

EPPO Datasheet: *Chrysomyxa arctostaphyli*

Last updated: 2023-11-20

IDENTITY

Preferred name: *Chrysomyxa arctostaphyli*

Authority: Dietel

Taxonomic position: Fungi: Basidiomycota: Pucciniomycotina:
Pucciniomycetes: Pucciniales: Coleosporiaceae

Other scientific names: *Melampsoropsis arctostaphyli* Arthur,
Peridermium coloradense Arthur & Kern

Common names: broom rust of spruce, common yellow witches'
broom rust

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EPPO Categorization: A1 list

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EU Categorization: A1 Quarantine pest (Annex II A)

EPPO Code: CHMYAR



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Notes on taxonomy and nomenclature

Chrysomyxa arctostaphyli is a basidiomycete fungus, a causal agent of spruce broom rust. It is also known by its synonym (*Melampsoropsis arctostaphyli*) and the anamorph's name (*Peridermium coloradense*). Historically, Arthur and Kern (1906) described two species of *Peridermium* (*P. coloradense* and *P. boreale*) for the spruce broom rust distinguishing species based on whether peridial cells overlap or not, and whether infected needles are adherent or not. Later, the rust on spruce (*Picea*) was thought to be conspecific with *Melampsorella caryophyllacearum* Schroet., the causal agent of broom rust on *Abies* (Crane, 2000). Then later, it was clarified that the spermogonial morphology of the specimens found on spruce is more consistent with a *Chrysomyxa* than with *Melampsorella* (Crane, 2000). Pady (1941, 1942) documented many differences between the morphology of the rusts on the two conifer hosts and maintained that they were different species with the same telial host. The connection between the telia on *Arctostaphylos* and the aecial state *Peridermium coloradense*, on spruce was finally proven experimentally by Peterson (1961) and confirmed by Ziller (1974). Currently, *C. arctostaphyli* is a well-defined and distinguishable species of the family Coleosporiaceae (Vogler & Bruns, 1998).

HOSTS

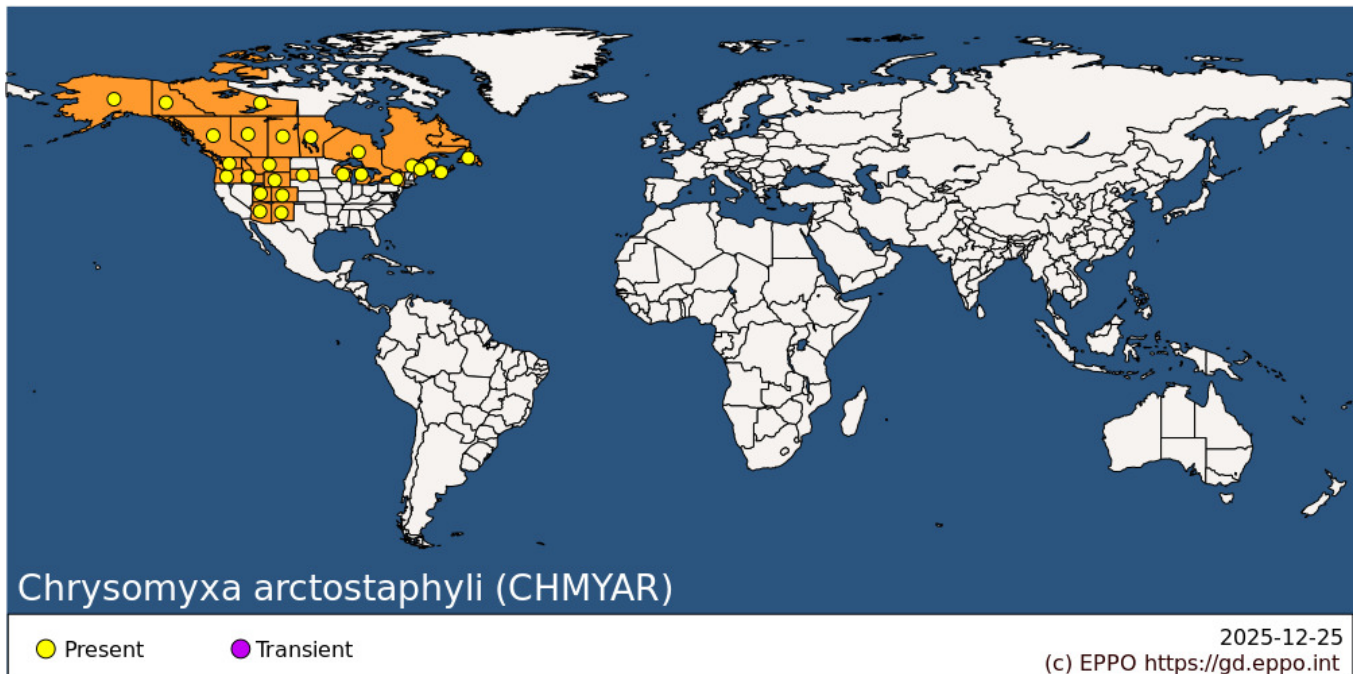
C. arctostaphyli is a fungal pathogen with a 2-year life cycle alternating between the aecial host *Picea* spp. and the telial host *Arctostaphylos* spp. The fungus primarily infects members of the genus *Arctostaphylos*, which are commonly known as manzanitas, a group of evergreen shrubs and small trees native to North America. *C. arctostaphyli* is often referred to as manzanita rust because it causes rust-like symptoms on these plants. The pest develops aecia on *Picea* spp. and the main reported aecial hosts are *Picea engelmannii* and *Picea pungens*. *Picea glauca*, *Picea mariana*, and *Picea rubens* are also reported as hosts (Crane, 2000; Sinclair & Lyon, 2005). *Arctostaphylos uva-ursi* is reported as the most important alternate host of the rust, but *Arctostaphylos nevadensis* and *Arctostaphylos patula* have also been reported as telial hosts (Sinclair & Lyon, 2005). *A. uva-ursi* is present both in North America and in Europe, *A. nevadensis* and *A. patula* are only present in Western North America (EFSA, 2018).

