cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Profile for

Cronartium pini (Willd.) Jørst
(syn. *Cronartium flaccidum* (Alb. & Schwein.) G. Winter)

Scots pine blister rust

Pest Rating: A

Kingdom: Fungi, Phylum: Basidiomycota,
Class: Pucciniomycotina, Subclass: Pucciniomycetes,
Order: Pucciniales, Family: Cronartiaceae

Comment Period: 07/19/2024 through 09/02/2024

Initiating Event:

This pathogen has not been through the pest rating process. It is listed on the National Priority Pest List for the Cooperative Agricultural Pest Survey (CAPS) program, Plant Protection Act 7721. The risk to California from *Cronartium pini* is described herein and a permanent rating is proposed.

History & Status:

Background: Scots pine (sometimes called Scotch pine), *Pinus sylvestris*, is one of the most widely distributed conifers in the world. Its native range extends from Great Britain and Spain east through Siberia, south to the Caucasus region, and north to Lapland. Scots pine has been widely planted and it is naturalized in the U.S. Northeast, Midwest, and Pacific Northwest with limited plantings in the San Francisco Bay area (Calflora, 2024). It is an important species for Christmas tree farming.

Scots pine blister rust, caused by *Cronartium pini*, occurs broadly across Europe and Asia, however, there are no North American records of this disease. It is a damaging pathogen on Scots pine and several types of Mediterranean pines. It has been reported to infect pines native to California planted in China, including *Pinas radiata* (Monterey pine) and *P. ponderosa* (ponderosa pine) (CABI, 2024). The susceptibility of these and other pines in North America is unknown, however, if the pathogen can

infect them here and is accidentally introduced, there could be significant economic and ecological impacts.

Cronartium pini is biotrophic and requires a living host for survival and reproduction. This rust fungus has a complex biology and epidemiology with two different life-cycle forms and five different spore stages (aeciospores, urediniospores, teliospores, basidiospores, and spermatia). The two life-cycle forms were previously regarded as two distinct species: one obligately host-alternating (heteroecious) (syn. *Cronartium flaccidum* (Alb. & Schwein.) G. Winter) and one non-alternating (autoecious) (syn. *Peridermium pini* (Willd.) Lév., *Endocronartium pini* (Willd.) Y. Hirats.). The name *C. pini* (now inclusive of both life-cycle forms) is the currently accepted name of this fungus (Royal Botanic Gardens, Kew Citation 2023). Wijesinghe et al. (2019) and Samils et al (2021) confirmed this relationship between the two forms as the same fungus.

The heteroecious form completes its life cycle with the spermogonial and aecial stages occurring on pines, mostly in the subgenus *Pinus* (hard or two-needled pines), alternating with the uredinial, telial and basidial stages on dicotyledonous plants in 14 families within the genera of *Apocynum, Asclepias, Bartsia, Caiophora, Castilleja, Delphinium, Euphrasia, Gentiana, Grammatocarpus, Hyoscyamus, Impatiens, Loasa* (*Nasa*), *Melampyrum, Myrica, Nemesia, Nicotiana, Odontites, Paeonia, Papaver, Pedicularis, Rhinanthus, Ruellia, Saxifraga, Schizanthus, Siphonostegia, Swertia, Tropaeolum, Verbena, Veronica*, and *Vincetoxicum* (CABI, 2024). The autoecious form of the pathogen spreads clonally, directly from pine to pine, primarily on Scots pine and mugo pine (Kaitera and Nuorteva, 2008). The contrasting differences in host pathogenicity between the two life cycle forms of *C. pini* have been confirmed by infection studies where aeciospores of the heteroecious form were shown to infect alternate herbaceous host plants, but never pines. In contrast, the autoecious phase infects only pines, never the alternate herbaceous plants (Kaitera et al., 1999).

Hosts: Cronartium pini occurs on species of “hard” or two-needled pines and on the leaves of herbaceous species.

Pine Hosts: *Pinus brutia* (brutian pine), *P. densiflora* (Japanese red pine), *P. halepensis* (Aleppo pine), *P. koraienis* (fruit pine), *P. laricio* (black pine), *P. massoniana* (masson pine), *P. montana* (dwarf mountain pine), *P. mugo* (mountain, Mugo pine), *P. nigra* (black, Austrian pine), *P. pallasiana*, *P. pinaster* (maritime pine), *P. pinea* (stone pine), *P. ponderosa* (ponderosa pine), *P. pumila* (dwarf Siberian pine), *P. radiata* (Monterey pine), *P. rotunda, P. sylvestris* (Scots pine), *P. tabuliformis* (Chinese pine), *P. taiwanensis* (Taiwan red pine), *P. uncinata* (mountain pine), *P. wallichiana* (blue pine), and *P. yunnanensis* (Yunnan pine).

