



EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
ORGANISATION EUROPEENNE ET MEDITERRANEENNE POUR LA PROTECTION DES PLANTES

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Report of a Pest Risk Analysis for

Citrus bark cracking viroid



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This summary is based on a pest risk analysis (PRA) prepared by Slovenia in 2016 (Radišek and Benko-Beloglavec, 2016), some information available in a German express PRA revised in 2020 (Wilstermann *et al.*, 2020) and subsequent discussions in the EPPO Panel on Phytosanitary Measures. Since Citrus bark cracking viroid (CBCVd) was recently added to the EPPO A2 List of pests recommended for regulation as quarantine pests (in 2017), additional searches for more recent literature have not been conducted. Probability of entry, establishment, spread, and potential impact, with associated uncertainties are provided as in the PRA (on a three-level scale: low, moderate and high).

- Pest:** *Citrus bark cracking viroid* (CBCVd)
- PRA area:** EPPO region
- Assessors:** Slovenian PRA prepared by Dr. Sebastjan RADIŠEK (Slovenian Institute of Hop Research and Brewing),
Extended to the EPPO region by Ms Anita BENKO-BELOGLAVEC (Slovenian NPPO) and Dr. Sebastjan RADIŠEK, and subsequent discussions in the EPPO Panel on Phytosanitary Measures.
- Date:** The PRA was prepared in 2016 and extended on request of the EPPO Panel on Phytosanitary Measures (meeting in Paris, 2016-05) so that it is valid for the EPPO region. The Panel on Phytosanitary Measures (2016-11) and the Working Party on Phytosanitary Regulations (2017-06) agreed with the measures recommended. The Panel on Phytosanitary Measures discussed the PRA report in 2021-04 to better formalize the measures recommended for the regulation of the pest in the EPPO region.

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Based on this PRA report, measures for plants for planting of *Humulus lupulus* (other than seeds) are recommended. In addition to the measures to be implemented by the exporting countries, importing countries are encouraged to implement additional measures.

STAGE 1: INITIATION

Reason for doing PRA: (References available in the Slovenian PRA)	In 2007, in the region of Šempeter (Savinja Valley, Slovenia), an outbreak of an unknown and aggressive disease was reported causing stunted growth of hop plants with rapid spread dynamics. In 2011, the presence of <i>Hop stunt viroid</i> (HSVd) was detected in the affected plants. However, following further investigation, it was demonstrated that the main agent of the new disease in Slovenia was <i>Citrus bark cracking viroid</i> (CBCVd), whilst HSVd was inactive in the infected plants (most probably due to the antagonist relationship to CBCVd) or could no longer be detected. The new disease on hop caused by CBCVd was called the 'severe hop stunt disease'.
Taxonomic position of pest:	Virus and viroids, Riboviria, Pospiviroidae, <i>Cocadviroid</i> Other scientific names: Citrus viroid IV Citrus bark cracking cocadviroid

STAGE 2: PEST RISK ASSESSMENT

PROBABILITY OF INTRODUCTION

Entry

Geographical distribution:

(Source: EPPO Global Database last consulted 2021-02-11, details on distribution are available in Global Database).

AFRICA

Egypt, South Africa, Sudan, Tunisia

AMERICA:

Cuba, USA (California, Texas)

ASIA

China (Sichuan, Zhejiang), Iran, Japan, Lebanon, Oman, Pakistan, Syria

EPPO Region

Cyprus, Germany, Greece, Israel, Italy, Slovenia, Turkey

Major host plants:

(see the Slovenian PRA and EPPO Global Database for references)

Hosts: *Citrus* spp., *Poncirus trifoliata*, hop (*Humulus lupulus*)

Artificial hosts of the Rutaceae family: *Atalantia buxifolia* [syn. *Severinia buxifolia*], kumquats (*Fortunella margarita*, *F. crassifolia*, *F. obovata*), limes (*Citrus warburgiana* [syn. *Microcitrus warburgiana*]; *C. australis* x *C. australasica* [syn. *M. australis* x *M. australasica*]), *Pleiospermium* sp.

Other artificial hosts: cucumber (*Cucumis sativus*), winter melon (*Benincasa hispida*), tomato (*Solanum lycopersicum*), eggplant (*Solanum melongena*), *Dendranthema x grandiflorum* [syn. *Chrysanthemum morifolium*], *Gynura aurantiaca*, *Datura stramonium*, bittersweet nightshade (*Solanum dulcamara*).

