EPPO Datasheet: *Cheravirus avii*

Last updated: 2020-09-10

IDENTITY

Preferred name: *Cheravirus avii*
Taxonomic position: Viruses and viroids: Riboviria: Orthornavirae: Pisuviricota: Pisoniviricetes: Picornavirales: Secoviridae
Other scientific names: *Apple flat apple virus, CRLV, Cherry rasp leaf cheravirus, Cherry rasp leaf virus*
Common names: American rasp leaf of cherry, flat apple, rasp leaf of cherry
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EPPO Categorization: A1 list
view more categorizations online...
EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II A)
EPPO Code: CRLV00



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Notes on taxonomy and nomenclature

CRLV is a type member of the genus Cheravirus. This genus Cheravirus contains viruses that were previously classified as tentative members of the genus Nepovirus. In common with nepoviruses, the members of the genus Cheravirus are characterised by their bipartite genome encapsidated in icosahedral particles with each genome segment producing a polyprotein. However, unlike nepoviruses, these viruses contain three distinct coat protein subunits of a fairly similar size (20-25 kDa) and phylogenetic analyses suggest, that the cheraviruses should be classified in a distinct genus within the plant picornavirus family Secoviridae (Sanfaçon *et al*., 2012).

It has been shown that Cherry rasp leaf virus and Flat apple disease-associated virus (FAV) are isolates of the same virus (James *et al*., 2001).

HOSTS

The main hosts of CRLV are sweet cherry (*Prunus avium*), and peach (*P. persica*); and susceptible cherry rootstocks include both mazzard (*P. avium*) and mahaleb (*P. mahaleb*) (Wagnon *et al*., 1968; Stace-Smith and Hansen, 1976). The reports about CRLV occurring in sour cherry (*P. cerasus*) are based only on symptomatology and need to be confirmed.

CRLV has also been found in apple (*Malus domestica*), in which it causes 'flat apple' disease (Parish, 1976, 1977; Hansen and Parish, 1990). There are only two reports on the detection of CRLV using ELISA in asymptomatic raspberry plants (*Rubus idaeus*), but these were not confirmed by molecular genetic methods (Jones *et al*., 1985; Stace-Smith and Ramsdell, 1987). CRLV was also detected on potatoes (*Solanum tuberosum*) in Wisconsin (Thompson *et al*., 2004; Osman *et al*., 2017), *Sambucus nigra* subsp. *caerulea* and *Malva* spp. showing symptoms of chlorotic ring patterns and leaf deformation in Washington State (Villamor and Eastwell, 2016), and on tomato (*Solanum lycopersicum*) in Minnesota (Bratsch *et al*., 2020), but the status of these hosts remains unclear. CRLV has been reported in asymptomatic or weakly symptomatic weed species, such as *Balsamorhiza sagittata, Taraxacum officinale* (Asteraceae) and *Plantago major* (Plantaginaceae) (Hansen *et al*., 1974).

The experimental host range of CRLV includes many domesticated and weedy species that are asymptomatic or express only minor symptoms including the plant families Amaranthaceae (*Atriplex hortensis, Gomphrena globosa*), Cucurbitaceae (*Cucurbita maxima*), Fabaceae (*Cyamopsis tetragonoloba, Phaseolus vulgaris, Sesbania exaltata*), Lamiaceae (*Ocimum basilicum*), and Solanaceae (*Nicotiana* spp., *Physalis floridana, Solanum betaceum, Solanum sisymbriifolium*) (Hansen *et al*., 1974). Other plants that express symptoms of mottle, lesions, and rings include the plant families Amaranthaceae (*Chenopodium album, C. giganteum, C. murale, C. quinoa*) and Cucurbitaceae (*Cucumis sativus*) (Hansen *et al*., 1974).

