CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Cryphonectria parasitica (Murrill) M.E. Barr 1978
≡*Endothia parasitica* (Murrill) P.J. Anderson & H.W. Anderson 1912

Chestnut blight

Current Pest Rating: None

Proposed Pest Rating: A

Kingdom: Fungi, Phylum: Ascomycota,
Subphylum: Pezizomycotina, Class: Sordariomycetes,
Subclass: Sordariomycetidae, Order: Diaporthales,
Family: Valsaceae

Comment Period: 02/16/2022 through 04/02/2022

Initiating Event:

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

History & Status:

Background:

Chestnuts (genus *Castanea*, family Fagaceae) occur in temperate climates worldwide and have ecological, economic, and cultural importance in their native ranges of North America, Europe, the Caucasus Mountains, and eastern Asia. Until the beginning of the 20th century, the American chestnut, *Castanea dentata*, was a dominant forest species in the eastern United States and parts of southern Canada, its range extending from Georgia and Mississippi northward into Ontario and New England. It was often the largest, tallest, fastest growing, and most common tree in those forests. It provided edible chestnuts, a source of food for humans and for wildlife, and important habitat for wildlife. The wood was rot-resistant, straight-grained, and suitable for furniture, fencing, and building materials. Chestnut was preferred in times of early colonization for log cabin foundations, fence posts, flooring, and caskets. Later, railroad ties and both telephone and telegraph poles were made from chestnut, many of which are still in use today (Agrios, 2005; CABI, 2021).

Castanea dentata was annihilated in North America as a timber and nut tree by the exotic fungal pathogen *Cryphonectria parasitica. This pathogen has* killed billions of trees and brought the species to the brink of extinction. In 1904, blight symptoms were first observed on large chestnut trees at the Bronx Zoo. These trees began to turn brown and die. It is believed that the pathogen came from East Asia with Japanese chestnut trees brought in for commercial purposes (Miller et al., 2014). From New York City, chestnut blight spread so rapidly throughout eastern North America that by the 1920s the blight could be found throughout the entire natural range of *C. dentata*. *Cryphonectria parasitica* reduced the American chestnut and several eastern chinquapins (see explanation below) from their former dominance in the eastern forest ecosystem to early-successional-stage shrubs (Anagnostakis, 2000). The chestnut lumber industry is gone, and the bulk of the 20-millon pound annual nut crop now comes from introduced European or Asian chestnut species grown here or from nuts imported from Italy or Turkey.

The common name “chinquapin” is an eastern indigenous American name applied to various chestnut-like members of the family Fagaceae, including members of the genera *Castanea*, *Castanopsis*, and *Chrysolepis*. Members of the genus *Chrysolepis* were formerly included in *Castanopsis*, which is a large Asian genus like *Castanea*, but have been found to be distinct based on morphological and molecular comparisons. The common name “chinquapin” is loosely applied to taxa with nuts like small chestnuts. (Farr and Rossman, 2022; R. Price, Primary State Botanist, pers. comm).

The fungal pathogen that causes chestnut blight was identified in the early 20th century and was initially named *Diaporthe parasitica*, and then *Endothia parasitica* (Shear et al., 1917). The name *E. parasitica* was used until Barr (1978) placed the fungus in the genus *Cryphonectria*. *Cryphonectria* and *Endothia* ended up in different families, Valsaceae and Gnomoniaceae, respectively, based on the arrangement of perithecia, either valsoid or diatrypoid, in stromatic tissues. They also differ in the shape and septation of their ascospores. Both *Cryphonectria* and *Endothia* have *Endothiella* conidial states, but this name is seldom used for the chestnut blight fungus as both asexual and sexual states are typically present in the same stroma (Farr and Rossman, 2022).

Chestnut blight has been found and eradicated multiple times in Western North America, in British Columbia, Washington, Oregon and California. Although there are no native *Castanea* sp. in western North America, America, European and Asian chestnuts have all been planted there. The first California interception was in 1914 in San Francisco on trees imported from Japan. In 1935, infected, Chinese chestnuts (*C. mollissima*) were found on the UC Berkeley experimental growing grounds in Alameda County. In 1942 in Chico (Butte County), a chestnut tree that was either *C. stativa* or a hybrid of *C. sativa x mollissima* with cankers that originated in Washington was found in a varietal planting in the USDA Plant Introduction Garden. In 1946, infected *C. sativa* (European chestnut) were found near Placerville at the USDA’s Institute of Forest Genetics.

