

## California Pest Rating Proposal for

***Bretziella fagacearum* (Bretz) Z.W. de Beer, Marinc., T.A. Duong & M.J. Wingf. 2017**  
≡ ***Endoconidiophora fagacearum* Bretz 1952**  
≡ ***Ceratocystis fagacearum* (Bretz) J. Hunt 1956**  
= ***Chalara quercina* B.W. Henry 1944**

### Oak wilt

**Current Pest Rating: None**

**Proposed Pest Rating: A**

Kingdom: Fungi, Phylum: Ascomycota,  
Subphylum: Pezizomycotina, Class: Sordariomycetes,  
Subclass: Hypocreomycetidae, Order: Microascales,  
Family: Ceratocystidaceae

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

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#### **Initiating Event:**

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

#### **History & Status:**

##### **Background:**

Oak wilt is a serious disease of many *Quercus* spp. in the Midwestern and Eastern United States, as well as Texas (Juzwik et al., 2011). The origin of *B. fagacearum* is unknown, and the disease has not spread to other continents (Juzwik et al., 2008). Oak wilt is considered one of several significant diseases that threaten the health of *Quercus* spp. worldwide, and it is a quarantine pest for many other countries. The asexual state of the fungus was described first and named *Chalara quercina* (Henry 1944). Bretz (1951) and Hepting (1951, 1952) showed that the fungus was heterothallic and that the sexual state could be grown in culture by crossing isolates of opposite mating types. Bretz (1952) named the sexual state *Endoconidiophora fagacearum*. *Endoconidiophora* was synonymized with *Ceratocystis*, and Hunt (1956) transferred *E. fagacearum* to that genus.

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Reclassification of the Ceratocystidaceae (Microascales) was done by de Beer et al., in 2017. Based on multi-gene phylogenetic inference, they have shown that *Ceratocystis fagacearum* does not belong in any of the genera in which it has previously been classified. They confirmed the synonymy of *Chalara quercina* (the original anamorph) and *Endoconidiophora fagacearum* (the name applied when the sexual state was discovered). Phylogenetic analyses confirmed that the species resides in a well-supported monophyletic lineage in the *Ceratocystidaceae* but is distinct from all other genera in the family. The new genus *Bretziella* was described to accommodate the oak wilt fungus. The genus is distinguished from all other genera of the *Ceratocystidaceae* based on the mycelial mats that it forms on infected oak trees. These mats form pressure cushions or pads that push the bark away from the underlying sapwood. This causes cracks in the bark, exposing the mats to fungal-feeding arthropod vectors, primarily nitidulid beetles. There is only one known species in the genus, *B. fagacearum*.

*Bretziella fagacearum* infects more than 30 species of *Quercus* spp. and several species in other genera of the Fagaceae based on documented natural infections and/or artificial inoculation studies. Red oaks (subgenus *Lobatae*) are highly susceptible and may die in as few as 4 to 6 weeks, or early in the subsequent growing season. American white oaks (subgenus *Quercus*) are more resistant to disease than red oaks, but no North American oak is known to be immune. Moderately resistant oak species die over a period of 2 to 4 years while highly resistant species (e.g., *Q. alba*) may dieback over many years, or may recover. To assess the susceptibility of European oaks, trees were artificially inoculated with *B. fagacearum* in West Virginia and South Carolina; all individual oaks appeared susceptible regardless of the species and died within the year following inoculation (MacDonald et al., 2001).

*Hosts: Castanea mollissima, C. pumila, C. sativa, Chrysolepis sempervirens, Notholithocarpus densiflorus, Quercus agrifolia, Q. alba, Q. chrysolepis, Q. coccinea, Q. dumosa, Q. ellipsoidalis, Q. engelmannii, Q. falcata, Q. fusiformis, Q. garryana, Q. ilex, Q. imbricaria, Q. kelloggii, Q. laevis, Q. laurifolia, Q. lobata, Q. macrocarpa, Q. marilandica, Q. muehlenbergii, Q. nigra, Q. palustris, Q. petraea, Q. phellos, Q. prinus, Q. pubescens, Q. robur, Q. rubra, Q. shumardii, Q. stellate, Q. suber, Q. texana, Q. velutina, Q. virginiana, Q. wislizenii* (EPPO, 2021; Farr and Rossman, 2021).

*Symptoms:* This disease is a vascular wilt; the symptoms can be non-specific and resemble other root and crown diseases or disorders.

Red oaks: symptoms are often expressed in spring but can continue into the summer. Symptoms start from the tip and outer edges of leaves and move toward the midrib and base of leaves, often with a distinct margin. First, leaves turn dull green or bronze, can appear water-soaked, and wilt. Later, the leaves turn yellow and/or brown, curl around the midrib, and are shed at branch tips. Finally, both green and symptomatic leaves throughout the crown fall. Symptoms often develop quickly throughout the crown in red oak. Trees may die only 1 or 2 months after symptoms appear and seldom survive more than a year.

White oaks: Symptoms can be the same as those of red oaks with quick mortality, but typically, white oaks die slowly over several years, with only a few branches showing symptoms and dying per year. Scattered branch wilt in white oaks (e.g., *Q. macrocarpa, Q. fusiformis, Q. virginiana*) that exhibit moderate resistance die slowly over several years while 'highly' resistant species (e.g., *Q. alba*) exhibit

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symptoms typical of a slow crown decline. The leaves often remain attached with discoloration only at the margins. Other times, however, white oaks seem to recover. Brown to black discoloration commonly develops in the outer sapwood of infected white oaks. This symptom is less common in infected red oaks (Juzwik et al., 2011)

Black and gray fungal mats are common in infected red oaks but less common or less apparent in white oaks. The mats form beneath the bark soon after mortality. These mats occasionally raise and crack the bark (USDA, 2011).

