CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Gymnosporangium globosum (Farl.) Farl. 1886

American hawthorn rust

Current Pest Rating: Q

Proposed Pest Rating: A

Comment Period: 11/15/2019 through 12/30/2019

Initiating Event:

On September 4, 2015, CDFA agricultural inspectors at the Needles border inspection station intercepted 10 lbs. of "hand-picked pears" with a traveler from Louisburg, Kansas, heading for Santa Cruz, California. The pears were sent to CDFA plant pathologist Cheryl Blomquist at the diagnostics laboratory in Meadowview. On September 24, 2015, she identified *Gymnosporangium globosom*, American hawthorn rust, from the pears. This pathogen is not known to occur in California and was assigned a temporary Q rating. The risk to California from this pathogen is assessed herein and a permanent rating is proposed.

History & Status:

Background: Rust diseases are caused by fungi that are obligate parasites: 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. The biggest impacts from these rusts are on the rosaceous hosts and damages include growth loss and degraded fruit quantity and quality. Numerous infections, which can be common in wet years, can reduce host vigor and increase secondary attacks by other diseases or insects. The *Gymnosporangium* rusts cause stem swelling and occasionally the ones that cause branch knots can kill their juniper hosts. Although the strange appearance and bright orange color of the telial horns on the junipers can be alarming, damage is usually minor. Rarely, numerous infections may reduce juniper vigor (Scharpf, 1993).

American hawthorn rust is the common name for the disease caused by *Gymnosporangium globosum*. This pathogen is native to the United States but historically has occurred only east of the continental divide, with one record from Alaska (Laundon, 1977). The most serious disease losses have been observed on tejocote fruit (*Crataegus gracilior*), grown in Mexico, where the pathogen was first discovered on this host in 2018 (Alvarado-Rosales, et al., 2018).

Hosts: Aecial stage - *Crataegus* spp. (hawthorn), *Amelanchier nelsonii* (serviceberry*), Malus* spp. (apple), *Pyrus* spp. (pear), and *Sorbus americana* (American mountain ash). Telial stage - *Juniperus virginiana = Sabina virginiana* (eastern redcedar) (Farr and Rossman, 2019).

Symptoms: *Gymnosporangium globosum* is a macrocyclic rust pathogen with four distinct fruiting structures producing four different spore forms, spermatia, aeciospores, teliospores, and basidiospores, that appear in a definite sequence (Agrios, 2005). It requires two taxonomically unrelated hosts: *Juniperus virginiana* (eastern redcedar) as a telial host and a *Crataegus* (hawthorn) or closely related species such as *Amalanchier, Pyrus, Sorbus*, or *Malus* as an aecial host. The pathogen produces inconspicuous galls in the branches of infected juniper trees and overwinters in the form of mycelia within the galls. The following spring, usually after a heavy rain, orange masses of telial horns extrude from the galls. Teliospores within the gelatinous horns produce basidiospores that are wind-blown to the aecial hosts and infect the mainly the leaves, and occasionally the twigs and fruit. After a successful infection, spermogonia develop in orange lesions on the upper surfaces of leaves, and after several weeks, gray spikes or aecia develop on the lower surfaces of the leaves. Aeciospores are produced and are wind-blown to juniper trees from early summer to fall. Following successful infections of juniper trees, galls are produced and during the following spring, telial horns form to produce basidiospores, thereby completing the life cycle. Generally, *Gymnosporangium* rusts complete only one disease cycle per year (Agrios, 2005). The aecial hosts can be partially defoliated but infections on fruits are less common with *G. globosum* (EPPO, 2019).

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. Any *J. virginiana* from the eastern United States should be considered to be potentially infested with. *G. globosum*. Like other *Gymnosporangium* spp., *G. globosum* can be latent during winter and may not be detectable at pre-export phytosanitary certification (EPPO, 2019). The pathogen may also move in the aecial phase with infected leaves, twigs, and fruit although signs of the pathogen are very conspicuous on these hosts.

Damage Potential: Gymnosporangium globosum causes galls, stunted and bushy branches, including witches' brooms, stem dieback, and orange gelatinous spore masses on *J. virginiana*. 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, 2019).

