EPPO Datasheet: *Curtovirus betae*

Last updated: 2023-05-11

IDENTITY

Preferred name: *Curtovirus betae*
Taxonomic position: Viruses and viroids: Monodnaviria: Shotokuvirae: Cressdnaviricota: Repensiviricetes: Geplafuvirales: Geminiviridae
Other scientific names: *BCTV, Beet curly top curtovirus, Beet curly top virus, Beet mild curly top virus, Beet severe curly top virus, Cal/Logan BCTV, Colorado BCTV, Pepper curly top virus, Pepper yellow dwarf virus, Potato green dwarf virus, Sugarbeet curly leaf virus, Sugarbeet virus 1, Tomato yellows virus, Western yellow blight virus, Worland 4 BCTV*
Common names: curly leaf of sugarbeet, curly top of beet, curly top of sugarbeet, green dwarf of potato, western yellow blight, yellows of tomato
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EPPO Categorization: A1/A2 (formerly)
view more categorizations online...
EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II A)
EPPO Code: BCTV00



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Notes on taxonomy and nomenclature

Varsani *et al.* (2014) redefined curtoviruses from many separate viruses into a single virus, *Beet curly top virus*, with many strains. There are currently many strains of beet curly top virus that differ in symptomatology and severity on hosts including BCTV-Svr, BCTV-Mld, BCTV-Wor, BCTV-PeCT, BCTV-PeYD, BCTV-SpCT, BCTV-CO (Lam *et al.*, 2009; Chen *et al.*, 2010; Varsani *et al.*, 2014; Chen *et al.*, 2017; Strausbaugh *et al.*, 2017; Peinado *et al.*, 2018).

Curtoviruses contain 7 ORF (open reading frames) or coding regions, with 3 on the virion sense DNA strand and 4 on the complimentary sense strand. They also contain a conserved stem loop intergenic region. A related virus group, becurtoviruses are also members of the family Geminiviridae (Heydarnejad *et al.* 2013). Members of this group include Beet curly top Iran virus (BCTIV) and Spinach curly top Arizona virus (SCTAV). Becurtoviruses have 5 ORFs with 3 on the virion sense strand that are closely related to the corresponding ORFs of curtoviruses, and 2 ORFs on the complementary-sense strand that lack any similarity. Becurtoviruses have a slightly different sequence from curtoviruses in their stem loop intergenic region.