Host list:

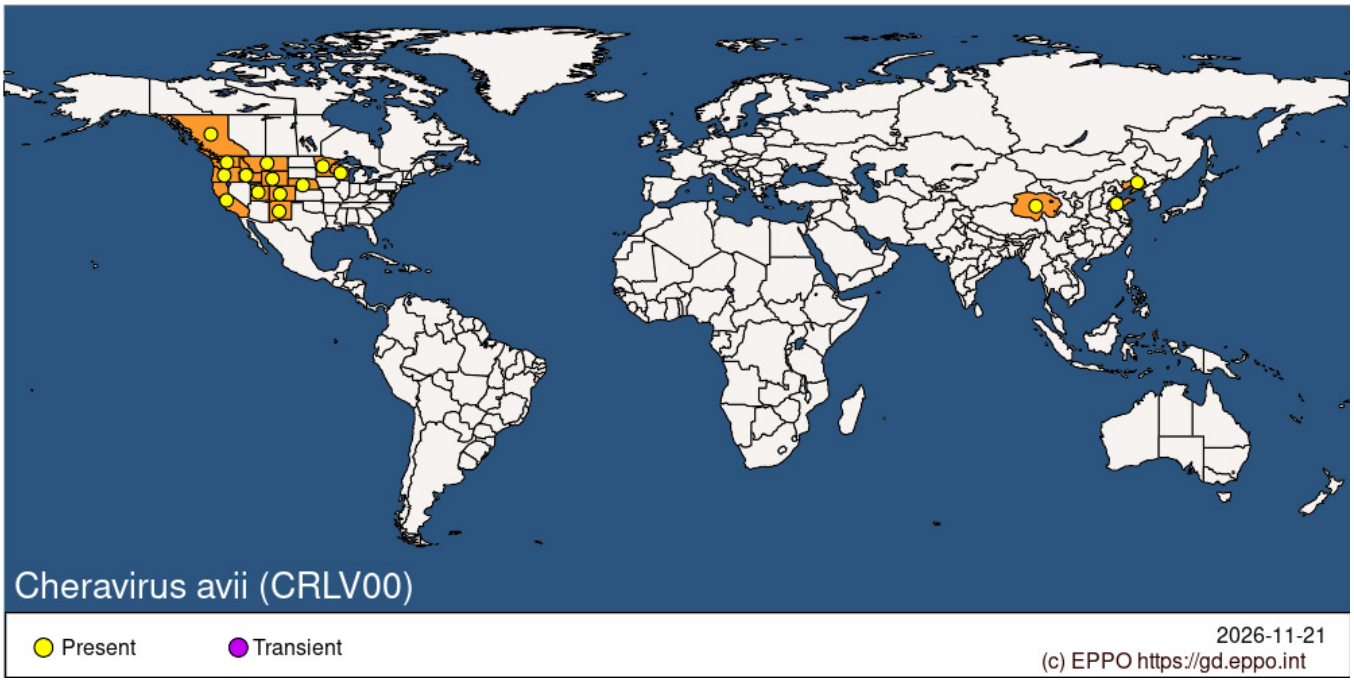
Balsamorhiza sagittata, *Malus domestica*, *Malva sp.*, *Plantago major*, *Prunus avium*, *Prunus mahaleb*, *Prunus persica*, *Rubus idaeus*, *Sambucus nigra*, *Solanum lycopersicum*, *Solanum tuberosum*, *Taraxacum officinale*

GEOGRAPHICAL DISTRIBUTION

CRLV was first found in 1935 in Colorado, USA (Bodine and Newton, 1942). The virus is native to western North America where it is present over a wide geographic area. The virus is present primarily in the foothills west of the Rocky Mountains from Colorado, Utah and California, and north to southern British Columbia (Stace-Smith and Hansen, 1976).

In 2013 CRLV was detected in an asymptomatic sweet cherry (*Prunus avium*) orchard in Shandong province, China (Ma *et al*., 2014).

In 1960-1970, there were many reports on the detection of the CRLV on cherry plants in other parts of the world, based on the presence of rasp-leaf symptoms. But later, it was established, that leaf enation symptoms in cherry in both Europe and North America can also be caused by viruses other than CRLV, such as strains of *Prunus necrotic ringspot* virus or *Tomato ringspot virus* (Nyland, 1976). European cherry rasp leaf (Pfeffinger disease) is caused by a combination of *Prune dwarf virus* with either *Raspberry ringspot virus* or *Arabis mosaic virus* (Nyland, 1976). *Cherry leaf roll virus* has also been found to be associated with mild leaf enations in some cherry varieties (Wagnon *et al*., 1968). As a result, in the absence of definitive diagnostic testing, reports of CRLV in cherry outside of the known CRLV-infested areas of western North America should be considered as unconfirmed.



