cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Phymatotrichopsis omnivora (Duggar) Hennebert 1973

Current Pest Rating: A

Proposed Pest Rating: A

Comment Period: 11/15/2019 through 12/30/2019

Initiating Event:

A periodic review of CDFA's state interior and exterior quarantines for Ozonium root rot has triggered a request for a pest rating review. The risk this pathogen poses to California is reviewed herein and a permanent rating is proposed.

History & Status:

Background: *Phymatotrichopsis omnivora*, known by the common names cotton root rot, Texas root rot, and Ozonium root rot, is native to the southwestern United States and northern Mexico. It was first described in Texas more than a century ago (Duggar, 1916). It has perhaps the widest host range and is one of the most destructive of all plant pathogenic fungi, with the ability to parasitize thousands of wild and domesticated dicotyledonous plants. Its hosts include many fruit, forest, and shade trees, *most* vegetables and flowers, ornamental shrubs, and weeds. The greatest agronomic losses occur in cotton crops in the area from Texas to Arizona and into Northern Mexico (Agrios, 2005; Isakeit, 2016; Farr and Rossman, 2019).

There is a state interior quarantine in the California desert to prevent movement of *Phymatotrichopsis omnivora*. The area under quarantine includes all Imperial County and portions of Riverside (Palo Verde and Coachella Valley areas) and San Diego (Jacumba area) Counties. Regulated articles include soil and nursery stock or plants with roots. Exceptions from the quarantine are a) house plants grown in the home and not for sale, b) smooth root vegetables such as potatoes, sweet potatoes, carrots, onions, turnips, and beets (but not mangels and sugar beets) if not for planting and free from moist clods of soil, c) sugar beets for processing, provided the beets are screened prior to or while loading to remove moist clods of soil, d) cactus plants with roots, provided the roots are dry and free of soil, e)

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aquatic plants such as water hyacinth and water lilies, f) dry resurrection plants, g) orchid plants growing in osmunda fibre, and h) air-layered rooted cuttings, if free from soil (CDFA, 2019).

The fungus survives best and causes considerably more damage to plants growing in alkaline, calcareous, black, heavy clay and clay loam soils that are poorly aerated. The fungus requires high temperature and adequate soil moisture for greatest activity. The soil pH needs to be between 7.0 and 8.5. It can grow at a depth of 2 meters and has the potential of surviving for many years in land that is maintained fallow, with no plants growing (Agrios, 2005; Lyda, 1978).

Synonyms for *P. omnivora* include *Phymatotrichum omnivorum* and *Ozonium omnivorum*. This fungus had long been affiliated with polypore fungi of the Basidiomycota, but its precise taxonomy remained uncertain. More recently constructed phylogenetic trees based on nuclear ribosomal DNA, RNA polymerase II subunit 2 (RPB2), and beta-tubulin genes indicate that *P. omnivora* should be placed in the Order Pezizales within the Ascomycota. Based on rDNA sequences, it was found to be most similar to the doughnut fungus, *Rhizina undulata* in the monotypic family Rhizinaceae, which is parasitic on conifer seedlings (Marek, 2005).

Hosts: The major host of this fungus is cotton (*Gossypium herbaceum, G. hirsutum*, and *G. barbadense*), but it is also pathogenic on more than 2300 species of dicotyledons including 31 economic field crops, 58 vegetable crops, 18 fruits and berries including citrus, 35 forest trees and shrubs, 7 herbaceous ornamentals, and 20 weeds (Streets, 1937; Streets and Bloss, 1973; Farr and Rossman, 2019; French, 1989). The name “omnivora” is a tribute to its extremely large list of hosts. Monocotyledons are thought to be immune, but fungal strands have reportedly been found on monocot hosts. Many native plants within the native range of this pathogen are either resistant or tolerant.

