EPPO Datasheet: *Caulimovirus venafragariae*

Last updated: 2023-03-08

IDENTITY

Preferred name: *Caulimovirus venafragariae*
Taxonomic position: Viruses and viroids: Riboviria: Pararnavirae: Artverviricota: Revtraviricetes: Ortervirales: Caulimoviridae
Other scientific names: *SVBV, Strawberry vein banding caulimovirus, Strawberry vein banding virus, Strawberry virus 5*
Common names: leaf curl of strawberry, vein banding of strawberry
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EPPO Categorization: A2 list
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EU Categorization: RNQP ((EU) 2019/2072 Annex IV)
EPPO Code: SVBV00



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Notes on taxonomy and nomenclature

Strains of *Strawberry vein banding virus* (SVBV) that have been identified include: strawberry yellow veinbanding virus, strawberry necrosis virus (Schöninger), strawberry chiloensis veinbanding virus, strawberry eastern veinbanding virus. In North America, most strains found on the west coast are more severe than those found along the east coast.

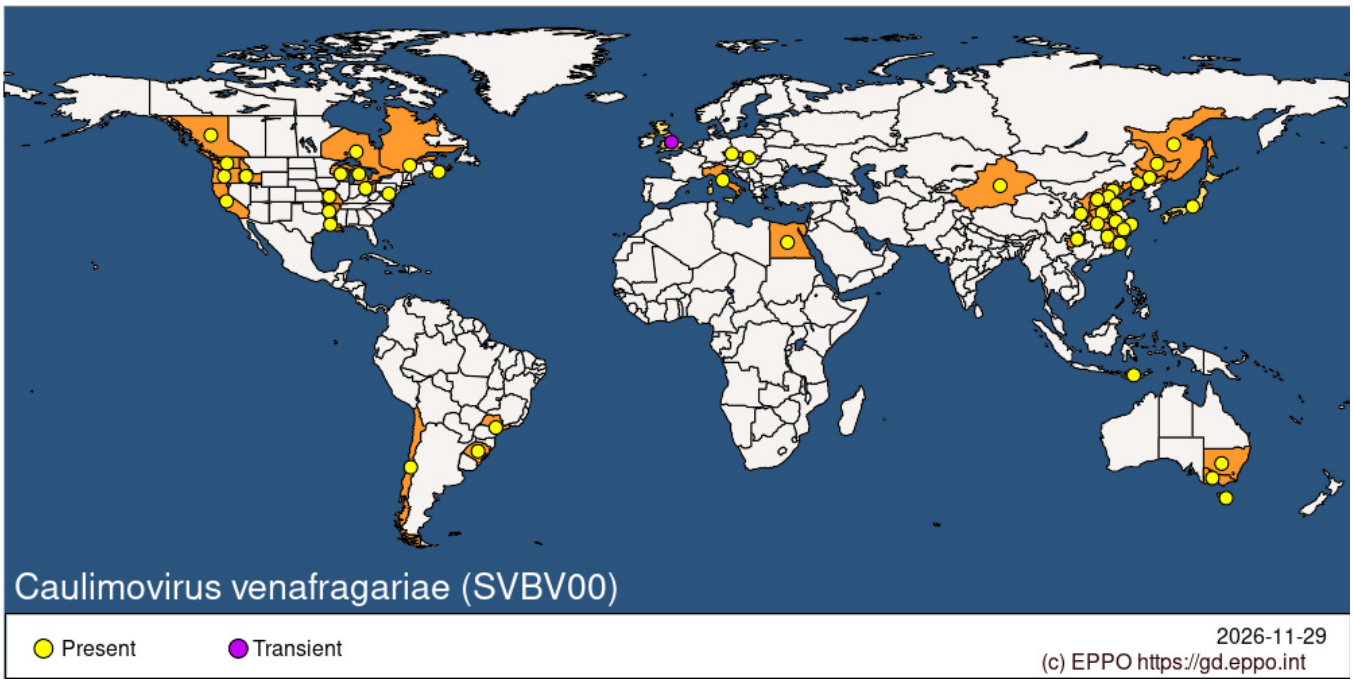
HOSTS

The virus is known to occur only on *Fragaria* spp. The main host is *Fragaria vesca* (wild strawberry). Commercial strawberries may also be infected.