Asia: China (Liaoning, Qinghai, Shandong)
North America: Canada (British Columbia), United States of America (California, Colorado, Idaho, Minnesota, Montana, Nebraska, New Mexico, Oregon, Utah, Washington, Wisconsin, Wyoming)

BIOLOGY

CRLV is transmitted by the dagger nematodes *Xiphinema americanum sensu stricto*, *X. californicum* and *X. rivesi* (Brown *et al.*, 1992, 1993, 1994) and through budding and grafting. As with other nematode-vectored virus diseases, symptoms appear in localized areas of an orchard and tend to spread outward in a circular pattern.

Local transmission by nematodes and the presence of CRLV in weeds or other native hosts probably explain the slow spread of the disease and its presence over much of western North America (Hansen *et al.*, 1974). In Colorado,

a detailed survey of a sweet cherry orchard in which Cherry rasp leaf virus was present showed a 5% increase in the disease over a 6 year period (Luepschen *et al.,* 1974).

CRLV is readily transmitted by sap inoculation. Seed transmission at levels of 10-20% has been shown to occur in some herbaceous hosts, such as *Chenopodium quinoa* and *Taraxacum officinale.* However, seeds taken from infected parts of cherry trees failed to germinate (Hansen *et al*., 1974).

The virus has been detected in pollen from infected cherry trees, but transmission by pollen has not been confirmed (Jones, 1987).

DETECTION AND IDENTIFICATION

Symptoms

On peaches and cherries

Leaves of cherries and peaches infected with CLRV become deformed, narrow, folded, puckered or distorted, shortening of the internodes, and a general decline of the tree (Stace-Smith and Hansen, 1976). On the underside of the leaves between the lateral veins and along the midrib develop prominent leaflike growths called enations can be observed. Affected leaves are distorted but remain green.

The virus spreads slowly within infected trees so symptoms are often sporadic and may not appear on all leaves or shoots. Symptoms begin on the lower part of the tree and move upward as the virus spreads. Because fewer leaf buds develop on infected wood, limbs become bare near the base of the tree, while leaves higher up develop rasp leaf symptoms.

Hansen (1995) indicated that all cherry cultivars seem to react similarly.

On apples

The leaf symptom consists of a rolling of the leaf margins toward the midrib, they become small, long and narrow and appear to be dry (Blodgett *et al*., 1963) . The leaves also tend to point toward the terminus of the spur or shoot. The resulting appearance is one of water stress or drought. The fruit is flattened along the longitudinal axis, but has a normal seed count. The calyx basin is more prominent and the stem cavity is shallow. Reaction severity varies considerably among cultivars. Symptoms of flat apple occur mainly on cultivars Delicious, Golden Delicious, Jonagold and Gala. Cultivars Fuji, Empire and Granny Smith exhibit relatively mild symptoms (Hansen and Parish, 1990).

On Rubus

Infection is symptomless (Jones *et al*., 1985).

Morphology

CRLV is a RNA-virus. CRLV has isometric particles ca 28-30 nm in diameter which contain bipartite single-stranded RNA (Stace-Smith, Hansen, 1976). RNA-1 and RNA-2 consists of 6992 and 3274 nucleotides, respectively (James, Upton, 2002, 2005; James, 2004).

Detection and inspection methods

Infection can be confirmed by sap inoculation to herbaceous indicators (ISHS, 1980). *Chenopodium quinoa* and *C. murale* are the most reliable indicator species. Commercial ELISA kits to CRLV have been produced by Nano Diagnostics and Creative Diagnostics (both in the USA) to be used for DAS-ELISA. The Nano Diagnostics kit can be used to detect CRLV in cherry and other woody plants as well as herbaceous host plants.

Both conventional RT-PCR and real-time RT-PCR tests are available. For conventional RT-PCR, a test to amplify the vp24 gene of CRLV RNA2 the primer pairs vp24F (5'-GGCCCTGACCCTTTTTCCTTTCATTTG-3') and vp24R (5'-GGTGTACTCAGCTTTGAGGGCTC-3') can be used. DNA fragments of ca.580 bp are amplified (Ma *et al*., 2014).

