

California Pest Rating Proposal for
***Gymnosporangium juniperi-virginianae* Schwein. 1822**

cedar-apple rust

Current Pest Rating: A

Proposed Pest Rating: A

Domain: Eukaryota, Kingdom: Fungi,
Phylum: Basidiomycota, Subphylum: Pucciniomycotina,
Class: Pucciniomycetes, Order: Pucciniales,
Family: Pucciniaceae

Comment Period: 02/03/2022 through 03/20/2022

Initiating Event:

This pathogen has not been through the pest rating system. The risk to California from *Gymnosporangium juniperi-virginianae* is described herein and a permanent rating is proposed.

History & Status:

Background:

Rust diseases are caused by fungi that are obligate parasites (i.e., they develop only on living hosts). To complete their life cycles, *Gymnosporangium* rusts must alternate between a juniper host and a rosaceous host, such as apple, pear, hawthorn, mountain ash, or quince. Numerous infections per plant for either host, which can be common in wet years, can reduce host vigor and increase secondary attacks by other diseases or insects. The greatest impacts from these rusts are on the rosaceous hosts and include growth loss and degraded fruit quantity and quality. Although the strange appearance and bright orange color of the telial horns on the junipers when the fungus is fruiting can be alarming, damage is usually minor (Scharpf, 1993). On junipers, they occasionally cause hip cankers that can result in tree death.

Cedar–apple rust, caused by the fungus *Gymnosporangium juniperi-virginianae*, is widespread in eastern North America. It causes galls, often called cedar apples, that produce jelly-like horns, on junipers. These spores are airborne and infect the leaves, fruits, and twigs of susceptible species of apples and crab apples. Aecial rust pustules on the apple leaves and fruit produce spores that infect junipers. The control of *Gymnosporangium* rusts can be achieved by keeping the alternating hosts sufficiently far apart so that it cannot complete its life cycle (up to 2 miles). This, however, is often impossible or impractical, when both hosts have value, or are common in the landscape.

Hosts:

Telial hosts: *Juniperus chinensis* (Chinese juniper), *J. chinensis* f. *globosa*, *J. communis* var. *depressa* (common juniper), *J. horizontalis* (creeping juniper), *Juniperus horizontalis* f. *alpina*, *Juniperus pinchotii* (redberry juniper), *Juniperus scopulorum* (Rocky Mountain juniper), *Juniperus silicicola* (southern red cedar), *Juniperus* sp. (juniper), *Juniperus utahensis* (Utah juniper), *Juniperus virginiana* (eastern red cedar), *Juniperus virginiana* cv. *canaertii*, *Juniperus virginiana* cv. *elegantissima*, *Juniperus virginiana* cv. *glauca*, *Juniperus virginiana* cv. *globosa*, *Juniperus virginiana* cv. *pyramidalis*, *Juniperus virginiana* var. *crebra* (Farr and Rossman, 2021).

Aecial hosts: *Crataegus mollis* (red hawthorn), *Crataegus* sp. (hawthorn), *Malus angustifolia* (Southern crabapple), *Malus baccata* (Siberian crabapple), *Malus coronaria* (sweet crabapple), *Malus domestica* (apple), *Malus floribunda* (Japanese crabapple), *Malus fusca* (Western crabapple), *Malus glaucescens* (American crabapple), *Malus ioensis* (prairie crabapple), *Malus pumila* (apple), *Malus sieboldii* (Toringo crabapple), *Malus* sp. (apple), *Malus spectabilis* (Asian crabapple), *Malus sylvestris* (European crabapple) (Farr and Rossman, 2021).

Symptoms: Needles or buds of junipers are infected in the summer with windblown spores produced on apples. Growth inside the needles is initially slow with galls beginning to appear as small swellings on the upper surface of the needle by the next spring. The galls are dikaryotic mycelium growing between plant cells. In the fall, the galls enlarge rapidly reach a maximum of 3 to 5 centimeters in diameter and turn brown, with a surface covered with small circular depressions. The following spring, the small depressions on the galls absorb water during warm, wet weather, swell, and produce very conspicuous orange-brown, jelly-like telial “horns” that are 10 to 20 mm long. The jelly-like horns are columns of teliospores that germinate in place for several weeks and produce basidiospores that can infect apples. The galls eventually die but may remain attached to the tree for a year or more.