HOSTS

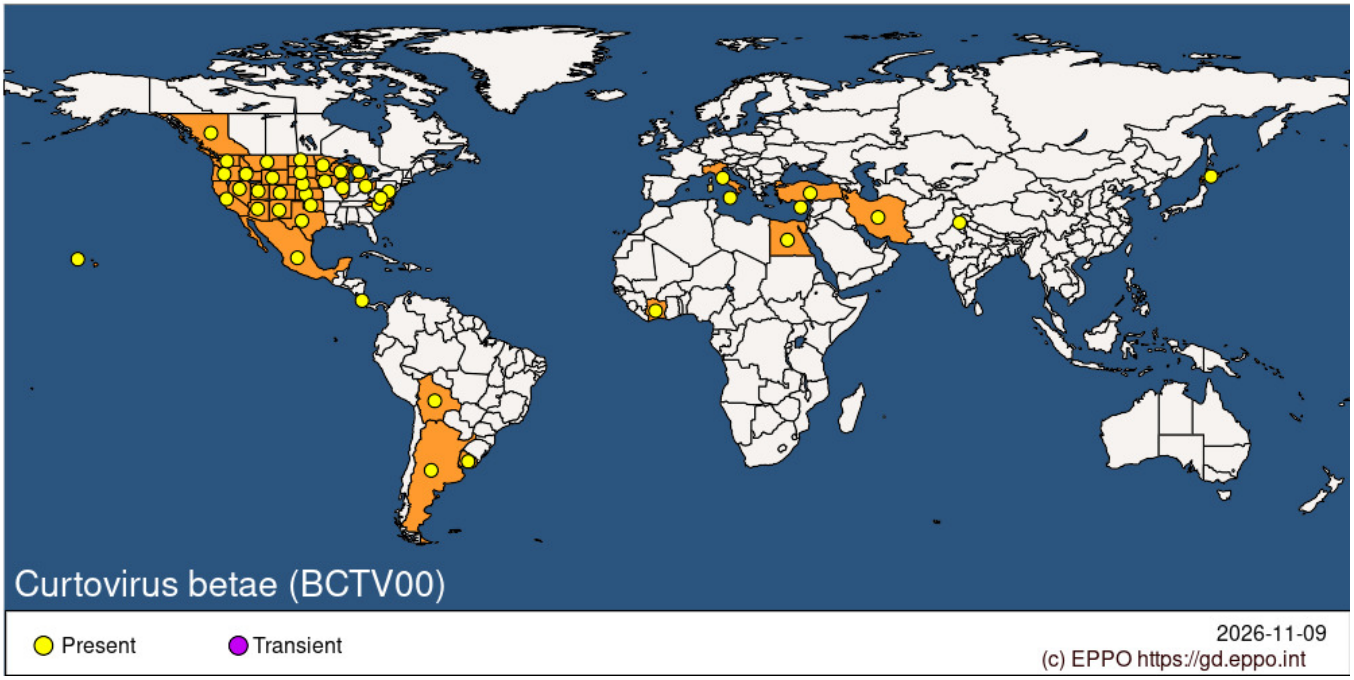
BCTV has an extremely wide host range, but its most economically important crop hosts are bean (*Phaseolus vulgaris*), common coriander (*Coriandrum sativum*), cucurbits, peppers (*Capsicum* spp.), potato (*Solanum tuberosum*), spinach (*Spinacia oleracea*), sugarbeet (*Beta vulgaris*) and tomato (*Solanum lycopersicum*) (Bennett, 1971; Creamer *et al.*, 2003; Strausbaugh *et al.*, 2008, Chen *et al.*, 2010; Chen & Gilbertson, 2016). In addition to its crop hosts, a number of other species, including weeds, in many families are reported as hosts, including in Asteraceae, Brassicaceae, Chenopodiaceae, Geraniaceae and Solanaceae.

Host list: *Acmispon americanus, Acmispon strigosus, Amaranthus deflexus, Amaranthus graecizans, Amaranthus retroflexus, Armoracia rusticana, Atriplex argentea var. expansa, Atriplex bracteosa, Atriplex fruticulosa, Atriplex patula, Atriplex rosea, Bassia scoparia, Beta vulgaris, Brassica oleracea var. capitata, Brassica rapa, California macrophylla, Cannabis sativa, Capsella bursa-pastoris, Capsicum annuum, Capsicum baccatum, Capsicum chacoense, Capsicum chinense, Capsicum frutescens, Celosia argentea, Chenopodiastrum murale, Chenopodium leptophyllum, Citrullus lanatus, Coreopsis tinctoria, Coriandrum sativum, Cosmos bipinnatus, Cucumis melo, Cucurbita pepo, Datura ferox, Dianthus plumarius, Dysphania ambrosioides, Erodium botrys, Erodium cicutarium, Gnaphalium chilense*

, Lasthenia minor, Lepidium nitidum, Malva parviflora, Malva pusilla, Medicago polymorpha, Microseris douglasii, Mirabilis jalapa, Modiola caroliniana, Monolepis nuttalliana, Moricandia arvensis, Pelargonium x hortorum, Persicaria amphibia, Persicaria lapathifolia, Persicaria maculosa, Petroselinum crispum, Petunia hybrids, Phacelia ramosissima, Phaseolus vulgaris, Physalis acutifolia, Plantago erecta, Polygonum aviculare, Raphanus sativus, Scabiosa atropurpurea, Solanum douglasii, Solanum lycopersicum, Solanum tuberosum, Sonchus asper, Spinacia oleracea, Streptanthus lasiophyllus, Tropaeolum majus, Viola cornuta, Viola tricolor, Xanthium spinosum, Xerochrysum bracteatum, Zinnia elegans

GEOGRAPHICAL DISTRIBUTION

BCTV is thought to have originated in the eastern Mediterranean area and to have spread from there to America (Bennett, 1971). The virus has been widely recorded from Canada to Mexico, and there are also records in other parts of the world.