For additional information, see Ziller (1974) and Sinclair & Lyon (2005).

Host list: *Arctostaphylos nevadensis*, *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Picea abies*, *Picea engelmannii*, *Picea glauca*, *Picea mariana*, *Picea pungens*, *Picea rubens*, *Picea sitchensis*

GEOGRAPHICAL DISTRIBUTION

C. arctostaphyli is distributed only in natural ecosystems throughout North America wherever the two host genera, *Picea* and *Arctostaphylos*, occur together (Crane, 2000). In Canada, the pathogen is widespread (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Ontario, Quebec, Saskatchewan, and Yukon). In the USA, it is present in the northern and western states (Alaska, Arizona, Colorado, Idaho, Maine, Michigan, Montana, New Mexico, New York, Oregon, South Dakota, Utah, Washington, Wisconsin, and Wyoming). The pathogen has not been reported in Europe and in the EPPO region.



North America: Canada (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Ontario, Québec, Saskatchewan, Yukon Territory), United States of America (Alaska, Arizona, Colorado, Idaho, Maine, Michigan, Montana, New Mexico, New York, Oregon, South Dakota, Utah, Washington, Wisconsin, Wyoming)

BIOLOGY

The pest was originally considered to be microcyclic on *Arctostaphylos* spp. (Crane, 2000) and the life cycle was debated over several years. However, it is now agreed that *C. arctostaphyli* has a 2-year life cycle alternating between the aecial host *Picea* spp. and the telial host *Arctostaphylos* spp. (Crane, 2000). Aeciospores of the pest are produced during the summer on *Arctostaphylos* spp. and they re-infect the hosts from the same genus. Basidiospores are produced latter, and they infect a *Picea* spp. after overwintering, in early summer. The fungus persists in the twig and bud tissues of the brooms in spruce and colonizes the current year's needles after overwintering, in the spring. Aeciospores are subsequently produced and infect *Arctostaphylos* spp. (Hennon & Trummer, 2001).

On *Arctostaphylos* spp.: There are no uredinia and urediniaspores. Telia form on reddish spots that blacken with age, usually hypophyllous, may also be epiphyllous on *A. patula*; gelatinous, found in groups, confluent when mature, forming pulvinate crusts erumpent through epidermis, 0.3–1.0 mm across (Crane, 2000).

On *Picea* spp.: Spermogonia and aecia on chlorotic, stunted, current-year needles of perennial witches' brooms of *Picea* spp. (Bergdahl & Smeltzer, 1983). Spermogonia are subepidermal and aecia are peridermioid, bullet- or tongue-shaped. Aeciospores orange-yellow, spore walls are verrucose without a smooth spot.