S*ymptoms*: Similar above ground symptoms can be caused by other wilt pathogens (e.g. *Verticillium* spp., *Fusarium oxysporum*) or abiotic agents (e.g. drought). Symptoms are most likely to occur from June through September when soil temperatures reach or exceed 28 °C. Symptoms develop rapidly and death can occur within three days on plants that previously had been asymptomatic and growing well. Wilt is usually seen when plants are flowering, sometimes earlier in the season, but not at seedling stages. The first symptoms are slight yellowing or bronzing of the leaves followed by rapid wilting. Usually the wilted leaves remain firmly attached to the plant. Trees and shrubs may die more slowly, and infected plants appear in patches in the field. Large number of plants may wilt simultaneously as temperature thresholds for rapid fungal growth are met. It is also possible to see non-symptomatic plants that have escaped infection surrounded by diseased plants. As the disease progresses, clear dead spots will be seen within the field. Affected areas of the field increase in size following rain or irrigation. Disease will consistently re-occur within discrete areas of the field, which changes only slightly, from year to year, depending upon crop rotation and weather. In dry years, diseased areas may be smaller, or even absent. (Streets and Bloss, 1973; Agrios, 2005; Isakeit, 2016).

The pathogen can be detected by visual inspection of the surface of the roots of its host plants for the presence of the characteristic network of brown rhizomorph-like mycelial strands (EPPO, 2019). Observation of the strands under the microscope reveals the presence of mycelium with characteristic cruciform branches. The creamy-yellow cushion-like spore masses (spore mats) formed by the fungus

on the soil surface near the dying plants can also be useful in diagnosis, but they are not always formed, particularly in row crops (Streets and Bloss, 1973; Lyda, 1978; EPPO, 2019). Below the soil line, and in some plants up to 30 centimeters or more above the soil line, the bark and cambium turn brown, resulting in a firm brown rot of the root and the lower stem. The rotted roots are usually partly covered by coarse, brown, parallel strands of mycelium, and this characteristic helps in diagnosis. Roots are usually extensively invaded by the fungus by the time wilting occurs. Affected plants can be pulled from the soil with little effort. Root bark is decayed, and brownish, and bronze colored wooly strands of the fungus are frequently apparent on the root surface (Lyda, 1978).

Spore mats are sometimes seen in the soil. They vary in size, usually from 3 to 40 cm in diameter and 0.3–2 cm in thickness (Streets and Bloss, 1973). Initially, the mats appear white and fluffy; later, the color turns creamy to light brown. Conidiophores are formed on the surface of the mats and conidia are formed on the conidiophores. Germination of the conidia has rarely been observed and their role in the life cycle, if any, is unknown (Streets and Bloss, 1973).

Transmission: Phymatotrichopsis omnivora survives in the soil as rhizomorph-like mycelial strands on the surface of roots or as sclerotia (Alderman and Hine, 1982). The fungus is not seedborne (EPPO, 2019). The fungus grows through the soil until coming in contact with growing plant roots and enters the plant below the soil line and then grows downward throughout the root system. On some plants, it also invades the lower stem. Sclerotia (densely compact masses of thick-walled cells) form in the strands following death of the plant and later germinate to produce new mycelium. The fungus spreads from plant to plant through the growth of the mycelial strands and through the spread of the strands or sclerotia by farm equipment, transplants, and in contaminated soil. Once introduced into an area, the fungus can survive indefinitely with its huge host range, provided the soils and temperature conditions are favorable. The pathogen cannot survive at temperatures below freezing for any appreciable amount of time, and its narrow geographic distribution seems to be the result of its high temperature and alkaline soil requirements (Lyda, 1978). Mycelial strands and sclerotia have been found at depths down to 2.4 m (Rogers, 1942) allowing it to persist in fallow soil. Under favorable conditions, sclerotia can survive up to 12 years in the soil (McNamara et al., 1934; Streets and Bloss, 1973).

