

## California Pest Rating Proposal for

*Fusarium solani* f. sp. *eumartii* (C.W. Carp.) W.C. Snyder & H.N. Hansen 1931)

(≡ *Neocosmospora falciformis* (Carrión) L. Lombard & Crous 2015)

(≡ *Fusarium falciforme* (Carrión) Summerb. & Schroers 2002)

**Fusarium foot rot**

**Current Pest Rating: C**

**Proposed Pest Rating: C**

Kingdom: Fungi; Division: Ascomycota;  
Class: Sordariomycetes; Order: Hypocreales;  
Family: Nectriaceae

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**Comment Period: 09/03/2021 through 10/18/2021**

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### Initiating Event:

In May 2018, a University of California, Davis, Cooperative Extension Specialist in the department of Plant Pathology contacted mycologists at the CDFA Plant Pest Diagnostics Center to report the detection of *Fusarium falciforme* in her research and extension work. This pathogen has been described affecting tomatoes in Mexico, causing a significant crown rot disease (Vega-Gutiérrez et al., 2019). The specialist reported that over the past four years, *F. falciforme* has been recovered in over one hundred fields in nine counties, representing the major processing tomato-producing regions. It has been described as an important, emerging problem, causing serious vine decline (AgAlert, 2/23/2021).

In August 2019, researchers from the University of California Davis published a first report of *Neocosmospora falciformis* (syn. *F. falciforme*) as a pathogen of pistachio rootstocks in California. A risk analysis of the threat posed by *F. falciforme* to California agriculture and the environment is described herein and a permanent rating is proposed.

### History & Status:

#### Background:

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*Fusarium solani* f. sp. *eumartii* was first described as a pathogen of potato (*Solanum tuberosum*) and was named Eumarti wilt. Symptoms of the disease on potato include dry rot of the stem end of potato tubers and general wilt of foliage. In 2004, potato plants exhibiting symptoms of Eumarti wilt were found in fields in San Joaquin County (Romberg and Davis, 2004). In addition to Eumarti wilt of potatoes, isolates of *F. solani* f. sp. *eumartii* can cause other diseases, including foot rot of tomato. Beginning in 1984, a foot rot of tomato caused by *F. solani* was reported in Yolo County, California by Cucuzza et al. (1991). A survey of symptomatic fields in 2000-01 in California indicated that the disease was already present in at least five counties, Yolo, Sutter, San Joaquin, Sacramento, and Stanislaus (Sagara, 2004; Romberg and Davis, 2007). Greenhouse and field trials established that isolates from tomato and potato could be pathogenic on tomato, potato, eggplant, pepper. All the California isolates of *F. solani* f. sp. *eumartii* formed a single monophyletic clade distinct from other formae speciales and mating populations of *F. solani* (Romberg and Davis, 2007).

Beginning in 2017, an unusual form of tomato foot rot in processing tomato was reported in Fresno, San Joaquin, and Yolo counties in multiple fields (C. Swett, UC Davis, pers. comm). The pathogen was initially identified as a member of the *Fusarium solani* species complex and seemed likely to be *F. solani* f. sp. *eumartii*. Early pathogenicity screenings, however, showed this pathogen was a stronger crown rotter and a weaker root rotter; the opposite of what was previously reported for *F. solani* f. sp. *eumartii*.

Differentiating *Fusarium* species and formae speciales is done with a combination of genetic data and morphological characterizations. When compared to data from Genbank, California isolates matched most closely with strains identified as members of the *F. solani* species complex, and a BLAST search, the isolates matched to strains called "*F. solani* 3+4 pp". This is now considered a synonym for *F. falciforme* (O'Donnell et al., 2008). There is also recent report of *F. falciforme* causing foot rot and wilt of tomatoes in Mexico (Vega-Gutiérrez et al., 2019). As of now, there is strong support to indicate that the pathogen many are currently calling *F. falciforme* is the same as the *Fusarium* foot rot pathogen *F. solani* f. sp. *eumartii* described by Romberg and Davis (2007). This is based on analysis of their deposited Genbank isolates and one from Dr. Thomas Gordon's collection at UC Davis from 1993, which are equally virulent to recently collected *F. falciforme* isolates on tomato (C. Swett, UC Davis, Pers. Comm).

There are differing opinions among mycologists and pathologists about a preferred name for this pathogen. Some are using *F. solani* f. sp. *eumartii*, and some are using *F. falciforme*. The most recently published name is *Neocosmospora falciformis* (Geiser et al., 2013), but this name is not universally accepted. Earlier names are *Cephalosporium falciforme* Carrión 1951, and *Acremonium falciforme* (Carrión) W. Gams 1971. Because this pathogen has been found in multiple counties, it is reasonable to assume it has been present in California for many years. The recent first report of *Neocosmospora falciformis* in California as a pathogen of pistachio rootstocks in multiple counties strengthens this hypothesis (Crespo et al., 2019).

