

**California Pest Rating Proposal for**  
***Macrophomina phaseolina* (Tassi) Goidanich 1947**

**charcoal rot**

**Current Pest Rating: C**

**Proposed Pest Rating: C**

Domain: Eukaryota, Kingdom: Fungi  
Phylum: Ascomycota, Subphylum: Pezizomycotina,  
Class: Dothideomycetes, Order: Botryosphaerales,  
Family: Botryosphaeriaceae

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**Comment Period: 03/06/2024 through 04/20/2024**

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**Initiating Event:**

This pathogen has not been through the pest rating process. The risk to California from *Macrophomina phaseolina* is described herein and a permanent rating is proposed.

**History & Status:**

**Background:** *Macrophomina phaseolina* is a soil-borne fungus found all over the world, affecting at least 500 plant species in more than 100 families. It can survive on crop debris for a long period and causes charcoal rot disease by secreting a diverse array of cell wall-degrading enzymes and toxins (Islam et al., 2012). It causes stem and root rot, charcoal rot, and seedling blights. Under high temperatures (30–35 °C) and low soil moisture (below 60%), this fungus can cause substantial yield losses in multiple crops (Marquez et al., 2021; Ghosh et al., 2018).

*Macrophomina phaseolina* is a member of the Botryosphaeriaceae, a family of sac fungi found in all geographical and climatic areas of the world, except the polar regions. It includes a range of morphologically diverse fungi that are pathogens, endophytes, and saprobes, mainly on woody hosts. The Botryosphaeriaceae has many species that are plant-associated, and many are known to cause disease on important agronomic and ornamental hosts. The taxonomy of these fungi has been strongly influenced by sequence-based phylogenetics and the description of cryptic species based on DNA

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sequence data has been implemented when morphological characters were not sufficiently variable for this purpose (Phillips et al., 2013).

No subspecies or physiological races, based on morphological or genomic characterizations, have been identified for *M. phaseolina* (Su et al., 2001; Crous et al., 2006). For many years *M. phaseolina* was the only species in the genus *Macrophomina*, but two additional species, *M. pseudophaseolina* and *M. euphorbiicola* were described in the last decade. Field diagnosis is difficult due to the similarity of symptoms with those caused by other important soilborne pathogens. For strawberries, the internal crown discoloration is an important feature that distinguishes charcoal rot from Verticillium wilt. However, Fusarium wilt of strawberries causes symptoms that are identical to those of charcoal rot. To identify which pathogen is causing strawberry plant collapse, affected plants must be tested by a plant pathology laboratory (Martin, 2013).

*Macrophomina phaseolina* primarily relies on microsclerotia that are found in host tissue or the soil for survival and dissemination. Ascomata are not reported. Conidiomata are pycnidial, and immature pycnidiospores are enclosed in a mucous sheath. At maturity, pycnidiospores are medium to dark brown, without any mucoid appendages. Pycnidia are not seen in the field and their role in disease epidemiology is undefined (Phillips et al., 2013).

**Hosts:** This pathogen has an extensive host range with over 500 hosts recorded in literature. Reported hosts in California include alfalfa, bean, citrus, coriander, cucurbits, grape, hemp, lavender, lettuce, marigold, olive, onion, pepper, parsley, privet, palm, raspberry, stone fruit, strawberry, sunflower, tomato, watermelon, and zinnia (CDFFA PDR database, 2024).

**Symptoms:** The symptoms of charcoal rot are often limited or absent during the cool, early part of the growing season. Initial symptoms of charcoal rot in strawberry usually occur after the plants are well established and begin to produce fruit: the older leaves wilt, turn gray-green, and begin to dry up. Symptoms worsen during the mid to late summer when plants are under stress, especially heat and drought stress. The symptoms also include yellowing and senescence of leaves, wilting, and browning, as well as the development of light gray streaks in the taproot and lower stem. Plants will stop growing and appear to be stunted when compared to healthy plants. As disease progresses, virtually all the foliage will collapse and dry up except for the central, youngest leaves. Fruit production of infected strawberry plants may decrease prior to the development of disease symptoms. Upon examination of the internal tissues of plant crowns, vascular and cortical tissues are dark to orange-brown, and the main roots may also show the same dark brown discoloration (Koike et al., 2018; Marquez et al., 2021; Martin, 2013).

