CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Cronartium quercuum (Berk.) Miyabe ex Shirai 1899

Current Pest Rating: Z

Proposed Pest Rating: C

Comment Period: 08/29/2019 through 10/13/2019

Initiating Event:

On May 15, 2019, a shipment of cut Smilax foliage was intercepted in San Luis Obispo County by county agricultural inspectors. The shipment originated in Florida and was destined to a floral company in San Luis Obispo County. The county inspectors noticed that foliage of a second type of plant, not Smilax, was comingled in the shipment. This foliage had yellow pustules on it. A sample of the diseased foliage was submitted to the CDFA Botany Lab for identification and to the Plant Pathology Lab for diagnosis of any associated pathogens. On May 17, Genevieve Walden, CDFA Botanist, identified the foliage as live oak, *Quercus virginiana*, and assigned it a D rating. On May 21, Cheryl Blomquist, CDFA Plant Pathologist identified the fungal pathogen *Cronartium quercuum*, common name eastern gall rust, as the source of the yellow pustules. This pathogen has been reported in multiple California counties over many decades and therefore was assigned a temporary Z rating. An assessment of the status of *Cronartium quercuum* in California is presented herein, and a permanent rating is proposed.

History & Status:

Background:

The rust fungus *Cronartium quercuum* is a pathogen of both pines and oaks in North America (Peterson and Jewell, 1968; Hiratsuka and Powell, 1976; Sinclair et al., 1987). This disease has the common name of eastern gall rust and can cause moderate levels of damage to pines in temperate forests (CABI, 2018). Eastern gall rust is a different disease than Western gall rust, caused by *Endocronartium harknessii*, an autoecious fungus and needs no alternate host.

The scientific name *Cronartium quercuum* is applied to all stages in the life cycle of this fungus on all hosts; the species epithet '*quercuum*' refers to the fact that the sexual stage (telia) occurs mainly on species of *Quercus*. At one time, all pine-oak rust was called *C. quercuum*. Now researchers have shown that eastern gall rust is a genetically variable, complex species group with a number of local races or

forms, some of which have been separated as distinct in morphology and host range, including *Cronartium orientale* in eastern Asia (Ito , 1974; Kaneko, 2000) and *Cronartium fusiforme* in the south-eastern United States (Kaneko and Powers, 1991; Vogler and Bruns, 1998; Kaneko, 2000; Chen, 2003; Ostry and Juzwik, 2012). Work is ongoing to define and differentiate the lineages within this complex on a molecular level. The life history and potential pathological effects of these different lineages are not completely understood (CABI, 2018).

Hosts: Pines *(Pinus spp.*) are the hosts of the aecial state of the pathogen and trees in Fagaeae, oaks (*Quercus spp.*) and chestnuts (*Castanea spp*.), are the hosts for the telial and uredinial states. In North America the aecial hosts are two- and three-needled species of *Pinus*, of which the most important are jack pine (*P. banksiana*), shortleaf pine (*P. echinata*), and Virginia pine (*P. virginiana*). Other species of pines that can be hosts include the Japanese umbrella pine (*P. densiflora*), slash pine (*P. elliottii*), spruce pine (*P. glabra*), khasya pine (*P. kesiya*), smooth leaved pine (*P. leiophylla*), luchu pine (*P. luchuensis*), Masson pine (*P. massoniana*), Montezuma pine (*P. montezumae*), bishop pine (*P. muricata*), black pine (*P. nigra*), ponderosa pine (*P. ponderosa*), Table Mountain pine (*P. pungens*), red pine (*P. resinosa*), pitch pine (*P. rigida*), Scots pine (*P. sylvestris*), Chinese pine (*P. tabuliformis*), loblolly pine (*P. taeda*), Taiwan pine (*P. taiwanensis*), Takahashii pine (*P. takahasii*), and Japanese black pine (*P. thunbergii*) (CABI, 2018; Powers et al., 1991).

The telial hosts are mainly species of red oaks, particularly southern red oaks (*Quercus falcata* and *Q. pagoda*), southern willow oaks (*Q. phellos* and *Q. nigra*), northern red oak (*Q. rubra*) and Virginia live oak (*Q. virginiana*). Other recorded hosts are: sawtooth oak (*Q. acutissima*), California live oak (*Q. agrifolia*), oriental white oak (*Q. aliena*), kermes oak (*Q. coccifera*), scarlet oak (*Q. coccinea*), daimyo oak (*Q. dentata*), Faber's oak (*Q. fabri*), Garry oak (*Q. garryana*), red-bark oak (*Q. gilva*), ring-cup oak (*Q. glauca*), paisang oak (*Q. griffithii*), holm oak (*Q. ilex*), Turkey oak (*Q. laevis*), laurel oak (*Q. laurifolia*), banj oak (*Q. leucotrichophora*), overcup oak (*Q. lyrata*), blackjack oak (*Q. marilandica*), swamp chestnut oak (*Q. michauxii*), Mongolian oak (*Q. mongolica*), water oak (*Q. nigra*), cherry bark oak (*Q. pagoda*), pin oak (*Q. palustris*), dwarf chinquapin oak (*Q. prinoides*), brown oak (*Q. semecarpifolia*), glandbearing oak (*Q. serrata*), post oak (*Q. stellata*), cork oak (*Q. suber*), oriental cork oak (*Q. variabilis*), and black oak (*Q. velutina*). In addition, other trees in the family *Fagaceae* that have been recorded as telial hosts for the pine-oak rust include American chestnut (*Castanea dentata*), hairy chestnut (*C. mollissima*) and Allegheny chinquapin (*Castanea pumila)* (CABI, 2018; Farr and Rossman, 2019). There are also reports from CDFA of tanoak (*Notholithocarpus densiflorus)* as a host (French, 1989).