The fungus does not produce uredia or uredospores. Basidiospores from the junipers are windborne and may be carried for up to 3 to 5 kilometers. Their germ tubes penetrate young apple leaves or fruit directly and produce haploid mycelium that spreads through or between the apple cells. The mycelium forms orange-colored spermagonia on the upper leaf surface and, after fertilization of the receptive hyphae by compatible spermatia, produces aecial cups on concentric rings on the lower side of leaves and on fruits. The area of the leaf where aecia are produced is swollen, and the clusters of orange yellow aecial cups and their white cup walls stand out conspicuously.

In the fruit, spermagonia appear first in the center of the spot and the aecia form subsequently in the surrounding area. Infected areas of fruit are usually flat or depressed rather than swollen. The aeciospores are produced in chains and they are released in the air during dry weather in late summer and are carried by wind to the junipers, where they start new infections. The pathogen spends approximately 21 months on the juniper host and 3 months on the apple host.

Transmission: The pathogen is dispersed via wind and movement of infected plants and propagative plant parts as well as infected nursery stock and fruit (Agrios, 2005). In the nursery plant trade, juniper from quarantined counties (all east of the Rocky Mountains plus Alaska) should be considered to be potentially infected with *G. juniperi-virginianae*. Like other *Gymnosporangium* rusts, *G. juniperi-virginianae* can be latent during winter as intercellular mycelium with very inconspicuous swellings and will likely not be detectable at pre-export phytosanitary certification stages (EPPO, 2021). The pathogen may also move in the aecial phase with infected leaves, twigs, and fruit although symptoms and signs of this pathogen are very conspicuous on the apple hosts.

Damage Potential: *Gymnosporangium juniperi-virginianae* causes galls, stunted and bushy branches, including witches' brooms, stem dieback, and orange gelatinous spore masses on the telial hosts. Young, infected junipers can be deformed and sometimes die, but larger trees are seldom killed, even though some growth reduction and brooming can occur. Only when trees are heavily infected or exhibit extensive brooms do they suffer growth reduction and mortality. The lumber quality can degrade in trees grown for harvest (UC IPM, 2021).

On their alternate apple hosts, *G. juniperi-virginianae* causes nonlethal swellings but unacceptable colorful spots on fruit, leaves, and twigs. Disease can be severe on young trees in nurseries but generally it is regarded as a minor pathogen of fruit crops (Aldwinckle, 2014). Infected fruit trees have resulted in delayed harvest and reduced fruit yields due to inhibition of photosynthesis and increased respiration.

Worldwide Distribution: Canada, United States (*Alabama, Arkansas, Colorado, Connecticut, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Mississippi, Missouri, Nebraska, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Dakota, Tennessee, Vermont, Virginia, Washington, Wisconsin, Wyoming*) (CABI-CPC, 2021).

Official Control: *Gymnosporangium juniperi-virginianae* is on the USDA PCIT's harmful organism list for Canada, China, Egypt, Honduras, Japan, Jordan, Korea (Republic of), Mexico, Morocco, Oman, Peru, Qatar, and United Arab Emirates (USDA, 2021). It is on the EPPO's A1 list for Bahrain, Comunidad Andina, European and Mediterranean Plant Protection Organization, Egypt, Inter-African Phytosanitary Council, Jordan, Paraguay, Ukraine, and Uruguay; A2 list for Comité de Sanidad Vegetal del Cono Sur, and a quarantine pest for Mexico, Morocco, Norway, New Zealand, and Tunisia (EPPO, 2021).

California has a state exterior quarantine for *Gymnosporangium juniperi-virginianae* (3274. CEDAR-APPLE RUST DISEASE: <http://pi.cdfa.ca.gov/pqm/manual/pdf/318.pdf>). The area under quarantine is

the State of Alaska and all states and districts east of and including the States of Montana, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. The quarantine is against the pathogen, its hosts, and possible carriers.