On their alternate hosts (e.g., apple, hawthorn, and pear), *G. globosum* causes nonlethal swellings and colorful spots on fruit, leaves, and twigs. Disease can be severe on *Crataegus* seedlings 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. *Gymnosporangium globosum* is reported to be a serious pathogen of tejocote fruit (*Crataegus gracilior*) in the Mexico where the incidence of rust affecting tejocote foliage usually ranges from 5 to 50% depending on the environmental conditions and the closeness of alternative juniper host.

Gymnosporangium globosum is not known to be present in California. If introduced, the State has suitable climates and hosts (*Malus, Pyrus*, *Sorbus*, and *Crataegus* species and *Juniperus virginiana*) for this pathogen to establish, survive, and spread (CABI, 2019). Furthermore, because cultivated, landscape, and residential junipers and apple, pear, or hawthorn trees often exist in proximity to each other within California, disease development can be greatly enhanced and likely to impact fruit production. While there is no specific information on the distance between hosts that *G. globosum* spores can traverse to infect either host, the pathogen is believed to behave similarly to a related species, *G. juniperi-virginianae*, that can infect a susceptible *Malus* host 3-5 km from a *Juniperus* host (USDA APHIS PERAL, 2018). *Juniper virginian*a is not native to California but it is present in natural environments and is commonly grown and sold as an ornamental plant in nurseries for public and private gardens and landscapes. The increased movement of juniper nursery stock and rosaceous nursery stock and fruit from regions where *G. globosum* is present can increase the risk of its introduction to California. Furthermore, because of its latency period in junipers, *G. globosum*-infected plants could be moved around for several months in the year before being diagnosed (EPPO, 2019).

Worldwide Distribution: North America: *Canada* (Ontario, Quebec, Saskatchewan), *Mexico*, *United States* (northeastern states, northcentral states, Alaska, Alabama, Florida, Georgia, North Carolina, and Texas), Asia: *Korea, China*. (Farr and Rossman, 2019)

Official Control: *Gymnosporangium globosum* is on the harmful organism list for Canada, China, Egypt, Honduras, Jordan, Korea, Mexico, Morocco, New Zealand, and Japan (USDA PCIT, 2019). It is on the EPPO A1 list in Argentina, Brazil, Chile, Jordan, Paraguay, Uruguay, and Ukraine. It is on the EPPO Quarantine list for Morocco, Mexico, and Norway (EPPO, 2019). This pathogen has a temporary Q rating in California.

California Distribution: None

California Interceptions: There was an interception of pears from Kansas at the Needles border station (see 'Initiating Events').

The risk *Gymnosporangium globosum* 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 close proximity.

   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 range for rust fungi is usually very narrow. Since this rust has alternating hosts, that range is larger. Known hosts include six genera in two families. New aecial hosts are still being described as the pathogen establishes in Asia (Hye et al., 2008).

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

4) **Economic Impact:**

   With suitable climate and available hosts, *Gymnosporangium globosum* is likely to establish and spread within California. Infected junipers may be asymptomatic during the winter months and thereby moved to non-infested regions before the pathogen is detectable. If introduced and left uncontrolled, *G. globosum* could affect commercial productions of apples, pears, crabapples, tejocotes, and junipers 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 distancing fruit trees from their alternate juniper host.

   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: Juniper trees are present in natural environments and are also commonly grown in public and private gardens and landscapes. Their presence in proximity to pear, hawthorn, apple, and crabapple trees and their critical role in the American hawthorn rust disease cycle could increase the overall impact of *G. globosum* in the environment. Subsequently, incidence of *G. globosum* could trigger additional official or private treatment programs. Home/urban gardening and ornamental plantings could also be impacted significantly.

Environmental Impact: 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.
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 globosum:* 14

Add up the total score and include it here.
-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: 14

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* **= 14**

Uncertainty: None

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Gymnosporangium globosum* is A.**

References

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Responsible Party:

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*Comment Period: 11/15/2019 through 12/30/2019

*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: A