Damage Potential: Although limited in distribution to favorable climates and soils, this pathogen causes epidemic level losses in cotton fields. Nationwide, annual losses can be up to $100M, essentially eliminating harvestable cotton on affected acres (Arif et al., 2014; Isakeit, 2016). In addition to a direct loss in yield because of premature plant death, the disease reduces cotton lint and seed quality and decreases harvest efficiency. Losses are also reported as high as 10% on pecan trees in Arizona (Hu, 2018). On perennial alfalfa in Oklahoma, more than 30% of the stand was lost in a 15-month study period (Mattupalli et al., 2018).

Worldwide Distribution: North America; *Mexico, United States* (Arizona, Arkansas, California, Louisiana, Nevada, New Mexico, Oklahoma, Texas, Utah); South America: *Venezuela*; Africa: *Libya*. (CABI, 2019; Farr and Rossman, 2019))

Official Control: CDFA maintains a state interior quarantine for Imperial County and parts of Riverside and San Deigo counties where the pathogen is known to occur. There is a state exterior quarantine (3261) against the entire states of Arizona, Oklahoma, and Texas, plus specific counties in the states of Arkansas, Louisiana, Nevada, New Mexico, and Utah. Articles and commodities include all soil, nursery stock, and plants with roots that are hosts or possible carriers.

Phymatotrichopsis omnivora is on the harmful orangisms list for the following countries: Algeria, Argentina, Azerbaijan, Brazil, Cambodia, Colombia, Canada, Chile, China, Costa Rica, Ecuador, Egypt, Eurasian Customs Union, Georgia, Guatemala, Honduras, India, Indonesia, Israel, Japan, Jordan, Madagascar, Mexico, Moldova, Morocco, Namibia, New Zealand, Nicaragua, Paraguay, Peru, South Africa, Sri Lanka, Taiwan, Tajikistan, Thailand, Timor-Leste, Turkey, Turkemnistan, Ukraine, United Arab Emirates, Uruguay, Uzbekistan, and Viet Nam (PCIT- PExD reports, 2019). Additionally, it is on the A1 list for East Africa, and Southern Africa, plus Bahrain, Kazakhstan, and the A2 list for China, and it is listed as a quarantine pest in Belarus, Isreal, Mexico, and Morocco (EPPO, 2019).

California Distribution: Imperial County and portions of Riverside and San Diego counties (desert only).

California Interceptions: none

The risk *Phymatotrichopsis omnivora* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** *Phymatotrichopsis omnivora* is native to the deserts of southeastern California. It affects mainly plants grown in alkaline and calcareous soils that rarely freeze (Percy, 1983). It has likely reached its full expansion potential in field soils.

   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:** *Phymatotrichopsis omnivora* has the largest host range of dicots of any phytopathogenic fungi studied, with thousands of hosts.

   Evaluate the host range of the pest.

   Score: 3

   - 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:** *Phymatotrichopsis omnivora* does not spread quickly but it is very long lived with long lasting sclerotia left in the soil, some at considerable depths. It does not have an aerial spore stage, it moves with soil and with infected host plants or plant parts.

   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:** There is a California interior state quarantine for California counties and an exterior quarantine against other states where this pathogen is known to occur. Multiple countries have quarantines against the United States because of this pathogen (EFSA, 2019).

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

   Economic Impact: A, B, 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: **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:** Once established, *Phymatotrichopsis omnivora* is virtually impossible to eradicate because of its ability to survive at depth in the soil and produce long lived sclerotia. It is native to the desert southwest of the United States.

   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 *Phymatotrichopsis omnivora:* High

Add up the total score and include it here.
-Low = 5-8 points
-Medium = 9-12 points
-**High = 13-15 points**

6) **Post Entry Distribution and Survey Information**: *Phymatotrichopsis omnivora* is likely native to the southwestern United States and northern Mexico. It is adapted to the soil, moisture and temperature conditions of the deserts.

Evaluation is 'Low'.

Score: -1 (score followed by bolded bullet)
-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:

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 *Phymatotrichopsis omnivora* is A.**

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Responsible Party:

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***Comment Period: 11/15/2019 through 12/30/2019**

***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 plant.health[@]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