C. arctostaphyli overwinters as mycelium in the systemically infected brooms on spruce (Crane, 2000) and as mycelium in the leaves of *Arctostaphylos* spp. Telia form on *Arctostaphylos* spp. in early spring and produce basidiospores that cause new infections on spruce, probably through the young needles of newly opened vegetative buds but it is not confirmed yet (Crane, 2000).

For further details see also Savile (1950), Ziller (1974), and Crane (2000).

DETECTION AND IDENTIFICATION

Symptoms

On *Picea* spp.: The first symptom of the pest is needle etiolation in summer. Release of dormant buds results in conspicuous, compact, perennial witches' brooms with yellow-green needles on which foul-smelling, subepidermal pycnia are found. These are followed by aecia which give the brooms a yellow-orange appearance. Needles subsequently die and fall in the autumn, leaving the broom to appear dead during the winter. The fungus causes the production of numerous short lateral shoots causing the broom (Hennon & Trummer, 2001). The internodes and needles on the brooms are also shorter than normal (EFSA, 2018). The brooms grow over time and may become up to 2 m tall (Sinclair & Lyon, 2005). Witches' brooms of conifers not caused by rust retain the colour of normal dark-green foliage throughout the year; only a few of their needles are shed. Sometimes cankers, fusiform swellings and secondary brooms form on the branches and trunk. The branch and stem at the base of the broom become swollen due to the infection and may form a canker or gall (EFSA, 2018). Trees lose vigour and spike tops, dead branches and mortality are common. It is rare that more than 25% of *Picea* spp. trees in a stand are infected; and fewer than 1% of trees in an infected trees bear brooms. The disease is mainly found in spruce stands where the *Arctostaphylos* spp. host is also found (Hennon & Trummer, 2001). The abundance of brooms showed no trend with stand age (EFSA, 2018).

On *Arctostaphylos* spp.: The rust is most noticeable in late spring and causes a reddish leaf spot. Orange-brown, waxy telia form in crowded groups on these spots on the underside of leaves.

Morphology

Spermogonia numerous, prominent, dark reddish-brown when dry, subepidermal, sometimes arising between epidermis and hypodermis; in cross section, usually globose or with a slightly flattened base, 80–160 µm wide x 80–114 µm high (Crane, 2000). Spermatia variable in shape and size, globose, ovoid or ellipsoidal, 1.6–4.5 x 1.2–2.5 µm. Aecia amphigenous, crowded along most of the needle length. Aeciospores variable in shape and size, ellipsoidal, ovoid, or polygonal, occasionally globose, subglobose, clavate, or fusiform, often with both ends flattened or with a cap, part of a longitudinal stripe, 16–36 x 12–24 µm. Spores are orange-red, with warts annulate, irregular in shape, often joined laterally into ridges, basal connections lacking; wall hyaline, very thin (0.8 µm). Peridium tubular, dehiscing at apex, outside of cells shallowly concave, smooth, inside of cells shallowly concave, with crowded irregular warts similar to the spores (Crane, 2000).

Black telia are similar to pulvinate crusts erumpent through epidermis, 0.3–1.0 mm across, confluent when mature (Crane, 2000). Teliospores catenulate, oblong, rounded at both ends, wall smooth and colourless, uniformly 10–19 µm high x 6–16 µm wide (Ziler, 1974; Crane, 2000). Basidia curved, four-celled, basidiospores regular in size and shape, globose to subglobose with a tiny apiculus; 6–43 x 5–7 µm (Ziler, 1974; Crane, 2000).

Detection and inspection methods

The disease can be easily identified based on the symptoms, i.e. as dense witches' brooms on spruce. A key is available to distinguish *C. arctostaphyli* from other tree rusts in western Canada based on the morphology and symptom descriptions (Ziller, 1974). The most conspicuous symptoms of spruce broom rust occur in early summer, when yellowish infected needles are present on shoots of witches' brooms (Crane, 2000). After production of spermogonia and aecia, the needles shrivel and fall off, leaving bare, dead-looking brooms during the winter. Brooms can occur on the trunk or branches, and after many years attain a diameter of 1 m or even up to 2 m. Trees with up to 41 brooms have been reported in Newfoundland, CA (Singh, 1978).

