CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Fusarium mangiferae Britz, M.J. Wingf. & Marasas 2002
Mango Malformation Disease

Current Pest Rating: Q

Proposed Pest Rating: B

Kingdom: Fungi, Phylum: Ascomycota,
Subphylum: Pezizomycotina, Class: Sordariomycetes,
Subclass: Hypocreomycetidae, Order: Hypocreales,
Family: Nectriaceae

Diseased mango inflorescence - Photo T. Miller, Los Angeles Co. AgComm

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Comment Period: 10/07/2024 through 11/21/2024

Initiating Event:

In August 2024, Los Angeles County Ag Commissioner's Office Plant Pathologist Thomas Miller submitted a symptomatic mango inflorescence (*Mangifera indica*) from a tropical fruit tree nursery to CDFA's Pest Diagnostics Center at Meadowview. Senior diagnostician Suzanne Rooney-Latham isolated *Fusarium* from the symptomatic tissues and identified *Fusarium mangiferae* by sequencing two DNA regions. This is the first detection of *Fusarium mangiferae*, which causes mango malformation disease, in California. This pathogen has not been through the pest rating process. The risk to California from *Fusarium mangiferae* is described herein and a permanent rating is proposed.

History & Status:

Background: Mangos are tropical to subtropical trees that require warm, humid climates and temperatures between 65- and 90-degrees F to grow well and produce fruit. They can be severely damaged or die if exposed for too long to temperatures below freezing. Mangos are grown in backyard orchards in frost-free parts of Southern California, from Santa Barbara to San Diego. Riverside County has limited acreages of commercial mango fruit production in the Coachella Valley. Most of the mangos consumed in the United States are imported from Mexico.

Mango malformation disease (MMD) is one of the most important diseases affecting mangos worldwide (Ploetz, 2001). When it affects the flowers, it can cause a drastic reduction in the number of fruits produced, resulting in severe economic losses. When it affects juvenile shoots, it does significant damage to nursery stock. Several causal agents, all members of the genus *Fusarium*, have been associated with this disease. *Fusarium mangiferae* (previously recognized as *F. moniliforme* and later as *F. moniliforme* var. *subglutinans*) is the most widespread (Lima et al., 2019). *Fusarium mangiferae* has been in Florida for more than 50 years (Ploetz and Gregory, 1992). *Fusarium mexicanum* and *F. pseudocircinatum* have been reported as causes of MMD in Mexico (Montoya-Martinez et al., 2022).

A study by Gamliel-Atinsky et al. (2009) concluded that the presence of *Aceria mangiferae*, the mango bud mite, within buds increased the frequency and severity of bud colonization by the pathogen, indicating that the bud mites may enhance fungal infection. There are no records of this mite in California.

Hosts: Mangifera indica (mango), *Sansevieria trifasciata* (snake plant), *Vanilla planifolia* (vanilla orchid) (Farr and Rossman, 2024).

Symptoms: This disease causes misshapen growth of both vegetative and reproductive parts of the tree. Symptoms included an abnormal development of vegetative shoots with shortened internodes with dwarfed leaves and hypertrophied short and thickened panicles. Inflorescence malformation includes short, thick, and branched axes of the inflorescence, larger flowers, and an increased number of male flowers. Malformed inflorescences do not bear any fruit (Kumar et al., 1993). Malformed panicles may produce as many as three times the normal number of flowers. Inflorescences may also have an increased ratio of male vs. perfect flowers (Freeman et al., 2014).

Transmission: Dry, malformed inflorescence debris dropped onto the orchard floor serves as a source of inoculum. Both micro- and macroconidia are produced by this species, but chlamydospores are absent and no teleomorph has been described. Conidia penetrate the plant tissue via apical and lateral buds where they remain dormant until bud break. No systemic infection happens, only local colonization of the bud tissues. When infected buds open, malformed vegetative and inflorescences are produced that are covered with the fungus. Airborne conidia need at least two hours of leaf wetness to infect new mango shoots or flowers (Gamliel-Atinsky et al., 2009). Spread is possible by grafting and with infected nursery stock (Pernezny and Ploetz, 2000). Fruits are not known to be a source of inoculum.

Damage Potential: Although trees are not killed, infection of the shoots impedes the canopy development of young trees. In the floral phase, infection reduces fruit yield dramatically. Substantial economic losses can occur since malformed inflorescences do not bear fruit. The losses in India, where there are hot and wet summers, are typically from 50 to 60%, and in some cases, the severity in the orchard can be up to 100% (Summanwar, 1967). In Egypt, which has hot and dry summers, disease incidence ranges from 5-20% (Ploetz et al., 2002).

Worldwide Distribution: Australia, Brazil, China, Egypt, India, Indonesia, Israel, Malaysia, Mexico, Reunion Island, Oman, Pakistan, South Africa, Spain, Sri Lanka, United States (Florida) (Farr and Rossman, 2024).

Official Control*: Fusarium mangiferae* is on the USDA PCIT's harmful organisms list for Peru (USDA-PCIT 2024).

California Distribution: One detection at a nursery in Los Angeles County (see initiating event).

California Interceptions: none

The risk that *Fusarium mangiferae* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction**: Mangos are a tropical plant requiring a climate that stays above freezing or protected conditions such as inside a greenhouse. It is likely the pathogen can survive wherever its hosts can grow.

   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 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:** The host range is mango and two additional species.

Evaluate the host range of the pest.

Score: 1

- 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:** *Fusarium mangiferae* produces large numbers of micro- and macro conidia that are spread with the wind. It does not have a sexual state, and it does not produce long-lasting resting structures.

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:** This disease causes significant economic losses and has a very direct impact on fruit yield when it destroys inflorescences. It is a quarantine pest in Peru.

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

Economic Impact: A, 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: **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:** Establishment of this disease could have a very negative impact on home and urban gardening, which is the location of most mango trees in California.

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 *Fusarium mangiferae:* Medium

Add up the total score and include it here. **9**
-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.

Nursery detections that are transient and under eradication are not counted towards distribution.

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 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* ***= 9***

Uncertainty:

MMD can be caused by different *Fusarium* species, including *F. mangiferae*, *F. mexicanum*, *F. sterilihyphosum, F. proliferatum, F. subglutinans and F. tupiense* (Mohamed Nor et al., 2013). These

species can co-occur. Distinguishing these species requires an expert diagnostician with the ability to use molecular gene sequencing techniques.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Fusarium mangiferae*** **is B.**

References:

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Responsible Party:

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***Comment Period: 10/07/2024 through 11/21/2024**

***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.

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: B