A pair of primers was also identified that reliably detected CRLV-FA. The primers FAVR1-7F (5?TGA CTT TCC CAA GGA TGA GA 3?) and FAVR1-8R (5?GTG ACA TAC CAT AGA TCC 3?) target the putative RNA-dependent RNA polymerase gene of CRLV-FA RNA-1, and amplify a 447 bp fragment (James, 2005).

For real-time RT-PCR the primers CRLVnew-5565f / CRLVnew-5630r and probe CRLVnew-5585p can be used against the CP-gene of the virus (Osman, 2017).

PATHWAYS FOR MOVEMENT

The main pathway for CRLV is international movement of infected host plants for planting, mainly cherry, peach, and apple trees. The virus has been intercepted several times in imported plant material from North America, e.g. in Scotland (Jones *et al.*, 1985).

CRLV is disseminated only slowly by its nematode vectors. Unless assisted by moving water or soil, the nematode vector can only move short distances (for example, 1 m per year (Smith *et al*., 1997)). The virus could possibly be carried by the nematode vector in soil accompanying plants, although the nematode is prone to desiccation and does not survive for long periods in dry soil.

PEST SIGNIFICANCE

Economic impact

Cherry rasp leaf disease caused by CRLV infects a range of economically important plants (Osman, 2017).

CRLV causes serious stunting in peach trees, and fruit yield and quality reductions in cherries and apples. Infected spurs and branches usually die, giving the tree an open, bare appearance and reducing fruit production. Infected trees show a general decline and increased levels of winter injury mortality. Young infected trees show retarded development and often die (Luepschen *et al*., 1974; Nyland, 1976; Stace-Smith and Hansen, 1976).

Because of its slow spread, the disease is mainly a nuisance in nuclear stock propagation. However, it can reach high levels of infection in older orchards. In older orchards, CRLV can reach high levels of infection, and trees planted on previously infected sites can also become infected for example in cherry-producing districts of Colorado high incidences of the virus were found (23% and 38% of infected trees) (CABI).

CRLV could be troublesome in nuclear stock propagation, probably throughout the EPPO region. Rootstocks and some scion cultivars may not show obvious symptoms. None were seen on raspberries known to be infected.

Control

Prevention of introduction and spread of CRLV is the main method of control. For control of CRLV, using certified and healthy planting material is essential. To prevent spread of the virus, infected plants should be immediately removed.

Broadleaf weed control and soil-fumigation to reduce populations of vector-nematodes are effective in helping to control the disease (Ogawa and English, 1991).

CRLV (flat apple isolate) can be eliminated from apple trees by heat therapy. Virus elimination was confirmed by RT-PCR analysis of first and second year growth of heat-treated plants. Fruit and leaves produced by trees subjected to heat therapy were normal in appearance (James *et al*., 2001).

Phytosanitary risk

The potential of CRLV in the EPPO region depends on the introduction of its nematode vector *Xiphinema americanum* or on the possibility of its transmission by related nematode species. The A2 listing of *X. americanum* by EPPO is to a large extent based on the virus risk, rather than on any direct risk from the nematode.

PHYTOSANITARY MEASURES

CRLV is listed as an A1 pest recommended for regulation as a quarantine pest by EPPO (since 1978) (EPPO, 1984), IAPSC (1989), EAEU (2016), it is an A1 Quarantine pest (Annex II A) for EU (2019) and listed as an A2 quarantine organism for COSAVE (2018).

Imported propagating material of host plants should have been subject to a visual growing-season inspection. If such material is imported from countries where the virus is present, it should originate from a pest-free area or from a certification scheme giving appropriate guarantees. EPPO recommends such a certification scheme, for use within the region, but it could readily be extended to other regions. EPPO Standards (PM 4/10, PM 4/27, PM 4/29 and PM 4/30) describe in detail the production of pest-free material of *Rubus* spp., *Malus* spp., *Prunus avium* and *Prunus persica*. (EPPO, 1999, 2001a, 2001b, 2009a). Measures should also be taken against the nematode vector *X. americanum* including soil testing (EPPO, 2009b).

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CABI and EFSA resources used when preparing this datasheet

CABI Datasheet on Pest Cherry rasp leaf virus (cherry rasp leaf). https://www.cabi.org/cpc/datasheet/16197

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Datasheet history

This datasheet was first published in the EPPO Bulletin in 1983 and revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 1997. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', 'Hosts', and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

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