Which pathway(s) is the pest likely to be introduced on:

(see the Slovenian PRA for references. All the pathways have been reworded according to the categories defined in the guidance document for EPPO Standard PM 5/5¹)

All parts of plants can be systemically infected with CBCVd. The main pathways identified in the PRA are:

Host plants for planting (other than seeds).

There is no information on the possible transmission of CBCVd via seeds. Plants for planting may be asymptomatic.

Import of *Citrus* spp. and *Poncirus trifoliata* plants for planting other than seeds is prohibited in many EPPO countries (e.g. into the EU from non-EU countries). In addition, citrus plants for planting are generally not grown in hop growing areas (i.e. no commercial *Citrus* production, although *Citrus* may be grown as ornamentals).

¹ https://www.eppo.int/media/uploaded_images/RESOURCES/eppo_standards/pm5/guidance_pm5-05.pdf

There are no data on import of hop plants for planting in the EPPO region. Trade of hop plants for planting is considered limited because of the production of local varieties.

Host fruits

The volume of citrus fruits imported in the EPPO region is very high. As demonstrated in Slovenia, CBCVd is present in sampled citrus fruits originating from countries where the pest is present. Most household waste ends up on regulated dumps. However, the risk of entry increases if organic waste is not handled appropriately (e.g. citrus waste dumped in hop growing areas, as suspected in Slovenia).

Introduction into hop growing areas where there is no production of citrus fruits may be possible via the importation of infested citrus fruits or ornamental plants for planting (although prohibition of importation exists for such plants for planting).

Other pathways for entry were considered of minor significance:

Used machinery, equipment/tools and travellers (e.g. clothes and footwear)

Viroids are transmitted mechanically by infected plant sap on machinery, tools, clothing and footwear during the different agro-technical activities. CBCVd on machinery was not considered able to survive transport. Introduction via tools and persons (clothing and footwear) was considered unlikely.

Above-ground fresh plant parts and stored products/dried plant parts

For citrus, this may cover cut branches. Import of *Citrus* spp. and *Poncirus trifoliata* plants other than fruits and seeds is prohibited in many EPPO countries (e.g. into the EU from non-EU countries).

CBCVd can survive in fresh hop cones but no data exist for dried hop cones. These are not considered as a pathway because these are thermally treated immediately after harvesting and processed in brewing or pharmaceutical industry in the country of destination.

Following hop harvesting, remaining plant debris are locally composted, buried into the soil, or processed in biogas power plants. At present, no trade in such plant material exists.

Establishment

Plants at risk in the PRA area:

Hop production in the EPPO region is mainly located in central European regions. However, Spain also has a hop production (570 ha, 95% of the production being located in the Leon province) (Martinez-Martinez, pers. comm., 2021). Apart from hop farms growing commercial hop varieties, wild hop is also found in many countries of the Northern Hemisphere. Citrus orchards are present in Mediterranean countries. Details on the area of hop and citrus production in individual EPPO countries are provided in the Slovenian PRA.

In addition, in certification scheme, hop plants intended for propagation stocks I and II (see Standard PM 4/16, EPPO, 2009) are usually grown in greenhouses.

Climatic similarity of present distribution with PRA area (or parts thereof):

CBCVd is present in several EPPO countries where citrus species are grown and is present in hop in Germany and Slovenia proving that it can further establish in the EPPO region. It is considered that CBCVd could establish in the EPPO region, wherever hosts plants are grown.

Characteristics (other than climatic) of the PRA area that would favour establishment:

None.

Which part of the PRA area is the area of potential establishment:

CBCVd can establish outdoors wherever hosts plants are grown. It can also establish in protected conditions.

Spread

Spread of CBCVd is only human-assisted (natural spread is not known to be possible). The following mechanisms could contribute to CBCVd spread.

Long-distance spread is possible via:

- **Host plants for planting (except seed)**

Although prohibitions exist, trade in plants for planting of *Citrus* spp. and *Poncirus trifoliata* exists between or inside EPPO countries as ornamental plants (most EPPO countries) or as plants for commercial production of fruits (citrus producing countries). However, citrus plants for planting are generally not grown in hop growing areas. The risk of spreading CBCVd with ornamental citrus plants for planting into areas where hop is grown is low. Hop plants for planting are not traded in large quantities between EPPO countries due to the use of local varieties but is considered as an important pathway for the infection of a new hop-growing region. It would also contribute to spread at a more local scale.