Symptoms: As a macro- or long cycle rust, *Cronartium quercuum* has 5 spore stages and produces different forms on its two, alternating hosts. It overwinters as mycelium inside pines. In springtime, perennial galls (swellings on the branches) producing spermatia and strikingly bright orange-yellow aeciospores. These spores infect only tender, young oak or chestnut leaves. The fungus grows inside the oak leaves and orange urediniospores are produced on the lower leaf surface. Urediniospores can infect new oak leaves in repeating cycles that amply disease severity. In the fall, infected oak leaves

produce teliospores then basidiospores that infect pine needles. The fungus grows inside the pine needles and takes approx. 1 year to form new galls that produce new spermacia and aeciospores. The galls are perennial and may need 2-3 years of growth to be detectable on branches. Witches' brooms, proliferation of small branches, often accompany the galls on infected trees.

Transmission: For both telial and aecial hosts of *Cronartium quercuum*, spores are wind dispersed and infect either new pine needles or new oak leaves, respectively. Aeciaspores can be dispersed over long distances and there can be multiple repeating cycles of urediniospores that re-infect oaks. The disease can spread through the movement of infected pine or oak nursery stock (Ostry and Juzwik, 2012). Absence of oaks in the pine growing areas can break the required two-host life cycle and minimize disease spread (Rajotte, 2017).

Damage Potential: Cronartium quercuum is an obligate parasite that mainly damages pines but requires an alternate foliar host to complete its life cycle. Generally, rust pathogens do not kill their hosts although they can reduce growth and yield (Agrios, 2005). If pine seedlings are infected in the nursery, they should be culled before planting. Seedlings infection can be reduced by removing nearby oaks. If infected pine seedlings are planted, they are often broken by wind as galls weaken the stems. And if planted out, they become a source of inoculum to oaks (Ostry and Juzwik, 2012). The damage on pines can be moderate to high with stunting, deformation and dieback of twigs and branches (Rajotte, 2017). Heavy production of uredinospores can cause defoliation of oaks. Eastern gall rust can cause serious damage in forest nurseries where the main stems of pine seedlings can become infected and die (Ostry and Juzwik, 2012). Losses also occur when infected, young pine trees are planted in outdoor environments where they provide a source of inoculum for subsequent infections of healthy trees. The alternate hosts, oaks and chestnuts, can be partially defoliated but are not seriously damaged.

Worldwide Distribution: Asia: *China, India, Japan, Korea (DPR), Korea (Republic), Philippines, Turkey*. North America: *Canada, United States* (Alabama, Arizona, Arkansas, California, Connecticut, Florida, Georgia, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Jersey, North Carolina, Oklahoma, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Virginia, Washington, Wisconsin, Wyoming); Central America and Caribbean: *Belize, Costa Rica, Cuba, El Salvador, Honduras, Mexico, Nicaragua, Panama*; South America: *Guyana;* Europe: *Russian Federation*. (EPPO, 2019; CABI 2019).

Official Control: The EPPO lists *Cronartium quercuum* as a quarantine pest, since it is absent from the European Union (EPPO, 2019). The pathogen is on the 'Harmful Organism Lists' for the Eurasian Customs Union, Mexico, Morocco, Namibia, Norway, South Africa, and Taiwan (USDA PCIT, 2019).

California Distribution: The disease has been found in multiple northern and central coastal counties of California in nurseries and landscapes on tanoak (*Notholithocarpus densiflorus*), coast live oak (*Quercus agrifolia*), canyon oak (*Q. chrysolepsis*), blue oak (*Q. douglasii*), coastal sage scrub oak (*Q. dumosa*), Engelmann oak (*Q. engelmannii*), Oregon white oak (*Q. garryana*), California black oak (*Q. kelloggii*), valley oak (*Q. lobata*), interior live oak (*Q. wislizenii*), Aleppo pine (*Pinus halepensis*),

ponderosa pine (*P. ponderosa*), and Monterey pine (*P. radiata*) (French 1989; CDFA PDR online database accessed 7/23/19).

California Interceptions: *Cronartium quercuum* has been intercepted on oak leaves mixed with florist's stock from Florida, see 'Initiating Event'.

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

Consequences of Introduction:

1) **Climate/Host Interaction:** This disease is already widely distributed in temperate forests on the California coast.

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 establish in a larger but limited part of California.**
- High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** This pathogen infects multiple species including pines, oaks, and chestnuts.

Evaluate the host range of the pest.

Score: 2

- 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:** Spores are produced in large numbers and are move over short and long distances by wind and infected planting material, respectively. *C. quercuum* is not seed borne.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 2

- 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:** *C. quercuum* is not very damaging to the oak/chestnut host but can cause moderate losses to its pine hosts. There are no damage reports from California forests.

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

Economic Impact: A, B

A. The pest could lower crop yield.
B. The pest could lower crop value (includes increasing crop production costs).
C. The pest could trigger the loss of markets (includes 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:** This pathogen has a moderate host range but generally does not kill its hosts past the seedling stage and damage is usually minor. It has been recorded in California for decades and likely if there were environmental impacts, they would have been observed and documented.

Environmental Impact: Low
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: 1
- **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 quercuum: Medium*

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

6) **Post Entry Distribution and Survey Information**: This disease is established in California on multiple aceial and telial hosts.

Evaluation is 'High'

Score: -3
-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 introduction score minus the post entry distribution and survey information score:

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= 6***

Uncertainty: none

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Cronartium quercuum* is C.**

References:

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Responsible Party:

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*Comment Period: 08/23/2019 through 10/07/2019

*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 plant.health[@]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.

Proposed Pest Rating: C
