CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Sawadaea bicornis (Wallr. : Fr.) Miyabe 1937

Powdery mildew of maple

Current Pest Rating: Z

Proposed Pest Rating: C

Kingdom: Fungi

Phylum: Ascomycota, Subphylum: Pezizomycotina

Class: Leotiomycetes, Order: Erysiphales

Family: Erysiphaceae

Comment Period: 9/18/2020 through 11/2/2020

Initiating Event:

In September 2005, a plant pathologist from the Santa Barbara County Agricultural Commissioner's office submitted an official sample of Norway maple (*Acer platanoides*) heavily infected with powdery mildew from a wholesale ornamental nursery located in Santa Barbara, California. The leaves had mycelia, conidia, and chasmothecia. CDFA plant pathologist Samantha Thomas identified the pathogen as *Uncinula bicornis* by morphology and it was given an unofficial C rating. No additional samples were submitted until 2017 when it was detected by a resident in a regional park in Contra Costa County on bigleaf maple, *Acer macrophyllum*. At that time, it was assigned a temporary Z rating. In 2018, a sample of carrotwood, *Cupaniopsis anacardiodes*, submitted by a resident of Anaheim, Orange County was found to be positive for this mildew pathogen. One additional sample on box elder, *Acer negundo*, was submitted in July 2020 from Yolo County by CDFA botanist Genevieve Walden. The risk to California from *Sawadeae bicornis* is described herein and a permanent rating is proposed.

History & Status:

Background: In September 2002, powdery mildew was first observed on leaves of Norway maple (*Acer platanoides*) trees along the Idaho-Washington border between Moscow, Idaho and Pullman,

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Washington. By morphology, it was identified as *Sawadaea bicornis*. This pathogen species was known on multiple types of maples (*Acer* spp.) in Europe with records from at least 22 countries as well as in Japan, China, and New Zealand. Infections in Idaho and Washington were limited to young trees and it had not been seen in previous years, suggesting the introduction into the United States was recent (Nischwitz and Newcombe, 2003). Subsequently it was found in California in 2005 (see initiating event), Wisconsin (Stanosz et al., 2007), and Utah (Barney and Nischwitz, 2020).

Hosts: Acer barbinerve (bearded maple), *A. campestre* (field maple), *A. caudatum* var. *georgii* (candle-shaped maple), *A. catalpifolium, A. cissifolium* (vine-leafed maple), *A. crataegifolium (*snake barked maple), *A. ginnala* (amur maple), *A. grandidentatum* (big-toothed maple), *A. henryi* (Henry's maple), *A. hispanicum* (Italian maple), *A. hyrcanum* (Balkan maple), *A. ibericum* (Georgian maple), *A. japonicum* (Japanese maple), *A. kawakamii* (Kawakami maple), *A. macrophyllum* (bigleaf maple), *A. mandshuricum* (Manchurian maple), *A. miyabei* (Miyabe's maple), *A. mono* (painted maple), *A. monspessulanum* (Montpellier maple), *A. negundo* (box elder), *A. oblongum* (Himalayan maple), *A. nipponicum* (Nippon maple), *A. obtusatum* (Bosnian maple), *A. opalus* (Italian maple), *A. palmatum* (Japanese maple), *A. palus, A. pictum* (yellow paint maple), *A. pensylvanicum* (striped maple), *A. platanoides* (Norway maple), *A. pseudoplatanus* (Sycamore maple), *A. pseudosieboldianum* (Korean maple), *A. semenovii* (Semenov's amur maple), *A. sieboldianum* (Siebold's maple), *A. rubrum* (red maple), *A. rufinerve* (red-vein maple), *A. saccharinum* (silver maple), *A. saccharum* (sugar maple), *A. stevenii* (Balkan maple), *A. tataricum* (Tatar maple), *A. tegmentosum* (Manchurian striped maple), *A. trautvetteri* (red bud maple), *A. triflorum* (three-flowered maple), *A. turcomanicum, A. turkestanicum, A. ukurunduense, A. velutinum* (velvet maple), *Aesculus hippocastanum* (European horse chestnut), *Alectryon excelsus* (titoki), *Cupaniopsis anacardiodes* (carrotwood), *Cinnamomum* sp. (camphor*)*, and *Dodonaea viscosa* (hopbush).

Symptoms: Powdery mildews are obligate parasites that usually have a narrow host range. They produce mycelium and asexual spores called conidia, and sometimes sexual spores called ascospores in chasmothecia (completely closed fungal fruiting bodies), on the surface of plant tissues. They obtain nutrients from the plant host by sinking their haustoria (specialized absorbing organs) into the epidermal cells of the host plant but do not kill these cells.

This species appears as white to grayish powdery mildew growing in spots or patches, first on young plant tissue, eventually covering entire leaves. Mildew growth is most common on the upper side of leaves but may also be found on the underside of leaves, young shoots, and stems. Spherical chasmothecia are pinhead-sized and initially white to yellow brown in color; they blacken with age. They develop singly or in clusters on older mildew colonies and can be seen without magnification (Agrios, 2005).