Herbaceous hosts: *Asclepias syriaca* (common milkweed), *Cynanchum fuscatum, C. laxum, C. nigrum, C. scandens, Cynanchum vincetoxicum* (swallowwort), *Delphinium delavayi, Euphrasia brevipila*, *E. frigida* (cold-weather eyebright), *E. maximowiczii*, *E. nemorosa* (common eyebright), *E. stricta* (strict eyebright), *Gentiana asclepiadea* (willow gentian), *Grammatocarpus volubilis, Loasa triphylla, L. urens, L. vulcanica*, *Melampyrum arvense* (field cow-wheat), *M. pratense* (common cow-wheat), *M. sylvaticum* (small cow-wheat), *Nemesia strumose* (cape jewels), *N. versicolor*, *Paeonia albiflora* (white peony), *P. anomala* (anomalous peony), *P. corallina, P. cultorum*, *P. daurica* (Crimean peony), *P.*

japonica (Japanese peony), *P. lactiflora* (Chinese peony), *P. lactiflora var. hortensis*, *P. lactiflora var. trichocarpa*, *P. mascula* (wild peony), *P. mlokosewitschii* (the golden peony), *P. moutan* (Moutan peony), *P. obovate* (woodland peony), *P. officinalis* (common peony), *P. oreogeton*, *P. peregrina* (scarlet peony), *Peony* sp., *P. suffruticosa* (tree peony), *P. taurica*, *P. tenuifolia* (fernleaf peony), *P. triternata*, *Pedicularis dolichorrhiza, P. palustris* (marsh lousewort*), P. palustris* subsp. *palustris*, *P. resupinate*, *P. sceptrum-carolinum, Ruellia formosa*, *Siphonostegia chinensis*, *Tropaeolum majus* (garden nasturtium), *T. minus* (dwarf nasturtium), *Verbena ×hybrida, V. teucrioides, Vincetoxicum albovianum, V. amplexicaule, V. fuscatum, V. hirundinaria, V. mongolicum, V. nigrum, V. officinale,* and *V. scandens* (CABI, 2024).

Symptoms: This rust fungus is most easily recognized from the aecial stage on pine when lesions with orange blisters (aecia) containing aeciospores develop on a stem or branch of the tree in early summer. It appears first as a diamond-shaped, resinous canker. The lesions are perennial and can produce aecia for several years. Diseased branches become swollen, and after the release of the aeciospores, the bark will crack, and darken. The end of the branch is killed if it becomes girdled. There can be branch flagging, and excessive pitch flow. For the heteroecious form, the aeciospores infect the alternate host plants, and orange pustules (uredinia) are formed on the leaves.

Transmission: The life cycles of *C. pini* are complex and take several years to complete. Urediniospores spread among host plants during the summer and the number of spores and uredinia produced can increase excessively through multiple infection cycles. The uredinia then turn into telia and produce teliospores, from which basidiospores are formed in autumn. The wind-dispersed basidiospores will reinfect pines. On pine, the sexual stage begins with the production of spermogonia and spermatia, and the first aecia are formed 3 years or more after the basidiospore infection (Kaitera and Nuorteva 2008). In the autoecious form, the aeciospores infect a pine host directly, without the intermediate stages on the alternate host. Aecia are formed 2 years or more after infection (Kaitera, 2003).

All the spores produced by this rust are spread by wind. Aeciospores and urediniospores may be disseminated over great distances, as much as 200 miles have been reported (although generally, they move less than 10 miles). The basidiospores are fragile and sensitive to drying, and their wind-borne movement is generally limited to less than 500 meters (Hunt, 1997). The introduction of the disease can occur in new areas if seedlings or young trees are moved while the systemic infections are latent.

Damage Potential: Small trees are killed relatively quickly by main stem infections. Larger trees are often infected in the middle of the crown, so if not killed by the girdling resinous canker, a tree may persist for decades with a dead top. This disease is a major cause of reduced forest productivity in Europe, especially in Fennoscandia (CABI, 2024). Dense plantation monocultures of Scots pine on Christmas tree farms are at even greater risk (Kim et al., 2009).

Where the heteroecious form is present, the distance between the alternate host plants and a pine is a limiting factor, since basidiospores produced on the alternate host plants can normally spread only short distances before drying out. The aeciospores and urediniospores, on the other hand, can spread up to 200 miles, and aeciospores from the autoecious form can directly infect pines.

Worldwide Distribution: Asia: *China, Japan, Korea Dem. People's Republic, Korea, Republic*. Europe: *Armenia, Austria, Azerbaijan, Belgium, Bulgaria, Czechia, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Spain, Sweden, Switzerland, Ukraine, United Kingdom* (EPPO, 2024)

Official Control*: Cronartium pini* is a regulated quarantine pest in the United States (EPPO, 2024). It is on the USDA PCIT's harmful organisms list for Chile, Colombia, the European Union, New Zealand, and Taiwan (USDA PCIT 2024).

