

California Pest Rating Proposal for

Neofusicoccum nonquaesitum Inderb., Trouillas, Bostock & Michailides 2010

Current Pest Rating: Z

Proposed Pest Rating: C

Kingdom: Fungi; Division: Ascomycota;
Class: Dothideomycetes; Order: Botryosphaerales;
Family: Botryosphaeriaceae

Comment Period: 04/08/2021 through 05/23/2021

Initiating Event:

In June 2006, a residential apple tree (*Malus domestica* cv. Honeycrisp) was submitted to the California Department of Food and Agriculture's Plant Pest Diagnostics Center. The bare root tree was planted in January 2006 in a landscape in Santa Clara Co. In the spring, the tree began exhibiting branch cankers and dieback symptoms. Plant pathologist Suzanne Rooney-Latham isolated a fungus from the cankers. Using rDNA sequencing of the ITS region, she showed it was 100% similar to the holotype isolate of *Neofusicoccum nonquaesitum* Inderb., Trouillas, Bostock & Michailides (Inderbitzin et al. 2010). It was assigned a temporary Z rating. The risk to California from *N. nonquaesitum* is described herein and a permanent pest rating is proposed.

History & Status:

Background: Members of the Botryosphaeriaceae are cosmopolitan fungi that exist on a continuum with some species seemingly innocuous endophytes, frequently isolated from non-symptomatic tissues, to destructive, aggressive pathogens. The family has numerous, mainly woody hosts, including fruit, nut, ornamental, and forest trees and shrubs. The genus *Botryosphaeria* once contained many strains that were classified broadly as *B. dothidea* based on morphological and serological analyses. In the last 20 years, research has produced more than a dozen new genera, including *Neofusicoccum*, *Diplodia*, *Dothiorella* and *Lasiodiplodia* (Crous et al., 2006). When Inderbitzin et al. (2010) used a multigene phylogenetic approach to study diversity of Botryosphaeraceae species on almonds in California, they described *N. nonquaesitum* causing band cankers in Colusa County. Additional isolates in their study came from almonds and California bay laurels in Butte and Napa counties, and

blueberries in Chile. The etymology of the species name is negative of the Latin 'quaesitus', meaning special, to describe it as having typical (not special) *Neofusicoccum* morphology.

In addition to apple, almond, and California bay laurel, additional hosts found in California include tanoak, walnut, giant sequoia and avocado, while blueberries have been identified as a host only in Chile (Carrillo et al., 2016; Rooney-Latham et al., 2012; Rooney-Latham and Soriano, 2016; Perez et al., 2014; Chen et al., 2014).

Hosts: *Araucaria araucana* (monkey puzzle tree), *Juglans regia* (English walnut), *Malus domestica* (apple), *Notholithocarpus densiflorus* (tanoak), *Persea americana* (avocado), *Prunus dulcis* (almond), *Quercus agrifolia* (California live oak), *Sequoiadendron giganteum* (giant sequoia), *Umbellularia californica* (California bay laurel), *Umbellularia* sp., *Vaccinium corymbosum* (blueberry), *Vaccinium* sp. (Farr and Rossman, 2021; Trouillas et al., 2011).

Symptoms: On almond, *N. nonquaesitum* and several other closely related species can cause band cankers. These are distinct in that they circle branches or the main trunk instead of growing longitudinally as other canker fungi generally do. Band cankers develop on the trunk or the lower portion of scaffold branches of almond trees but do not extend into the soil. The pathogen kills the bark and cambium layer, and the affected area becomes sunken. Copious amounts of amber-colored gum exudes from the cankered area, forming a necklace or band of gumballs around the affected part of the tree. Foliage and smaller branches above the cankers wilt and die back. It occurs most often on vigorously growing varieties and trees that are 3-6 years old. (Adaskaveg et al., 2017).

Symptoms of *N. nonquaesitum* infection of avocados includes shoot blight and dieback, leaf scorch, branch cankers, and stem end rot of fruit. Large, deep cankers form under the bark, which becomes dry and brittle and produces a powdery exudate (Carrillo et al., 2016). Affected branches are usually higher above the ground, beginning around the first main branch crotch or higher. Canker can affect twigs and smaller branches, as well as the upper portion of the trunk and larger limbs (Eskalen and Faber, 2016).

In commercial fields of highbush blueberries in Chile, diseased plants had yellowing and fading of foliage, dieback, unilateral stem death, and basal cankers with vascular discoloration and even plant death. Cankers were mostly detected at the base of semi and lignified stems. The severity of the necrotic lesions was higher in young, more tender tissues, and lower in older more lignified tissues (Perez et al., 2014).