Host list: *Fragaria chiloensis subsp. chiloensis, Fragaria vesca, Fragaria virginiana, Fragaria x ananassa*

GEOGRAPHICAL DISTRIBUTION

The distribution of SVBV shown on the map below is mainly based on references that used nucleic acid-based detection techniques (PCR and western hybridization), but it still contains several records of SVBV made before 1995 that were based solely on disease symptoms. These records have to be considered critically and require further confirmation



EPPO Region: Czechia, Italy (mainland), Russian Federation (Far East), Slovakia, United Kingdom
Africa: Egypt
Asia: China (Anhui, Beijing, Fujian, Guizhou, Hebei, Heilongjiang, Henan, Hubei, Jiangxi, Jilin, Liaoning, Shaanxi, Shandong, Shanghai, Shanxi, Xinjiang, Zhejiang), Indonesia (Nusa Tenggara), Japan
North America: Canada (British Columbia, Nova Scotia, Ontario, Québec), United States of America (Arkansas, California, Idaho, Louisiana, Maryland, Michigan, Missouri, Ohio, Oregon, Washington, Wisconsin)
South America: Brazil (Rio Grande do Sul, Sao Paulo), Chile
Oceania: Australia (New South Wales, Tasmania, Victoria)

BIOLOGY

In the field, SVBV is transmitted by aphids in a semipersistent manner, and the following species are cited as vectors: *Acyrthosiphon malvae malvae (*syn. *Macrosiphum pelargonii)*, *Amphorophora rubi*, *Amphorophora agathonica, A. rubifolii*, *Aulacorthum solani*, *Chaetosiphon fragaefolii*, *C. jacobi*, *C. tetrarhodum*, *C. thomasi*, *Macrosiphum rosae*, *Myzus ascalonicus*, *M. ornatus*, *M. persicae*.

Of these species, *Chaetosiphon* spp. are the most efficient vectors in glasshouse experiments, although other genera are probably important vectors when they occur in large numbers and frequently move from plant to plant. Aphids can acquire and transmit the virus in 30-120 min, but persistence in the vector is short, usually less than 8 h (semipersistent type). There are differences in the efficiency of clonal lines of aphids, and evidence that some species will only transmit certain strains of SVBV. *Aphis gossypii*, *A. fabae*, *Aulacorthum solani* and *Macrosiphum euphorbiae* failed to transmit the virus in a limited number of trials.

The virus is transmissible by grafting and by means of *Cuscuta subinclusa*. Attempts to transmit SVBV mechanically have been unsuccessful. The incubation period in the indicator host varies from 2 to 5 weeks depending on the strain.

For additional information, see Frazier (1955), Miller & Frazier (1970), Smith (1972).

DETECTION AND IDENTIFICATION

Symptoms

On Fragaria vesca

Symptoms initially appear on the youngest developing leaf; there is epinasty of the midrib and petiole, a tendency for opposite halves of leaflets to be appressed, irregularly wavy leaflet margins, and slight crinkling of the laminae. Usually, the above symptoms are mild and not all present simultaneously. It is not until the affected leaf expands that clearing, followed by yellowish banding of some or all of the veins, becomes visible. Often, the coloration occurs in scattered discontinuous streaks of varying lengths along the main and secondary veins.

The second and third leaves formed after onset of symptoms are affected more severely than the first or any subsequent leaf; in older leaves, chlorotic streaks are reduced in number, scattered and confined to portions of the leaflets. This may be followed by the appearance of a series of apparently healthy leaves and then reappearance of mild or severe symptoms.

For additional information, see Frazier (1955), Mellor & Fitzpatrick (1961), Miller & Frazier (1970), Smith (1972) and Frasier & Converse (1980).

On commercial strawberries

SVBV usually does not induce distinct symptoms in commercial cultivars, and often the only indications of infection are loss of vigour, stunting, lowered yields of a cultivar. In the cv. Marshall, for example, the veinbanding is usually diffuse, commonly located along main veins and may often appear as spots. As affected leaves mature, the veinbanded areas may gradually disappear, or they may become brownish-red or necrotic. In particular on outdoor plants, the veins become discoloured, without previous chlorosis. Affected leaflets characteristically exhibit epinasty, mild crinkling and wavy margins. SVBV rarely occurs singly in strawberry; frequently several viruses are present, and together they cause more severe reductions in productivity (Spiegel and Martin, 1998). Symptoms may be more severe in combination with the strawberry crinkle virus (Martin & Tzanetakis, 2006).

Morphology

The particle of this caulimovirus is isometric (40-50 nm in diameter). Native viral DNA is circular and double-stranded (Stengel *et al*., 1988).

Detection and inspection methods

Diagnosis can be made or confirmed by use of virus-free *F. vesca* indicator plants. The *F. vesca* clone UC-6, the *F. virginiana* clone UC-12 and *F. vesca semperflorens* are recommended for detecting and diagnosing SVBV (Converse, 1987). A modified leaf grafting technique is used (Frazier, 1974).