EPPO Region: Cyprus, Italy (mainland, Sicilia), Türkiye
Africa: Cote d'Ivoire, Egypt
Asia: India (Punjab), Iran, Islamic Republic of, Japan (Hokkaido)
North America: Canada (British Columbia), Mexico, United States of America (Arizona, California, Colorado, Hawaii, Idaho, Illinois, Iowa, Kansas, Maryland, Michigan, Minnesota, Montana, Nebraska, Nevada, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, South Dakota, Texas, Utah, Virginia, Washington, Wisconsin, Wyoming)
Central America and Caribbean: Costa Rica
South America: Argentina, Bolivia, Uruguay

BIOLOGY

The virus is not easily transmitted by mechanical means. BCTV is primarily found in phloem tissue, where it causes necrosis and hyperplasia (Bennett, 1971). Virus replication occurs in the plant nucleus.

The vectors of BCTV are phloem-feeding leafhoppers. *Circulifer (=Neoaliturus) tenellus* is the only vector of BCTV in North America, while in the Middle East, *C. opacipennis* and *C. haematoceps* have also been reported as vectors (Kheyri and Alimoradi, 1969; Taheri *et al.*, 2012). The virus is transmitted in a persistent circulative manner and does not multiply in the leafhopper vector. The leafhoppers can acquire the virus within 1 hour of feeding on infected material, with a 4-hour latent period sufficient to transmit the virus. The leafhoppers can retain the virus for up to 30

days (Soto & Gilbertson, 2003).

Many strains differing in virulence, symptomatology and host range have been reported, especially in North America (Thomas & Mink, 1979).

DETECTION AND IDENTIFICATION

Symptoms

Some symptoms induced by BCTV infection, such as plant stunting and thickened curled leaves are similar throughout its host range (Bennett, 1971).

In sugarbeet, the most reliable, early diagnostic feature is an inward rolling of the leaf margins and a clearing of the minute veins on the youngest, innermost leaves. Subsequently, development of pin prick-like protuberances on the veins of the lower leaf surfaces is characteristic. Leaves often become chlorotic, thick, crisp and brittle.

In tomatoes in the field, there is an inward rolling of leaflets along the midrib; the petiole and midrib frequently curve downwards, giving the leaf a drooping but not wilting appearance. Leaves become thickened and crisp and may later turn yellow with purple veins. Fruits, if formed, ripen prematurely and seeds are abortive. Leaves of tomato plants grown in glasshouses lack the purple venation. Inward curling of leaflets occurs, especially in older plants. There is a marked stunting of plants infected at an early stage, leading to whole plant chlorosis and possible death.

In other crops, in addition to stunting of plants and thickened curled leaves, symptoms include:

- - on peppers, chlorosis, crisp brittle leaves, stiff plant stems, lack of fruit set, and small rounded fruit if infection occurs after fruit set. Plants do not grow taller after infection (Creamer, 2003).
- - on cucurbits, stunting of leaves, poor fruit set, and sometimes increased vertical growth.
- - on bean, stunting and curling of leaves. Some bean varieties show chlorosis and reduced fruit set.
- - on spinach and other leafy vegetables, stunting and curling of leaves, and chlorosis.
- - on potato, yellowish, inward-rolled leaflets and sometimes a bending of the petioles. In advanced stages of infection, dwarfed shoots frequently develop in the axis of leaves near the tip of the plant. Infected plants can become chlorotic and die. - on hemp (*Cannabis sativa*), symptoms vary, but include stunted plants with thin curled leaves, chlorosis, mottling, and thickened bushy plants with symptoms differing among plants and locations (Giladi *et al.*, 2020; Chiginsky *et al.*, 2021).

Weed hosts rarely show distinctive symptoms of BCTV infection (Creamer *et al.*, 1996).

Morphology

Small geminate particles 18-22 nm in diameter, single or paired (geminivirus) (Thomas & Mink, 1979).