*Macrophomina phaseolina* can infect the roots of the host plant at the seedling stage via multiple germinating hyphae. Once in the roots, the fungus affects the vascular system, disrupting water and nutrient transport to the upper parts of the plants. Microsclerotia, visible as small black specks, may also form in the lower stem and taproot, giving them a charcoal-sprinkled appearance. Wilting can occur relatively quickly, and this pathogen can cause the premature death of the host plants (Martin, 2013).

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On sunflowers, the pathogen initially causes dark brown to black lesions on the roots. Infected plants may show a characteristic silvery discoloration of the stem base, but this symptom may not be seen until the plants are near maturity. The fungus spreads up the vascular tissues of the stem, finally forming numerous small microsclerotia, like finely powdered charcoal giving the infected stem pith tissues a greyish-black color (Mahmoud and Budak, 2011).

**Transmission:** Microsclerotia are thought to be the primary infective source of *M. phaseolina*. The microsclerotia are very long-lasting and able to survive up to 15 years in soil (Gupta et al., 2012). All forms of planting material and adhering soil may carry the pathogen. *Macrophomina phaseolina* has been detected on and within seeds of a wide range of herbaceous and tree species. However, there are few reports of seed transmission to the seedling. Nevertheless, the fungus could be expected to be transferred to the growing medium even where the infected seed failed to germinate (CABI, 2024).

**Damage Potential:** Charcoal rot is economically important across a broad range of crops throughout the world, particularly in regions that experience hot, dry summers. Under high temperatures (30–35 °C) and low soil moisture (below 60%), this fungus can cause substantial yield losses in crops such as soybean and sorghum (Kaur et al., 2012). On sunflowers, it is an important pathogen in hot regions. Attacks vary from year to year, mainly according to temperature (infection is favored by soil temperatures over 28 °C) and rainfall. Infected sunflowers show small, distorted heads with a central zone of aborted flowers. The disease reduces seed yield and oil quality (EPPO, 2024). Charcoal rot is a major pathogen on strawberries capable of infecting the majority of plants in a field (Martin, 2013).

**Worldwide Distribution:** The fungus has a wide geographical distribution and is especially found in tropical and subtropical countries with arid to semi-arid climates in Africa, Asia, Europe, and North and South America. There are records from over 70 countries (Farr and Rossman, 2024; CABI, 2024).

**Official Control:** *Macrophomina phaseolina* is on the USDA PCIT Harmful Organisms list for Colombia and Taiwan. *Macrophomina* sp. is a US-regulated plant pest (USDA APHIS, 2024).

**California Distribution:** Alameda, Butte, Colusa, Contra Costa, Fresno, Glenn, Imperial, Kern, Los Angeles, Madera, Mendocino, Merced, Orange, Placer, Riverside, Sacramento, San Benito, San Diego, San Joaquin, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Solano, Sonoma, Sutter, Tehama, Ventura, Yolo, and Yuba counties (CDFFA PDR Database, 2024).

**California Interceptions:** None

The risk that *Macrophomina phaseolina* would pose to California is evaluated below.

## Consequences of Introduction:

- 1) **Climate/Host Interaction:** Diseases caused by charcoal rot have been reported in many diverse climates in California, ranging from strawberries on the coast to alfalfa in the Imperial Valley.
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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 be established in a larger but limited part of California.
- **High (3) likely to establish a widespread distribution in California.**

**2) Known Pest Host Range:** This pathogen has a very large host range.

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:** This fungus mainly uses microsclerotia to reproduce and spread. Pycnidia are rarely seen in cropping systems. Microsclerotia are spread with seed, soil, and nursery material.

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:** Significant yield losses have been reported on multiple crops.

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

**Economic Impact: A, B, C**

- A. The pest could lower crop yield.**
- B. The pest could lower crop value (including increasing crop production costs).**
- C. The pest could trigger the loss of markets (including 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:** The pest can significantly impact cultural practices, home/urban gardening, and ornamental plantings.

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Evaluate the environmental impact of the pest on California using the criteria below.

**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.

**Consequences of Introduction to California for *Macrophomina phaseolina*: High**

Add up the total score and include it here. **13**

- 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'.***

**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 the 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 = 10***

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**Uncertainty:** None

### **Conclusion and Rating Justification:**

Based on the evidence provided above the proposed rating for *Macrophomina phaseolina* is **C**.

### **References:**

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### Responsible Party:

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**\*Comment Period: 03/06/2024 through 04/20/2024**

### \*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;

Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;

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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: C**

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