An ELISA test can be performed using Cauliflower mosaic virus antisera which cross-reacts with SVBV (Honetslegrova *et al*., 1995). However, no SVBV specific antiserum or commercial ELISA kit is available because of low yield of SVBV virus particles embedded in inclusion bodies and their low immunogenicity. Cloning and prokaryotic expression of SVBV genes seems to be a promising state-of-the-art method for the production of specific antisera in future (Jiang *et al*., 2020)

SVBV variability has been studied extensively. Several full length (Petrzik *et al.*, 1998) and dozens of partial sequences have been published in databases and molecular biology-based methods give the best detection results. The gene coding for the coat protein of the virus is highly conserved, and SVBV can be detected readily by PCR using primers in the coat protein open reading frame. Nucleic acid isolation from fresh plant tissue was the best template for PCR, and primers amplifying the shortest product should be recommended. Vaskova *et al.* (2004) developed a test for the detection of SVBV in *Fragaria* spp. based on nucleic acid sequence-based amplification (NASBA) and real-time detection using molecular beacons (real-time NASBA). Several multiplex RT-PCR (Thompson *et al*., 2003; Zhang *et al*., 2009) as well as quantitative PCR (q-PCR) (Diaz-Lara et al., 2021) and loop-mediated isothermal amplification (LAMP) (Ren *et al*., 2022) tests were developed for routine detection of SVBV.

PATHWAYS FOR MOVEMENT

In the field, the virus is transmitted by aphid vectors. Because of the ability of certain aphid species to undertake

long, high-altitude flights, wide natural dissemination is possible. This is, however, limited by the relatively short persistence of the virus in the vector.

In international trade, SVBV is liable to be carried on infected plants and propagating material of strawberries.

PEST SIGNIFICANCE

Economic impact

Because of the sporadic occurrence and low incidence of SVBV, the disease is only of minor importance but under extreme aphid pressure, the incidence can approach 100% in third-year fields (Martin & Tzanetakis, 2006). Fruit yield and size are affected, and runner production reduced. In combination with strawberry latent C disease, SVBV reduced yield by 17% in the first fruiting year, and total and saleable fruit by 88% and 100%, respectively, in the third year (Bolton, 1974; EPPO/CABI 1996).

Control

There are no specific control measures (Martin & Tzanetakis, 2013). Nevertheless, it is important, even in annual production systems, to control the aphid vectors (primarily *Chaetosiphon fragaefolii*) in order to reduce virus infections (Martin & Tzanetakis, 2006). SVBV is highly resistant to inactivation by heat therapy but it can be eliminated from plants by means of meristem tip culture. As a consequence, the use of certified planting material is the best control procedure, and certification schemes for the production of healthy planting material of strawberry are in operation in several EPPO countries. An EPPO certification scheme for strawberries is available and provides guidelines on how to produce healthy planting material (EPPO, 2008). Control of aphids with insecticides could reduce the incidence of the disease.

Phytosanitary risk

The most important factors in evaluating the potential impact of SVBV in a new area are the presence of aphid vectors and their mobility. Because of the variety of vectors, conditions can be defined only in so far as they affect aphids in general, e.g. extremely low winter temperatures killing overwintering nymphs and adults; windy climates restricting activity of alatae. In its evaluation for the European Union, EFSA (2014) considered that SVBV presented a minor risk to strawberry production under the current cultivation practices, in particular with the use of certified planting material and short crop cycles which have reduced the impact of strawberry viruses. EFSA concluded that SVBV met the criteria of a regulated non-quarantine pest (RNQP).

PHYTOSANITARY MEASURES

Importing countries may require that plants for planting of *Fragaria ananassa*, from countries where the pest occurs, should be derived from mother plants tested and found free from SVBV during the last three growing seasons and should have been maintained under conditions preventing their reinfection; the consignment must come from a field found free (along with its immediate vicinity) of the virus during the last growing season.

REFERENCES

Bolton AT (1974) Effects of three virus diseases and their combinations on fruit yield of strawberries. *Canadian Journal of Plant Science* **54**, 271-275.

CABI Compendium on Strawberry vein banding virus (vein banding of strawberry) (2021). https://doi.org/10.1079/cabicompendium.52407

Converse RH (Editor) (1987) *Virus diseases of small fruits*, 277 pp. *USDA Agriculture Handbook* No. 631.

Diaz-Lara A, Stevens KA, Klaassen V, Hwang, MS & Al Rwahnih M (2021) Sequencing a strawberry germplasm

collection reveals new viral genetic diversity and the basis for new RT-qPCR assays. *Viruses* **13**, 1442. https://doi.org/10.3390/v13081442

EFSA (2014) Scientific Opinion on the pest categorisation of Strawberry vein banding virus. *EFSA Journal* **12**(7), 3772. https://doi.org/10.2903/j.efsa.2014.3772

EPPO (2008) Certification scheme for strawberry. *EPPO Bulletin* **38**, 430–437.

