

California Pest Rating Proposal for *Ganoderma brownii* (Murrill) Gilb. 1961

Current Pest Rating: Z

Proposed Pest Rating: C

Kingdom: Fungi, Division: Basidiomycota,
Class: Agaricomycetes, Order: Polyporales,
Family: Ganodermataceae

Comment Period: 03/04/2021 through 04/18/2021

Initiating Event:

The exotic fungus *Ganoderma adpersum* has been introduced into California and is causing significant woody decay and root rot in almond trees in the Central Valley (<http://blogs.cdfa.ca.gov/Section3162/?p=3501>). *Ganoderma* spp. have traditionally been described morphologically, and species-level identifications have not been validated with genetic data. It is important to be able to distinguish exotic from endemic *Ganoderma* species and to assess their risk to California forests, landscapes, and agriculture. Samples of *Ganoderma* spp. from multiple counties have been submitted to CDFA's Plant and Pest Diagnostics Center at Meadowview. CDFA plant pathologist Albre Brown identifies them to species using multigene sequence analysis. She has made multiple detections of *G. brownii*, known to be endemic to California, and assigned it a temporary Z rating. The risk to California from *G. brownii* is evaluated herein and a permanent rating is proposed.

History & Status:

Background: *Ganoderma* spp. can saprophytically decay dead tree trunks or roots, or pathogenetically invade wounded trees and kill sapwood, causing heart rots or butt rots. Affected trees will exhibit varying degrees of dieback, including possible changes in foliage color, and have a generally unhealthy appearance. With time, the infected trunk wood and roots rot, become spongy and discolored, decompose, and disintegrate. Trees can decline or die. Field identification is often based on the presence and forms of basidiocarps, large fungal fruiting bodies that can be produced on the trunks of infected trees. *Ganoderma brownii* is the most prevalent dull, brown-capped *Ganoderma* species in the state and has been associated with fallen trees, and trunk rots of citrus (Adaskaveg and Ogawa, 1990).

Ganoderma brownii (syn. *Elfvigia brownii* Murrill), was described approximately 100 years ago on California bay laurel (*Umbellularia californica*) (Lowe and Gilbertson, 1961).

Hosts: *Citrus x aurantifolia* (key lime), *C. x latifolia* (Bearss lime), *C. x limon* (lemon), *C. maxima* (pomelo), *C. x meyerii* (meyer lemon), *Citrus reticulata* (mandarin), *C. x sinensis* (sweet orange), *Citrus* sp. (citrus), *C. x paradisi* (grapefruit), *C. x tangelo* (tangelo), *Eucalyptus* sp. (gum trees), *Hakea* sp. (needle bush), *Prunus cerasus* (cherry laurel), *P. dulcis* (almond), *P. persica* (peach), *Quercus* sp. (oak), *Quercus wislizenii* (interior live oak), *Schinus* sp. (peppertree,) *Umbellularia* sp. (bay laurel) (French, 1989; Farr and Rossman, 2021).

Symptoms: In general, trees affected by *Ganoderma* develop widespread, white rot decay of sapwood in the butt and major roots. Other symptoms include loss of vigor, undersized and sometimes yellowing or wilting leaves, thin crowns, and dead branches. Some infected trees may die while others are weakened and fall by windstorms because of internal decay. In advanced stages of decay, wood is light colored and stringy or spongy with a mottled rot where the loss of lignin exceeded that of cellulose. Large, reddish brown basidiocarps of *G. brownii* grow from roots or butts. Progression of decay may be favored by predisposing conditions from wounds, such as sunburn injury or lower trunk wounds created by cultivation and mechanical harvesting (Adaskaveg and Ogawa, 1990; Sinclair and Lyon, 2005).

Transmission: Basidiocarps of *Ganoderma* can be perennial brackets or conks that can reach 30 inches wide and 8 inches thick. They are semicircular and may be either stalked or sessile. They produce millions of basidiospores that are released under a variety of environmental conditions and for months at a time. When the soil is dry, the brackets pull moisture from the tree to continue spore release. Pathogen spread is via airborne spores or possibly by growing through the soil from infected to healthy tree roots, or when roots are grafted together. When *Ganoderma* spp. infect main or lateral roots, often infecting a wound, they form a whitish mat of mycelium under the bark that later turns brown. The white mycelium grows upward on crown roots to the trunk, where the fungus develops strands or ribbons called rhizomorphs. These structures produce the brackets or conks at or near the base of the tree, usually close to the original wounds (Sinclair and Lyon, 2005).

Damage Potential: *Ganoderma* spp. are frequently observed on fallen trees. It can be difficult to determine if they are acting as pathogens or as decay organisms breaking down dead wood. *Ganoderma brownii* is capable of infecting living trees through wounds. If the fungal growth is restricted to the heartwood, only the structural integrity of the tree is impaired. The infection may result in limb or trunk breakage due to wind or tree weight. Otherwise, trees with heart rot may remain productive for many years.

Worldwide Distribution: Brazil, United States (California) (Farr and Rossman, 2021; Torres-Torres et al., 2012).

Official Control: None

California Distribution: There are official detection records in Del Norte, Humboldt, and Marin counties and from published surveys in the Sacramento and San Joaquin valleys (Adaskaveg and Ogawa, 1990). The original record is from Strawberry Canyon, in Alameda County.

California Interceptions: None.

The risk *Ganoderma brownii* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** *Ganoderma brownii* has been found in fruit and nut orchards within the Sacramento and San Joaquin valleys in addition to Marin County in the Bay area. It has also been collected in Del Norte and Humboldt counties. It has therefore demonstrated its capability to establish widely on multiple hosts within the State.

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:** *Ganoderma brownii* has a moderate host range, including fruit, landscape, and forest 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:** Numerous basidiospores are produced by the fungus but are dependent on wind currents for dispersal and spread to non-infected trees. Spread through the soil is also a possibility but not widely documented.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 2

- 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: *Ganoderma brownii* causes wood decay and root rot resulting in decreased structural strength, growth, and stand of infected trees. Losses in citrus orchards from *Ganoderma* spp. have been documented, but it is not known to what extent *G. brownii* was involved (Futch et al., 2006; Adaskaveg and Ogawa, 1990).

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

Economic Impact: A

- 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: *Ganoderma brownii* is endemic to California forests. It has a role in forest ecosystems as a wood-degrading fungus. It can also be a pathogen of fruit trees and protecting them from wounding can be important to prevent fungal infection.

Environmental Impact: 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: 2

- 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.
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Consequences of Introduction to California for *Ganoderma brownii*: Medium

Add up the total score and include it here. **10**

-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.

Ganoderma brownii is endemic to forests in Northern California and in the Bay area. It has been found attacking fruit trees and citrus in the Sacramento and San Joaquin valleys. There are no records from citrus areas in the desert or Southern California.

Evaluation is 'Medium'.

Score: -2

-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:

With continued research, the genus *Ganoderma* is likely to undergo further revisions as species are epityped with genetic data.

Conclusion and Rating Justification:

Based on the evidence provided above, the proposed rating for *Ganoderma brownii* is C.

References:

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Tidwell, T.E. 1990. Index of Diseases and Microorganisms Associated with Eucalyptus in California. State of California Department of Food and Agriculture, 55 pages.

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Responsible Party:

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***Comment Period: 03/04/2021 through 04/18/2021**

***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.

Proposed Pest Rating: C