Detection and inspection methods

Detection of BCTV infection is based on specific symptoms on each crop host. Detection of BCTV is possible using polymerase chain reaction (PCR) with virus-specific primers based on the capsid region (Creamer *et al.*, 2005; Chen *et al.*, 2010), which will detect most strains of BCTV (except BCTV-PeCTV), and does not cross-react with

becurtoviruses. PCR can also be carried out with strain-specific primer sets (Chen *et al.*, 2010). BCTV can also be detected by ELISA using virus-capsid specific antibodies (Durrin *et al.*, 2010), which, as for the PCR on the capsid region, will react with most strains of BCTV (but not all) and will not cross-react with becurtoviruses.

PATHWAYS FOR MOVEMENT

BCTV is moved locally by its insect vectors. Internationally, it may be carried in infected host material, or possibly in the vector. There are no reports of the virus being seed-borne or tuber-borne and, therefore, such plant parts are not considered as possible infection sources.

Although seedlings of sugarbeet and tomato may be traded, they are less likely to be infected than mature plants and they show distinct symptoms when infected. In addition, tomato and pepper plants are poor sources for virus acquisition by the leafhopper vectors because they are not preferred hosts (Hudson *et al.*, 2010). Infected sugarbeet roots intended for planting, including breeding stocks, could potentially be a pathway.

PEST SIGNIFICANCE

Economic impact

The disease was first recognized causing important damage in 1888, in Nebraska (USA), and has since caused frequent and often very destructive outbreaks throughout the Western USA. Economic impact varies by location and crop in the Western USA, with periodic severe outbreaks in California in tomatoes, in New Mexico in peppers, in Colorado in tomatoes and hemp, and in Wyoming and Idaho in sugarbeets (Creamer *et al.*, 2003; Strausbaugh *et al.*, 2008; Chen & Gilbertson, 2016). Some strains are currently found only in a limited geographic region. Other strains are only found infecting certain crop plants and weeds. Some strains only cause symptoms on certain crop hosts. Infection rate may be above 50% per field in a certain years, with an infected plant producing no yield for tomatoes and peppers, and reduced sugar content for sugarbeets. In the EPPO region, in contrast, BCTV is not considered a significant pest. In Türkiye, beet curly top Iran becurtovirus was recently reported as the main viral agent responsible for beet curly top disease in sugarbeets (Yildirim *et al.*, 2023).

Control

Management of the virus is possible through a combination of measures, which is dependent on location and crop. Insecticide sprays to control the vector are applied in the breeding areas of the leafhoppers in California in the spring and in and around crop fields when leafhopper levels increase (CDFA, 2019). The disease is managed in sugarbeet through the use of seed-applied systemic insecticides (Strausbaugh *et al.*, 2012). There is some reported resistance to the virus in bean (*Phaseolus vulgaris*, dry bean type - Larsen *et al.*, 2010), while resistance has been identified in wild sugarbeet relatives (Eujayl *et al.*, 2018). Cultural controls, such as changing planting date, overseeding with late thinning, kaolin clay applications and improved weed management have been used in peppers (Creamer *et al.*, 2005).

Phytosanitary risk

BCTV used to be an EPPO A2 quarantine pest (EPPO, 1982), on the basis of the reported problems in North America. However, in view of the probable origin of the virus in the eastern Mediterranean area, its presence in several Mediterranean countries, its failure to spread in the EPPO region, the limited natural distribution of its vectors and its very minor importance in Europe, it was deleted from the EPPO list in 1984. There is a certain danger that severe strains of the virus could spread into the EPPO region in areas where sugarbeets, tomatoes and peppers are grown. The risk is highest in areas with warm dry climates where the leafhopper vector could become established on weed hosts.

PHYTOSANITARY MEASURES

Plants for planting of *Beta vulgaris* are the main pathway for entry of the virus (see Pathways for movement). The EU requires that, for plants for planting of *Beta vulgaris* (other than seeds), no symptoms of BCTV should have been

observed at the place of production since the beginning of the last complete cycle of vegetation (EU, 2023). Only plants with roots are relevant for phytosanitary requirements, as seeds and tubers do not carry the virus.

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Datasheet history

This datasheet was first published in the EPPO Bulletin in 1982 and revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 1997, as well as in 2019. 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.

CABI/EPPO (1992/1997) *Quarantine Pests for Europe (1st and 2nd edition)*. CABI, Wallingford (GB).

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