The largest California outbreak of chestnut blight occurred from 1934-1964 in San Joaquin County where the pathogen was found to be infecting Japanese and European chestnuts in a commercial grove in the Stockton. The eradication efforts took 25 years and involved more than 250 trees on

multiple properties. A statewide survey did not detect any more infected trees (Holderman, 1984). In 1986, several young European chestnut trees were found infected in San Joaquin. Only trunk cankers were found, with mycelial fans beneath the bark observed by CDFA plant pathologists D. Opgenorth and T. Tidwell (Opgenorth, 1986). No information about the location of this find, or about the disposition of the trees, is in CDFA files. No official detections of *C. parasitica* have been made anywhere in California since 1986 (Pers comms: T. Tidwell, Primary State Plant Pathologist (retired), and L. Pinfold, Assistant Agricultural Commissioner, San Joaquin County).

Hosts: The main host is *Castanea* (chestnut) and *Castanopsis* (chinquapin). Other reported hosts in the Fagaceae are *Fagus sylvatica* (European beech), and *Quercus* spp. Also reported from other hosts, including some in other families, but these are not verified (Farr and Rossman, 2022).

Symptoms: The most common symptoms of chestnut blight in California are cankers. The first evidence on trees may be a small, flat, orange-brown area on the smooth bark tissues of the main stem or branches. The lesions develop into sunken cankers as buff-colored mycelial fans develop in the bark, at one or more bark depths in the phloem to the vascular cambium. On trees of moderate diameter (less than one foot) with smooth bark, cankers are usually darker than healthy wood, slightly depressed in the center with raised margins, and have deep cracks or discolored fissures. Close observation may reveal orange pustules or fruiting bodies of the fungus on the surface of the canker. Cutting into the canker should expose a distinct margin of healthy wood and a cream to tan or brown mycelial mat. As the cut surface rapidly oxidizes, the mycelial mat will darken. On older trees with thick, rough bark, discolored sunken or fissured cankers may not be evident. In this case, observation of loose bark or wounded areas may be indicative of canker activity. When these conditions are not obvious, orange pustules may still be found deeply situated in the natural bark fissures of older trees and seen in cross section (Opgenorth et al., 1986).

Soon after infection, depending on the diameter of the stem, the canker expands around the circumference of the stem and the vascular cambium is girdled and killed on susceptible chestnuts. Wilting and death of the foliage above the branch or stem canker follows. In the eastern United States, the most common symptom of chestnut blight is blackening of leaves when young twigs have been girdled by the fungal cankers. The typical flagging of shoots has not been noticed in California. Small, yellowish to orange stromata containing conidiomata break through the bark and become larger and more numerous as the canker grows. Distinctive yellow tendrils (cirrhi) of conidia extrude from the stroma in wet weather. The pathogen is also known to produce typical cankers on some live oak (*Quercus virginiana*) and may grow as a saprophyte with orange pustules produced on members of the genera *Acer, Carya* and *Rhus*. (CABI, 2021).

Transmission: The pathogen produces both asexual pycnia with conidia and sexual perithecia with ascospores, often in the same stromatal structure. Stromata are typically slightly to moderately erumpent through the bark, are composed of both fungal and host cells. During moist periods, conidia are expelled in mucilaginous spore tendrils that are yellowish when young and coral red when old. The tendrils readily wash away during rains. Ascospores are forcibly released during rainy weather in a gelatinous envelope. Some stromata contain conidiomata and no ascomata. Spores are spread locally

by splashing rain, wind, and insects and over long distances, by birds or infected nursery stock. Ascospores are carried by eddies of wind to new hosts or to infect other parts of the same tree. As insects, birds, or other wildlife contact the cankers, they can mechanically disperse the conidia. Once on a new tree, or new area of the tree, the spores germinate and infect the inner bark through insect wounds and fissures in the outer bark. Seed transmission is rare. The fungus persists for years in short-lived but recurrent sprouts from old chestnut roots, and in less susceptible hosts (CABI, 2022).