California Distribution: None.

California Interceptions: None.

The risk that *Cronartium pini* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This pathogen could likely establish in its autoecious form wherever susceptible pines can grow, and in the heteroecious form wherever the alternating hosts can grow in proximity to one another.

   Evaluate if the pest would have suitable hosts and climate to establish in California.

   Score: **2**
   - Low (1) Not likely to establish in California; or likely to establish in very limited areas.
   - Medium (2) may be able to be established in a larger but limited part of California.
   - High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** The more significant hosts are two-needled hard pines of which there are multiple susceptible species. The alternating hosts include plants in more than a dozen families.

   Evaluate the host range of the pest.

   Score: 3
   - Low (1) has a very limited host range.
   - Medium (2) has a moderate host range.
   - High (3) has a wide host range.

3) **Pest Reproductive Potential:** Depending on the spore type, movement can occur over great distances with wind. With two life cycles, one heteroecious and one autoecious, this rust has more opportunities to reproduce than other species of blister rust.

   Evaluate the natural and artificial dispersal potential of the pest.

   Score: 3
   - Low (1) does not have high reproductive or dispersal potential.

- Medium (2) has either high reproductive or dispersal potential.
- High (3) has both high reproduction and dispersal potential.

4) **Economic Impact:** This is a very damaging pathogen of some pine species, causing yield losses. It is a federal quarantine pest in the US.

Evaluate the economic impact of the pest on California using the criteria below.

Economic Impact: A, C

A. The pest could lower crop yield.
B. The pest could lower crop value (including increasing crop production costs).
C. The pest could trigger the loss of markets (including quarantines).
D. The pest could negatively change normal cultural practices.
E. The pest can vector, or is vectored, by another pestiferous organism.
F. The organism is injurious or poisonous to agriculturally important animals.
G. The organism can interfere with the delivery or supply of water for agricultural uses.

Economic Impact Score: **2**

- Low (1) causes 0 or 1 of these impacts.
- Medium (2) causes 2 of these impacts.
- High (3) causes 3 or more of these impacts.

5) **Environmental Impact:** The susceptibility of native California pines in their native range is unknown. If Monterey or ponderosa pines are affected, losses could be very significant as these two species are important in California forests and landscapes.

Evaluate the environmental impact of the pest on California using the criteria below.

Environmental Impact:

A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.
B. The pest could directly affect threatened or endangered species.
C. The pest could impact threatened or endangered species by disrupting critical habitats.
D. The pest could trigger additional official or private treatment programs.
E. The pest significantly impacts cultural practices, home/urban gardening, or ornamental plantings.

Environmental Impact Score: 3

- Low (1) causes none of the above to occur.
- Medium (2) causes one of the above to occur.
- High (3) causes two or more of the above to occur.

Consequences of Introduction to California for *Cronartium pini:* High

Add up the total score and include it here. 13
-Low = 5-8 points
-Medium = 9-12 points
-High = 13-15 points

6) **Post-Entry Distribution and Survey Information**: Evaluate the known distribution in California. Only official records identified by a taxonomic expert and supported by voucher specimens deposited in natural history collections should be considered. Pest incursions that have been eradicated, are under eradication or have been delimited with no further detections should not be included.

Evaluation is 'not established'.

Score: 0
-Not established (0) Pest never detected in California or known only from incursions.
-Low (-1) Pest has a localized distribution in California or is established in one suitable climate/host area (region).
-Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.
-High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

7) **The final score is** the consequences of the introduction score minus the post-entry distribution and survey information score: (Score)

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= 13***

Uncertainty:

The susceptibility of California native pines to this pathogen is uncertain. There is potential for serious damage.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Cronartium pini*** **is A.**

References:

EPPO Database. https://gd.eppo.int/taxon/CRONFL Accessed 6/13/2024

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Samils, B., Kaitera, J., Persson, T., Stenlid, J. and Barklund, P., 2021. Relationship and genetic structure among autoecious and heteroecious populations of *Cronartium pini* in northern Fennoscandia. Fungal Ecology, 50, p.101032.

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Responsible Party:

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***Comment Period: 07/19/2024 through 09/02/2024**

***NOTE:**

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at permits[@]cdfa.ca.gov.

Comment Format:

- Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

  Example Comment:

  Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to "Climate/Host Interaction" here.]

- Posted comments will not be able to be viewed immediately.
- Comments may not be posted if they:

  Contain inappropriate language which is not germane to the pest rating proposal;

  Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;

  Violates agency regulations prohibiting sexual harassment or other forms of discrimination;

  Violates agency regulations prohibiting workplace violence, including threats.

- Comments may be edited prior to posting to ensure they are entirely germane.
- Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.

Pest Rating: A