*Transmission:* *Bretziella fagacearum* normally spreads slowly (over one to several years) between a diseased and a nearby healthy tree whose root systems are connected by grafts. Spores move passively in the transpiration stream of the xylem from wilted oaks to actively transpiring, healthy oaks leading to enlargement of oak wilt centers. Oak bark beetles, *Pseudopityophthorus* spp., and sap feeding *Nitidulidae* beetles, are attracted to the aromatic fungal mats produced by the pathogen under the bark of the trees. Fungal spores adhere to their bodies as they crawl over the mats, and they can carry the spores to healthy trees. Long distance spread occurs with movement of infected nursery stock. Human-aided spread of diseased oak material with sporulating mats infested with insect vectors is suspected to be the pathway implicated for several major extensions of the oak wilt range, e.g., in north central states and in New York (Jensen-Tracy et al., 2009; EPPO, 2021).

Sexual reproduction of the fungus is facilitated by insects that can carry conidia of opposite mating types. When mating types are joined, sexual spores are produced exuded in a gelatinous matrix from the resulting perithecia. Mat production may be limited by high summer temperatures and colonization by competing fungi. Mats deteriorate with higher temperatures, colonization by other microorganisms, and activity of larvae from insects utilizing mats for brood development. The pathogen usually dies in the above-ground parts of a colonized tree within one year of wilting. The root system may last longer, especially if the roots are grafted to those of neighboring trees (EPPO, 2021).

*Damage Potential:* The greatest negative economic impact from oak wilt has been in urban and community forests due to tree removal and replacement costs for highly valued oaks. Effects on forestry vary by region. In West Virginia, it is estimated that less than one tree per km<sup>2</sup> of oak forest is killed by the pathogen each year. In contrast, tens of thousands of primarily red oak species die each year in portions of Michigan, Minnesota, Texas, and Wisconsin where epidemics are on-going. Economic losses include reduced production of timber and decreased property values in heavily impacted areas. Salvage timber sales do occur for domestic production and sales of salvaged timber in oak wilt control zones covers the cost of treatments (Haight et al., 2011).

**Worldwide Distribution:** United States (Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Virginia, West Virginia, Wisconsin (EPPO, 2021; CABI-CPC, 2021).

**Official Control:** *Bretziella fagacearum* is on the USDA PCIT's harmful organism list for Albania, Azerbaijan, Bangladesh, Canada, Chile, China, Colombia, Ecuador, Eurasian Customs Union, European

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Union, Georgia, Holy See (Vatican City State), India, Israel, Japan, Jordan, Mexico, Moldova (Republic of), Monaco, Morocco, Namibia, New Zealand, Norway, Peru, San Marino, Serbia, South Africa, Taiwan, Tajikistan, Tunisia, Turkey, Turkmenistan, Ukraine, United Kingdom, and Uzbekistan (USDA, 2021). It is on the EPPO's A1 list for Asia and Pacific Plant Protection Commission, Chile, China, Eurasian Economic Union, European Plant Protection Organization, European Union, Georgia, Inter-African Phytosanitary Council, Jordan, Kazakhstan, Russia, Turkey, Ukraine United Kingdom, and a quarantine pest for Canada, Israel, Moldova, Morocco, Norway, and Tunisia (EPPO, 2021).

California maintains a State Exterior Quarantine 3251. CHESTNUT BARK DISEASE AND OAK WILT DISEASE <http://pi.cdfa.ca.gov/pgm/manual/pdf/302.pdf>

The quarantine is against the pests, their hosts, and possible carriers:

A. Pests. Chestnut bark disease (*Endothia parasitica*), a fungus carried by birds, insects, water, wind, and shipment of nursery stock and unpeeled wood; and oak wilt disease (*Ceratocystis fagacearum*), a fungus carried under the bark of live or dead trees or parts of trees and by oak bark beetles and sap beetles.

B. Area Under Quarantine. All states and districts of the United States except the State of Arizona.

C. Articles and Commodities Covered. All species and varieties of chestnut (*Castanea spp.*), chinquapin (*Castanopsis spp.*), oak (*Quercus spp.*), and tanbark oak (*Lithocarpus densiflora*) trees, plants, and parts thereof including grafts, cuttings, scions, nuts (except acorns), leaf mold, firewood, and unpeeled logs are hereby declared to be hosts and possible carriers of the pests herein quarantined against

**California Distribution:** None

**California Interceptions:** None

The risk *Bretziella fagacearum* would pose to California is evaluated below.

## Consequences of Introduction:

- 1) Climate/Host Interaction:** This disease and its vector occur from Texas to New York, representing a wide range of climates.

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 is mostly *Quercus spp.*
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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:** The pathogen spreads slowly from tree to tree through root grafts, but also with flying vectors that carry spores on their bodies.

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 lethal pathogen of oak trees. It is a quarantine pest in many other countries.

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

**Economic Impact: A, C, E**

**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:** Invasive oak pathogens can have a devastating effect on coastal forests in California.

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

**Environmental Impact: A, B, C, 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.**

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- 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 *Bretziella fagacearum*:**

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:**

None

**Conclusion and Rating Justification:**

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Based on the evidence provided above the proposed rating for *Bretziella fagacearum* is A.

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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).

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### 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;

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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**

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