Damage Potential: The loss of the American chestnut from eastern forests is often cited as one of the worst ecological disasters in modern times. The American chestnut was the most important tree species in the former chestnut-oak forest and a dominant species in the mixed mesophytic forest of eastern North America. It was very important economically for timber, edible nuts, and tannins. Today chestnuts primarily survive as understory sprouts, unable to live to maturity, no longer able to evolve as a species (Diller, 1965). Work on breeding chestnuts for resistance to blight and biocontrol using hypovirulent strains of *C. parasitica* that are infected with dsRNA hypoviruses has yielded some successes (CABI, 2022). California does not have native *Castanea* spp.

Worldwide Distribution: Africa: *Tunisia*. Asia: *Azerbaijan, China, Georgia, India, Iran, Japan, Lebanon, North Korea, South Korea, Taiwan, Turkey*. Europe: *Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, France, Germany, Greece, Hungary, Italy, Netherlands, North Macedonia, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Switzerland, Ukraine, United Kingdom*. North America: *Canada, United States* (Arkansas, Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Tennessee, Texas, Vermont, Virginia, Washington, West Virginia, Wisconsin. Oceania: *Australia*. (CABI-CPC, 2022)

Official Control: *Cryphonectria parasitica* is on the USDA PCIT's harmful organism list for Albania, Algeria, Argentina, Australia, Chile, Colombia, Ecuador, European Union, Guatemala, Holy See (Vatican City State), India, Israel, Madagascar, Monaco, Morocco, Namibia, Nauru, New Zealand, Nigeria, Norway, Paraguay, Peru, San Marino, South Africa, Serbia, Taiwan, Tunisia, Turkey, United Kingdom, Uruguay, Viet Nam (USDA, 2022). It is on the EPPO's A1 list for Argentina, Brazil, East Africa, European Union, Kazakhstan, Paraguay, Turkey, Ukraine, United Kingdom; on the A2 list for China, Jordan, Russia, Asia and Pacific Plant Protection Commission, Eurasian Economic Union, European and Mediterranean Plant Protection Organization, and a quarantine pest for Canada, Israel, Mexico, Moldova, and Norway (EPPO, 2022).

California maintains a state exterior quarantine as follows:
3251. CHESTNUT BARK DISEASE AND OAK WILT DISEASE
http://pi.cdfa.ca.gov/pqm/manual/pdf/302.pdf
The quarantine is against 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. Area Under Quarantine: All states and districts of the United States except the State of Arizona.

Other states that have external quarantines against chestnut blight are
Oregon (603-052-0075) Quarantine; Chestnut Blight
https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=157966
and
Washington (WAC 16-470-440): Chestnut quarantine
https://app.leg.wa.gov/WAc/default.aspx?cite=16-470-440&pdf=true

California Distribution: None known, see background information for historical detections

California Interceptions: None

The risk *Cryphonectria* parasitica would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** The disease occurs across a wide range of climates in the Eastern United States. It was hoped that it would be reduced or eliminated by hot, dry summers in California, but it was able to persist in San Joaquin County for many decades. Hosts are not widely cultivated in California

   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:** The host range includes many members of the family Fagaceae, but there is a range of virulence depending on the host

   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 very efficiently with two types of spores and can be carried incidentally by insects

   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:** Susceptible hosts of economic significance are not widely grown in California, likely in some part out of fear of this pathogen. It is a quarantine pest in California and many other places

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

Economic Impact: A, C

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:** Any detections in landscapes or nurseries would likely trigger an Emergency Quarantine Response from CDFA Pest Exclusion. Susceptible hosts are grown in small orchards and as specimen trees but there is no chestnut industry in California, for timber or nuts.

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

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 *Cryphonectria parasitica:* Medium

Add up the total score and include it here. **12**
-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.

   Detections in San Joaquin County are listed in French (1989), they date back to 1986. There have been no more recent detections. At that time, Chestnut blight was rated as an "A" pest in the California Consolidated Pest Rating Booklet. As a disease is of regulatory significance, and appropriate action would have been taken when the disease is found (Opgenorth et al., 1986).

   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* ***= 12***

Uncertainty:

None.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Cryphonectria parasitica* is A.

References:

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Responsible Party:

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***Comment Period: 02/16/2022 through 04/02/2022**

***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.

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