Coniferous hosts, including the giant sequoia in California and the monkey puzzle tree in Chile, can exhibit discoloration and necrosis of leaves, discoloration of internal stem tissues, branch cankers and dieback, and whole tree death (Perez et al., 2017; Rooney-Latham et al., 2012).

Transmission: Infection takes place in almonds primarily through growth cracks in the bark on young trees, with additional infection possibly via lenticels and pruning wounds. Sources of airborne conidial inoculum can be inside the orchard on stumps or living trees, and from outside of the orchard in riparian areas where other hosts are growing. More frequent pruning, such as is done in high-density

apple or almond orchards, can increase the probability of infection among trees, leading to an increase in canker development and a possible decrease in yield as branches with cankers either die back or are pruned out.

Heavy rainfall causes increased spore production and leads to increased rates of infection. Spores are spread by air and rain or irrigation splash off of infected tissues. Trees that are stressed are much more susceptible. Common stresses include poor irrigation, low-quality irrigation water, nutritional deficiencies, or severe insect or mite feeding. Drought stress especially promotes symptom development and triggers latent infections to develop into disease (Adaskaveg et al., 2017; Eskalen and Faber, 2016).

Damage Potential: Branch canker and dieback can be a serious problem in new plantings. Young trees sometimes arrive from the nursery with latent infections at the graft union. If the infection kills the graft union, the scion will die leaving a canopy of brown, dry leaves, with shoots and green leaves sprouting from the rootstock. The graft union may be unusually swollen and rough before the young tree dies. Inside the graft union, dark, discolored wood extends through the entire width of the small trunk. This disease is less important on established, older trees. Some of the smaller branches and sometimes large limbs can die back. Usually, an entire older tree is not affected, and the tree remains productive. In severe cases, the main trunk may be girdled, killing the tree. When branches are damaged or lost, yield of fruit or nuts is decreased (Adaskaveg et al., 2017; Eskalen and Faber, 2016).

For blueberries, Espinoza et al. (2009) reported between 15 and 45% disease incidence on the shrubs in Southern Chile which had a negative impact on fruit yield.

Worldwide Distribution: Chile and United States (California) (Farr and Rossman, 2021).

Official Control: *Neofusicoccum nonquaesitum* is on USDA-PCIT's harmful organisms list for Peru.

California Distribution: Alameda, Butte, Colusa, El Dorado, Marin, Napa, Orange, San Luis Obispo, Santa Barbara, Santa Clara, and Yolo counties.

California Interceptions: None

The risk *Neofusicoccum nonquaesitum* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** This fungus is likely to be found wherever its hosts can be grown.

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 several families of woody plants, both agronomic and forest species.

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 mainly spreads with asexual spores in splashing water. It requires a wound or natural opening to infect.

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: The loss of branches has a major impact on orchard health and productivity, especially for almonds, avocados and blueberries. Pruning practices are often modified to avoid wet periods, or pruning is increased to remove cankers from the canopies.

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

Economic Impact: A, 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: There are several California native trees that are hosts including the giant sequoia and tanbark oak. Trees may not often be killed but can suffer losses of branches.

Environmental Impact: A

- 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.

Consequences of Introduction to California for *Neofusicoccum nonquaesitum*: 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.

Evaluation is 'high'. The pathogen has been detected in 11 counties to date.

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 = 9*

Uncertainty:

In the past, it is likely that disease caused by *N. nonquaesitum* would have been identified as *Botryosphaeria* spp. or possibly as *Dothiorella* spp. It is likely that if a review could be made of these detections, many more hosts and a wider distribution of *N. nonquaesitum* would be found in California.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Neofusicoccum nonquaesitum* is C.

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Perez, S.F., Merino-Gergichevich, C., and Guerrero, J.C. 2014. Detection of *Neofusicoccum nonquaesitum* causing dieback and canker in highbush blueberry from southern Chile. J. Soil Sci. Pl. Nutr. 14(3): 581-588.

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Rooney-Latham, S., Tidwell, T.E., Blomquist, C.L., and Peek, K.S. 2012. First Report of *Neofusicoccum nonquaesitum* Causing Branch Cankers on Giant Sequoia (*Sequoiadendron giganteum*) in North America. Pl. Dis. 96: 905.

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Responsible Party:

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***Comment Period: 04/08/2021 through 05/23/2021**

***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
