceptible host for CBCVd. Because CBCVd on hop is causing a new and emerging disease in the EPPO region, the NPPO of Slovenia suggested its addition to the EPPO Alert List.

Where: CBCVd (formerly named Citrus viroid IV) was first identified in 1988 during citrus exocortis disease studies, in samples originating from California (US). Three years later, the first CBCVd nucleotide sequence was established from dwarfed grapefruit in Israel. Before outbreaks on hop in Slovenia, CBCVd was described as a minor pathogen of citrus species with limited occurrence, even in countries with citrus fruit production. CBCVd outbreaks on hop are currently present only in Slovenia, where strict eradication measures have been established.

EPPO region: Egypt, Greece, Italy, Israel, Tunisia (all on *Citrus* spp.) and Slovenia (severe outbreaks on *Humulus lupulus*; under eradication).

Africa: Egypt, South Africa, Sudan, Tunisia (on *Citrus* spp.).

Asia: China, Israel, Iran, Japan, Oman (on *Citrus* spp.).

North America: USA (California, Texas) (on *Citrus* spp.).

Central America and the Caribbean: Cuba (on *Citrus* spp.).

On which plants: the main hosts are citrus (*Citrus* spp., *Poncirus trifoliata*) and, since its discovery in Slovenia, also hop (*Humulus lupulus*). Artificial inoculations showed that some citrus-related plants from the Rutaceae family (*Fortunella margarita*; *F. crassifolia*; *F. obovata*, *Microcitrus warburgiana*; *M. australis* x *M. australasica*, *Pleiosperum* sp. and *Severinia buxifolia*) and other viroid indicator plants (*Cucumis sativus*, *Benincasa hispida*, *Solanum lycopersicum*, *Solanum melongena*, *Chrysanthemum morifolium*) could be symptomless hosts of CBCVd.

Damage: CBCVd is a minor pathogen on citrus, and is associated with bark cracking in trifoliolate orange (*Poncirus trifoliata*). The appearance of this symptom was why Citrus viroid IV was given the more descriptive name of *Citrus bark cracking viroid*. Studies have demonstrated that CBCVd does not have a negative effect on growth and yield in citrus. However, in trees co-infected with HSVd, a synergistic effect has been observed that reduces the yield. Several surveys in citrus orchards have shown that CBCVd is the least widespread of the citrus viroids and usually occurs in combination with other citrus viroids. In contrast with the observations on citrus, CBCVd causes severe symptoms on hop, which include plant stunting resulting from a shortening of the internodes of main and lateral branches, leaf

yellowing and downward curling, reduced cone production, and dry root rot. The first symptoms appear 4-12 months after infection and plants die within 3-5 years. Since hop is a perennial plant, which requires an extensive and long term support system for cultivation, infections of hop gardens have a high impact on production and cause major economic damage.

Transmission: CBCVd is sap-transmissible and therefore, it can be transmitted by vegetative propagation, grafting, foliar contact between neighboring plants, contaminated tools and machinery, clothing and human hands. Surveys on citrus have demonstrated a relatively low incidence and progression in commercial orchards. In contrast to citrus, CBCVd progresses rapidly (up to 20% every year) in affected hop gardens, mainly along plant rows. In hop production, returning fresh hop waste from CBCVd infected hop gardens after harvest into non-infected hop gardens represents a high risk of further spreading the disease. There are no reports of seed or pest transmission; however, additional studies should be done in the future. Hop growing is based on the cultivation of female plants, which are not pollinated, so seeds are present in a very small proportion. Seeds in hop and citrus production are important only for breeding new varieties. Over long distances, CBCVd can be transmitted by infected planting material or parts of plants. The CBCVd emergence on hop is still unclear, since citrus are not grown commercially in Slovenia. It is assumed that CBCVd transmission to hop occurred from the remains of imported citrus fruits or plants. The initial outbreak took place in a hop garden established on the site of a former waste dump, where such transmission probably happened. However, this hypothesis about possible transmission of CBCVd from infected citrus fruits to hop remains to be verified.

Pathway: plants for planting, parts of plants, citrus fruits, contaminated machinery from areas in which CBCVd occurs.

Possible risks: CBCVd is a minor pathogen on citrus, but on hop it can cause severe economic damage. Hop is a perennial climbing plant cultivated for the production of female inflorescences (cones), which are primarily used in the production of beer to provide bitterness and aroma. Hops are also used in herbal medicine and in the pharmaceutical industry. It is an important crop that is traditionally grown in some countries of the EPPO region and the rest of the world (USA is the biggest producer). In the EPPO region, hop is grown on more than 25 000 ha in 13 countries, of which Germany, the Czech Republic, the United Kingdom, Poland and Slovenia provide the majority of European hop production. CBCVd outbreaks in Slovenia represent a high risk for national, European and world hop production. With the aim of eradication and suppression, Slovenia has established an eradication program which includes a systematic monitoring programme and the introduction of viroid testing in the certification of hop planting material.

Sources

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