Both the ITS and the large subunit (28S) regions in the chromosome were also successfully used for conventional PCR test and barcoding PCR to distinguish *C. arctostaphyli* from other species as well as in phylogenetic studies (Feau *et al.*, 2011).

PATHWAYS FOR MOVEMENT

The main host commodities on which the pathogen can spread between countries are plants for planting and cut branches of *Picea* spp. (EPPO, 2018). Both pathways are closed for the EU countries due to the ban on importing plants of *Picea* spp., other than fruit and seeds, from non-EU countries (EPPO, 2018).

The pathogen could also be introduced on plants of *Arctostaphylos* spp., a pathway which is not currently regulated in EU countries (or elsewhere in the EPPO region). The most important alternate host, *A. uva-ursi* is present both in North America and in Europe (Calflora, 2023).

Long-distance dispersal is possible from infected plants of *Picea* spp. by wind-blown aeciospores, because aeciospores have a very high dispersal capacity and can survive for several months (Crane, 2000; EFSA, 2018).

PEST SIGNIFICANCE

Economic impact

C. arctostaphyli causes brooms and trees with abundant brooms often grow slowly and might die prematurely (Hennon & Trummer, 2001). Disease may also result in trunk deformations, cankers, growth loss, dead or broken tops and sometimes tree mortality (Sinclair & Lyon, 2005). In Southern Colorado and Northern Arizona (USA), the pathogen could infect many *Picea* species, but it only causes important damage to *P. engelmannii* and *P. pungens*. Nevertheless, the disease is not fatal generally and damage results from death of branches, deformation of trunks, reduced growth, and decay caused by secondary decay fungi which can enter via the rust infection sites (Hennon & Trummer, 2001; Sinclair & Lyon, 2005). In 21 stands of marketable *P. engelmannii* in Colorado, an average cull factor of 24% due to broken or dead trees' tops adjacent to dead rust brooms has been reported (Schwandt, 2006). Since diseased trees are liable to shed branches, they also represent a hazard to the public.

Control

Chemical control has not been shown to be effective to manage the disease on spruce (Hennon & Trummer, 2001). Other pest control methods can be applied, namely removal of infected *Picea* spp. trees through selective thinning. It is also recommended to remove *Arctostaphylos* spp. within 300 m of *Picea* spp. stands; this measure can reduce the damage to spruce trees (Hennon & Trummer, 2001). Pruning of brooms may also reduce the risk of breakage and maintain tree vigour in high value trees (Schwandt, 2006). Given that *C. arctostaphyli* does not normally kill spruce trees, one management option is to take no action, considering that witches' brooms offer refuge for many birds and small mammals, which may be a desirable feature for some tree or woodland owners (Hennon & Trummer, 2001).

Phytosanitary risk

Since *A. uva-ursi* is more commonly associated with *Picea* spp. in Eurasia than in North America, the rust is a potential danger to *Picea* spp. stands in Europe and Asia (Ziller, 1974).

It is unclear how susceptible *P. abies* is to the disease and what level of damage the species could sustain. *Picea sitchensis* is considered a minor host in North America but its susceptibility under European conditions is uncertain. It has been suggested, but not confirmed, that *Picea*-to-*Picea* transmission of the pathogen by aeciospores can occur (EFSAb, 2018).

PHYTOSANITARY MEASURES

The main phytosanitary measures are listed in the Standard PM 8/2 (3) Coniferae for *C. arctostaphyli* (EPPO, 2018). Import of plants for planting (except seeds) and cut branches of Coniferae including Christmas trees, originating in countries where *C. arctostaphyli* is present is allowed only from pest-free areas (EPPO, 2018). Import of wood, isolated bark of Coniferae originating in countries where *C. arctostaphyli* is present is allowed (EPPO, 2018) as the

fungus is an obligate biotroph that grows and reproduces only in living plant tissue and spreads by windblown spores formed on needles.

The pathogen could also be introduced on plants of *Arctostaphylos* spp., a pathway which is not currently regulated, especially since the main alternate host (*A. uva-ursi*) grows across Europe (mainly in mountain range, such as the Pyrenees, Alps, Carpathians, Scandinavian mountains, Grampians, the Balkan Mountain range) (EFSA, 2018). Import prohibition of *Arctostaphylos* spp. plants for planting would be a suitable measure to reduce the risk of introduction.

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Datasheet history

This datasheet was first published in the EPPO Bulletin in 1979 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).

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