- **Host fruits.**

Because most household waste ends up on regulated dumps, the risk of spreading CBCVd with citrus fruits into areas where hop is grown is low. However, the Panel on Phytosanitary Measures considered that the risk of spread increases if good agronomic practices are not implemented and organic waste is not handled appropriately.

In case of transmission to hop, rapid short distance spread of CBCVd is possible via intensive and specific hop cultivation that provides ideal conditions for mechanic transmission during the growing period:

- **mechanical transmission:**

- ✓ CBCVd could spread via infected plant sap that accumulates on **used machinery and equipment/tools** during the different agro-technical activities (e.g. at the time of cutting, training of offshoots, other spring operations and harvesting). In the case of hops, spread can be favoured by the interweaving of production sites (gardens). During the incubation period (4 months - up to 1 year), plants do not develop symptoms but are infective, increasing the risk of unintentional mechanical transmission.
- ✓ Survival may be possible in tissues of **infected plant remnants** until they are fully decomposed. Thus, moving fresh hop waste between hop production sites ('gardens') may contribute to the spread. Remark: in hop, CBCVd also causes the dry rotting of the root system, allowing that lignified parts of the vines become detached and may be more easily moved to an uninfected part of the place of production.

POTENTIAL ECONOMIC CONSEQUENCES

How much economic impact Citrus

does the pest have in its present distribution: In citrus growing countries, CBCVd is not considered as causing a significant disease on citrus species.

Hop

Hop is a permanent crop and may be cultivated for over 20 years. In Slovenia, CBCVd causes disease symptoms on hop plants already during the first-year post infection, which will in field conditions die within a period of 3 to 5 years. Plant destruction, machinery and tool disinfection, and the use of specific means of transport for the removal of hop remnants are costly. Financial support granted to hop garden owners in Slovenia to compensate for the plants destroyed amounted during 2011-2015 to 213,300 EUR. Impact of the disease on affected hop farms is high, though CBCVd infections have been restricted to a limited area, as a result of eradication measures implemented. In 2019, after the completion of the PRA, the Slovenian NPPO adopted more stringent measures due to the increased

infested area. Costs for inspection, sampling and testing, as well as for compensation from 2018-2020 amounted to 3,7 million EUR for a hop growing area in Slovenia of approximately 1600 ha. Economic impact was evaluated at more than 4,2 million EUR because some hop growers were not entitled for the compensations. These figures do not include costs for implementing hygiene measures, composting and treatments with glyphosate (Beloglavec, pers. comm., 2021).

Describe damage to potential hosts in PRA area:

The infection in natural conditions and impact of CBCVd on other crops are still unclear due to relatively unclear host specificity.

How much economic impact would the pest have in the PRA area:

Hop is cultivated by 14 EPPO countries, covering in 2015 more than 25,000 hectares. CBCVd would be expected to cause similar impact in other hop production areas to those reported in Slovenia, thus causing the death of hop plants and therefore considerably affecting the brewing industry.

CONCLUSIONS OF PEST RISK ASSESSMENT

Summarize the major factors that influence the acceptability of the risk from this pest:

Estimate the probability of entry:

Moderate with a moderate uncertainty.

Two pathways have been identified, host plants for planting (other than seeds) and host fruits. The moderate uncertainty associated with this evaluation is mainly related to the uncertainty on the source of infection in hop plants in Germany and Slovenia.

Estimate the probability of establishment:

Given the availability of suitable hosts and the suitability of the PRA area, CBCVd likelihood of establishment is considered to be high with low uncertainty (outdoors as well as under protected conditions).

Estimate the probability of spread:

Main pathways for spreading identified are host plants for planting (other than seeds), host fruits, used machinery/equipment and tools, and plant remnants. The magnitude of spread is expected to be

- moderate with a moderate uncertainty for citrus growing areas,
- low with a moderate uncertainty between different hop growing areas,
- high with a low uncertainty for hop at local level.

Estimate the potential economic impact:

The impact of CBCVd is expected to be low on citrus and high on hop with a low uncertainty.

Degree of uncertainty

The main knowledge gaps or uncertainties identified in the Slovenian PRA are related to the biology: host range, vectors, virus stability and seed/pollen transmission. However, no more details are available in the PRA on vectors.