California Distribution: None

California Interceptions: This pathogen is intercepted many times at the border stations and from high-risk package inspections by counties on leaves and fruits of apples, from parts of the country known to be infested.

The risk *Gymnosporangium juniperi-virginianae* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** California has suitable climate and hosts that would likely enable a widespread distribution in the State, particularly where the alternating hosts are cultivated in proximity. In years with wet spring weather, apples could be heavily impacted.

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

Score: 3

- 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:** The host ranges for these types of rust fungi are generally narrow. This rust has alternating hosts, and both hosts are required to cause repeating disease cycles. For this pathogen, the hosts are in the genera *Malus*, *Crataegus* and *Juniperus*.

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:** *Gymnosporangium juniperi-virginianae* has a high reproductive potential and spores are dispersed readily by wind currents and movement of infected plants and propagative plant parts, as well as infected nursery stock.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 3

- Low (1) does not have high reproductive or dispersal potential.
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- Medium (2) has either high reproductive or dispersal potential.
- **High (3) has both high reproduction and dispersal potential.**

4) Economic Impact: With a suitable climate and available hosts, *Gymnosporangium juniperi-virginianae* is likely to establish and spread within California. Infected junipers may be asymptomatic during the winter months and thereby moved to non-infested regions with nursery stock before the pathogen is detectable. If introduced and left uncontrolled, *G. juniperi-virginianae* could affect commercial productions of hawthorn, apple, crabapple, and juniper by lowering crop yields, lowering crop value and markets, increasing costs of production due to increased use of fungicidal treatments, and negatively changing normal cultural practices such as necessitating distancing of fruit trees from junipers. This rust is a quarantine pest for many countries.

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

Economic Impact: A, B, C, D

- 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: 3

- 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: Junipers are present in natural environments in California and are also commonly grown in public and private gardens and landscapes. Their presence in proximity to apple, and crabapple trees and their critical role in rust disease cycle could increase the overall impact of *G. juniperi-virginianae* in the environment. As a state exterior quarantine pest, incidence of *G. juniperi-virginianae* could trigger additional official or private treatment programs. Home/urban gardening and ornamental plantings could also be impacted significantly.

Evaluate the environmental impact of the pest to California using the criteria below

Environmental Impact: A, D, E

- 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.**
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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 *Gymnosporangium juniperi-virginianae*: High

Add up the total score and include it here. **14**

- 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 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 = 14

Uncertainty:

The USDA National Fungus Collections (<https://nt.ars-grin.gov/fungaldatabases/>) has a record of *G. juniperi-virginianae* on *Juniperus* sp. in California. This record is from prior to 1989 (French, 1989). Old CDFA pest and damage records show a detection on *Juniperus scopulorum* (Rocky Mountain Juniper), listed only as “Coast South”, and without a date. It is likely this was a single detection that lacked an

alternate host and could not spread (pers. comm, Timothy Tidwell, CDFA Primary State Plant Pathologist (retired)). Additionally, there are no herbarium specimens of this from California, and the previous detection(s) likely were either misidentifications on nursery stock that was later destroyed. Also, the aecial stage on apple is morphologically impossible to tell from other closely related species. In the recent past, when there has been molecular testing, we have only detected this from samples originating on the east coast and mid-west (pers. comm. Cheryl Blomquist, CDFA Plant Pathologist)

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Gymnosporangium juniperi-virginianae* is A.

References:

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- USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Gymnosporangium juniperi-virginianae*. Accessed 2/20/2021
- UC IPM. 2020. Cedar, cypress, and juniper rusts—*Gymnosporangium* spp. <http://ipm.ucanr.edu/PMG/GARDEN/PLANTS/DISEASES/cedcyrust.html> Accessed 12/20/2021
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Responsible Party:

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***Comment Period: 02/03/2022 through 03/20/2022**

*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](mailto: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.
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Proposed Pest Rating: A