*Hosts: Allium cepa* (onion), *Arachis hypogaea* (peanut), *Carica papaya* (papaya), *Cucumis melo* (cucumber), *Dactylis glomerata* (barnyard grass), *Dioscorea polystachya* (Chinese yam), *Glycine max*

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(soybean), *Gossypium hirsutum* (upland cotton), *Phaseolus lunatus* (fava bean), *Phaseolus vulgaris* (common bean), *Physalis ixocarpa* (tomatillo), *Pinus maximinoi* (thinleaf pine), *P. tecunumanii*, *Pistacia vera* (pistachio), *Solanum lycopersicum* (tomato), *Trichosanthes dioica* (pointed gourd), *Trifolium pratense* (Chilean clover), *Weigela florida* (weigela), and *Zea mays* (corn) (Farr and Rossman, 2021; Crespo et al., 2019).

**Symptoms:** On tomatoes in California, plants were observed to be in decline from water stress symptoms with sunburned fruit. Stem epidermal tissue appeared healthy and green on the surface. The internal pith was necrotic, extending longitudinally from the tap root (subterranean) to ~5-9 cm above the soil line. On tomatoes in Mexico, the symptoms included wilting, leaf yellowing, defoliation, vascular tissue darkening, drying, branch dieback, and eventual plant death. Plant crowns exhibited necrosis (visible in the interior) that advanced through the main root, along with a slight root rot (Vega-Gutiérrez et al., 2018). On onions in Mexico, symptoms included yellowish and chlorotic leaf tips (progressively developing downward), dwarfing in the plants, soft consistency in bulbs, necrosis in the basal part of the bulb, and a decrease in root tissue (Tirado-Ramírez et al., 2018). On beans in Cuba, symptoms included root decay, necrosis of the stem base and leaf chlorosis (Duarte et al., 2019). On lima beans in Brazil, Sousa et al. (2017) described symptoms as roots showing black coloring and a decrease in size with brownish longitudinal grooves in the cervical region, internal tissue showed red to brown discoloration and dwarfing. Pistachios in California showed symptoms of crown rot and stem canker according to Crespo et al. (2019).

**Transmission:** Infected plants, roots, stems, leaves, seeds, plant debris, soil, air currents, rainwater splash, and contaminated equipment can all spread spores (Agrios, 2005).

**Damage Potential:** On pistachio rootstocks, trees exhibited a general decline (Crespo et al., 2019). On lima beans in Brazil, 5% plant mortality was reported (Sousa et al., 2017). In Cuba, Duarte et al., (2019) reported up to 50% mortality on common bean plants. On onions and tomatoes in Mexico, the disease was observed in multiple commercial crops (Tirado-Ramírez et al., 2018; Vega-Gutiérrez, et al., 2019).

On tomatoes in California, the disease is considered economically significant. Affected plants suffer major yield losses; some are so severe that growers abandon sections of fields, or even in some cases, whole fields because it is not economically viable to harvest (AgAlert, 2021).

**Worldwide Distribution:** Australia, Brazil, Colombia, China, Cuba, Ethiopia, Ghana, India, Iran, Mexico, Poland, Spain, United States (*California, Illinois*) (Farr and Rossman, 2021).

**Official Control:** There is none for *F. falciforme*, but *F. solani* is on the harmful organism list for Colombia and the Syrian Arab Republic (USDA-PCIT, 2021)

**California Distribution:** In the northern and central California valleys and Ventura County.

**California Interceptions:** None

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The risk *Fusarium solani* f. sp. *eumartii* would pose to California is evaluated below.

### Consequences of Introduction:

- 1) **Climate/Host Interaction:** This pathogen has already been found in the main growing areas of two of its hosts in California; tomato and pistachio.

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 is likely to expand as pathogenic isolates are re-evaluated by molecular methods that separate the *Fusarium solani* species complex. The current known host range includes plants in diverse families, including tomatoes, onions, beans and pistachios.

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 Reproduction Potential:** *Fusarium solani* f. sp. *eumartii* has a high reproduction and dispersal potential through infected plants, roots, stems, leaves, seeds, soil, plant debris, air currents, rainwater splash, and contaminated equipment.

Evaluate the natural and artificial dispersal potential of the pest.

**Score: 3**

- 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 losses have been reported in tomatoes and pistachios.

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

**Economic Impact: A, B**

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

None have been reported

- 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: 1**

- **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 solani* f. sp. *eumartii* is Medium:**

Add up the total score and include it here. **11**

- 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'**. There are official records of detections listed at the species level, plus published records from the University of California show this pathogen has been found in many counties in Northern and Central California and in Ventura County.

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**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: 8**

**Final Score:** *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information = 8*

**Uncertainty:**

As diagnostic techniques improve, it is possible that hosts will be diagnosed with this formae speciales of *Fusarium solani*.

**Conclusion and Rating Justification:**

Based on the evidence provided above **the proposed rating for *Fusarium solani* f. sp. *eumartii* is C.**

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### **Responsible Party:**

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**\*Comment Period: 09/03/2021 through 10/18/2021**

### **\*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).

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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;
    - Violates agency regulations prohibiting sexual harassment or other forms of discrimination;
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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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