OVERALL CONCLUSIONS

CBCVd meets all the criteria to qualify as a quarantine pest. In particular, this viroid is absent from most hop production areas of the EPPO region and could cause significant damage to this crop if it were to be further introduced.

CBCVd poses a risk to the EPPO region and risk management options should be considered.

STAGE 3: PEST RISK MANAGEMENT

IDENTIFICATION OF THE PATHWAYS

Evaluation of the need for management measures for the different hosts

- ***Citrus spp., Poncirus trifoliata***

Measures were not recommended for citrus plants for planting. This was because the impact of CBCVd is expected to be low and because citrus plants for planting are generally not grown in hop growing areas (they may be present as ornamentals, but not in production, and consequently the likelihood of transfer to hop crops was assessed to be low). Only imports of citrus fruit may allow the transfer of CBCVd into hop growing areas, if citrus fruit waste is discarded close to hop orchards. Despite the high volumes of citrus fruits which are imported, most household waste ends up on regulated dumps. However, a general recommendation concerning citrus fruit waste is encouraged below.

- ***Humulus lupulus***

Hop does constitute a pathway for CBCVd, and management measures are recommended on this pathway.

Pathways studied in the pest risk management Plants for planting (except seeds) of *Humulus lupulus*

IDENTIFICATION OF POSSIBLE MEASURES

Possible measures for all pathways

Measures related to the crop or to places of production:

Pest free area

Pest free place/site of production, based on a combination of production practices, i.e.:

- Best hygiene practice;
- Unit of production, free from CBCVd in the past three years;
- Inspections have been carried out at the place/site of production and in its immediate vicinity since the beginning of the last two complete cycles of vegetation, and no symptoms of CBCVd have been observed.
- Absence of *Citrus* plants in the place/site of production

(Even though the pest free production site option was not proposed in the PRA, the Panel on Phytosanitary Measures considered that choice between a pest free production place or site was a decision to be taken by the NPPO based on the operational capacities of the producers and biological elements)

Production under a certification scheme that fulfils the requirements for pest free place/site of production

Measures related to consignments:

Testing. All plants in a consignment should be tested.

Measures upon entry of consignments

Post-entry quarantine, with visual checks and testing.

EVALUATION OF THE MEASURES IDENTIFIED IN RELATION TO THE RISKS PRESENTED BY THE PATHWAYS

Degree of uncertainty Uncertainties in the management part are:
Monitoring of symptoms in the first-year post infection.

IDENTIFICATION OF POSSIBLE MEASURES

Pathway	Measures identified for the exporting country
Plants for planting of <i>Humulus lupulus</i> (other than seeds)	Pest free area or Pest free place/site of production* [#] Or Testing of all plants in the consignment Or Post-entry quarantine with visual checks and testing (in the framework of a bilateral agreement) [§]

*Including cleaning (to remove any plant parts and remnants) and disinfection of tools and machineries entering the place/site of production, as well as application by personnel working in such facilities of hygiene protocols appropriate for CBCVd. The choice between a pest free production place or site is a decision to be taken by the NPPO based on the operational capacities of the producers and biological elements.

[#]Production under a certification scheme that fulfils the requirements for pest free place/site of production is also possible.

[§]The Panel on Phytosanitary measures considered that post entry quarantine should only be proposed in the framework of a bilateral agreement between the importing and the exporting country.

In addition to the measures to be implemented by the exporting countries, the Panel on Phytosanitary Measures encourages importing countries to implement the following measure:

Cleaning and disinfection of used machinery and tools/equipment to prevent entry of CBCVd in places of production that grow host plants should be encouraged. This differs from the PRA which recommends an import requirement for disinfection of tools and machinery.

Citrus fruit waste should be disposed of safely, not on agricultural land.

References:

Radišek S & Benko-Beloglavec A (2016) Pest risk analysis for Citrus bark cracking viroid (CBCVd). Slovenian Institute of Hop Research and Brewing. Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection. Available at <https://gd.eppo.int/taxon/CBCVD0/documents>

Wilstermann A, Schrader G, Pfeilstetter E, Schäfer BC, Ziebell H (2020) Express PRA for Citrus bark cracking viroid. Julius Kühn-Institute, Institute for national and international Plant Health. Replaces version of 2019-07-30. Available at <https://pra.eppo.int/pr/0a52821b-0965-4d92-9af1-9c4e932a091a>