EPPO/CABI (1996) Strawberry latent C 'rhabdovirus'. In: *Quarantine pests for Europe*. 2nd edition (Ed. by Smith IM, McNamara DG, Scott PR, Holderness M). CABI, Wallingford, UK.

Frazier NW (1955) Strawberry veinbanding virus. *Phytopathology* **45**, 307-312.

Frazier NW (1974) Detection of graft-transmissible diseases in strawberry by a modified leaf grafting technique. *Plant Disease Reporter* **58**, 203-207.

Frasier NW & Converse RR (1980) Strawberry vein banding virus- CMI/AAB Descriptions of Plant Viruses No. 219.

Honetslegrova J, Mraz I & Spak J (1995) Detection and isolation of Strawberry vein banding virus in the Czech Republic. *Acta Horticulturae* **385**, 29-32.

Jiang L, Xia WW, Shan WH, Jiang XZ, Zhang XX, Jiang T (2020) Cloning, prokaryotic expression and antiserum preparation of gene ORF I of Strawberry vein banding virus. *Acta Phytopathologica Sinica* **50**, 122-125.

Martin RR & Tzanetakis IE (2006) Characterization and recent advances in detection of strawberry viruses. *Plant Disease* **90**, 384-396. https://doi.org/10.1094/PD-90-0384

Martin R R & Tzanetakis IE (2013) High risk strawberry viruses by region in the United States and Canada: implications for certification, nurseries, and fruit production. *Plant Disease* **97**, 1358-1362.

Mellor FC & Fitzpatrick RE (1961) Strawberry viruses. *Canadian Plant Disease Survey* **41**, 218-255.

Miller PW & Frazier NW (1970) In: *Virus diseases of small fruits and grapevines, a handbook* (Ed. by Frazier, NW), pp. 8-10. University of California, Berkeley, California, USA.

Rojas R, Almada RD, Sandoval C, Keller KE, Martin RR & Caligari PDS (2013) Occurrence of aphidborne viruses in southernmost South American populations of *Fragaria chiloensis* ssp. *chiloensis. Plant Pathology* **62**, 428–435.

Petrzik K, Benes V, Mraz I, Honetslegrova-Franova J, Ansorge W & Spak J (1998) Strawberry vein banding virus-definitive member of the genus Caulimovirus. *Virus Genes* **16**, 303-305.

Smith KM (1972) *A textbook of plant virus diseases* (edition 3), 486 pp. Longman, London, UK.

Spiegel S & Martin RR (1998) Virus and Virus-like Diseases. In: Maas JL, ed. Compendium of strawberry diseases. St. Paul, USA: APS Press, The American Phytopathological Society, 62-63.

Stengel DC, Mullin RH & Morris TJ (1988) Isolation, molecular cloning, and detection of strawberry veinbanding virus DNA. *Phytopathology* **78**, 154-159.

Vaskova D, Spak J, Klerks MM, Schoen CD, Thompson JR & Jelkmann W (2004) Real-time NASBA for detection of strawberry vein banding virus. *European Journal of Plant Pathology* **110**, 213-221.

Thompson JR, Wetzel S, Klerks MM, Vaskova D, Schoen CD, Spak J &Jelkmann W (2003) Multiplex RT-PCR detection of four aphid-borne strawberry viruses in *Fragaria* spp. in combination with a plant mRNA specific internal control. *Journal of Virological Methods* **111**, 85-93.

Ren JD, Zhang JX, Wang QS, Zhou Y, Wang JX, Ran C & Shang QX (2022) Molecular characterization of strawberry vein banding virus from China and the development of loop-mediated isothermal amplification assays for

their detection. *Scientific Reports* **12**, 4912. https://doi.org/10.1038/s41598-022-08981-9

Zhang ZH, Chang LL, Yang HY, Xiao M, Li H & Dai HY (2009) Diagnosis and molecular analysis of strawberry viruses in China. *Acta Horticulturae* **842**, 187-190.

CABI resources used when preparing this datasheet

CABI Compendium on Strawberry vein banding virus (vein banding of strawberry). (2021) https://doi.org/10.1079/cabicompendium.52407

ACKNOWLEDGEMENTS

This datasheet was extensively revised in 2023 by Josef Špak, Biology Centre, Czech Academy of Sciences, Institute of Plant Molecular Biology. His valuable contribution is gratefully acknowledged.

How to cite this datasheet?

EPPO (2026) *Caulimovirus venafragariae*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int

Datasheet history

This datasheet was first published in the EPPO Bulletin in 1978 and revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 1997, as well as in 2023. 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).

EPPO (1978) EPPO data sheets on quarantine organisms No. 101, Strawberry vein banding virus. *EPPO Bulletin* **8** (2), 121-125. https://doi.org/10.1111/j.1365-2338.1978.tb02783.x



Co-funded by the European Union