This mildew species on maples and carrotwoods occurs mainly on the upper leaf surface as patches of dense, white mycelium with scattered or gregarious chasmothecia. It is not common for chasmothecia to be found in California as low temperatures are often required to trigger their formation. *Sawadaea bicornis* however, produces large numbers of cleistothecia, even in Santa Barbara in the early fall where temperatures are warm, and conditions are generally dry.

Transmission: On the plant surface, the fungal mycelium produces short conidiophores that in turn produce innumerous asexual conidia that appear as a white powdery mat. These conidia are easily dispersed by air currents to cause new infections of host plants. Depending on the species and the climate, the mycelium may produce chasmothecia containing the sexual ascospores. The disease can occur in cool or warm humid regions but can be very damaging in warm and dry climates because the spores only require humidity and not free-standing water to be released, germinate, and cause infections (Agrios, 2005). Once a plant is infected, mycelium continues to spread on a leaf surface regardless of the level of atmospheric moisture. Powdery mildews can overwinter inside dormant buds, which become infected as they form new leaves in a process called perennation. From infected buds the disease spreads to other young emerging leaves, which will begin producing new mycelial colonies and conidia immediately. Movement of infected nursery stock is likely how the pathogen spreads over long distances.

Damage Potential: In general, powdery mildews do not kill their hosts. However, they reduce photosynthesis, utilize plant nutrients, increase respiration and transpiration, impair plant growth, and can reduce yields up to 40% (Agrios, 2005). Damage to maples growing in public and private gardens, and nurseries has been reported. In Utah, 100% of the bigtooth maples in the city of Logan were affected with this mildew colonizing newly emerged leaves and covering both leaf surfaces with white mycelium (Barney and Nischwitz, 2020).

Worldwide Distribution: Argentina, Armenia, Austria, Australia, Belarus, Belgium, Bulgaria, Canada, China, Denmark, England, France, Georgia, Germany, Greece, Hungary, India, Iran, Ireland, Italy, Japan, Korea, Lithuania, Montenegro, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Scotland, South Africa, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, United States (Idaho, Utah, Washington, Wisconsin).

California Distribution: Contra Costa, Orange, Santa Barbara, and Yolo counties.

California Interceptions: None

The risk *Sawadaea bicornis* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** Powdery mildew fungi are most successful in warm and dry, with humidity but with low rainfall. These conditions exist throughout California.

   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 includes many *Acer* species worldwide. In California, it has been detected on Norway maple, box elder, bigleaf maple, and carrotwood trees.

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:** Powdery mildew fungi are obligate parasites, requiring a living host. This species produces large numbers of cleistothecia which produce sexual spores and are used as overwintering structures. It may also perinate dormant buds.

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:** Street and specimen trees can suffer esthetically, and their growth can be reduced by infection from powdery mildew.

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

Economic Impact: 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: **1**

- 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:** There are many susceptible hosts present in California landscapes and forests. Nursery stock may require preventative mildew fungicide treatments to prevent infection and movement of the pathogen

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.
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 *Sawadaea bicornis:* Medium

Add up the total score and include it here. **11**
-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 'High'. This pathogen has been detected on multiple hosts in the Bay area, Sacramento area, and in coastal southern California.

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: (Score)

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* **= 8**

Uncertainty:

Hirose et al. (2007) in a paper that describes work done on the molecular phylogeny and evolution of maple powdery mildew includes an isolate of *Sawadaea* sp. ex *A. negundo* collected in California but without a date and no additional information is given.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Sawadaea bicornis* is C.

References:

Agrios, G. N. 2005. Plant Pathology, 5th Edition. Elsevier Academic Press. 922 pg

Barney, K.E. and Nischwitz, C., 2020. First Report of Powdery Mildew (*Sawadaea bicornis*) on Bigtooth Maple (*Acer grandidentatum*) in the USA. Plant Disease, 104(5), pp.1541-1541.

Farr, D.F., and Rossman, A.Y. Fungal Databases, U.S. National Fungus Collections, ARS, USDA. Retrieved August 17, 2020, from https://nt.ars-grin.gov/fungaldatabases/

Hirose, S., Tanda, S., Kiss, L., Grigaliunaite, B., Havrylenko, M. and Takamatsu, S., 2005. Molecular phylogeny and evolution of the maple powdery mildew (Sawadaea, Erysiphaceae) inferred from nuclear rDNA sequences. Mycological Research, 109(8), pp.912-922.

Nischwitz, C. and Newcombe, G., 2003. First Report of Powdery Mildew (*Sawadaea bicornis*) on Norway Maple (*Acer platanoides*) in North America. Plant disease, 87(4), pp.451-451.

Stanosz, G., Smith, D. and Stanosz, J., 2007. *Sawadaea* Powdery Mildew of Box Elder (*Acer negundo*) in Wisconsin. Plant disease, 91(5), pp.636-636.

Responsible Party:

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***Comment Period: 9/18/2020 through 11/2/2020**

***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.

Proposed Pest Rating: C
