

California Pest Rating Proposal for

Fusarium oxysporum f. sp. *lactucae* *Matuo & Motohashi, 196* Fusarium wilt of lettuce

Current Pest Rating: C

Proposed Pest Rating: C

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

Comment Period: 03/22/2024 through 05/06/2024

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from *Fusarium oxysporum* f. sp. *lactucae* is described herein and a permanent rating is proposed.

History & Status:

Background:

California leads the nation with 75% of the leaf, head, and Romaine lettuce production. Lettuce is grown on nearly 200,000 acres and had a value of \$3.15 billion in 2022, making it the 5th most valuable crop in the state (CDFA Ag Stats, 2023). The top county for lettuce production is Monterey, specifically in the Salinas Valley, followed by Imperial, San Benito, Santa Barbara, and Fresno counties.

Fusarium oxysporum is a soil-borne, highly variable fungal species that contains many saprophytic and pathogenic forms that are morphologically identical. It predominantly uses asexual reproduction. *Fusarium oxysporum* is generally regarded as a 'species complex'—a collection of clonal lines that differ in their host range and aggressiveness. The various forms cannot be distinguished without using molecular tools and/or pathogenicity tests. *Fusarium oxysporum* is best known as a vascular wilt pathogen, colonizing the xylem of its hosts, turning vascular tissue brown, causing progressive yellowing as it grows internally into the plant, eventually causing collapse and death. Some strains cause crown rot, root rot, or bulb rot instead of vascular wilts (Agrios, 2005).

The plant pathogenic parasitic strains of *F. oxysporum* were grouped into formae speciales (f. sp.) by Snyder and Hansen (1940) based on their selective pathogenicity to a narrow range of plants, often a single species. The concept of formae speciales continues to evolve, especially with improvements in molecular approaches to characterize isolates (Edel-Hermann and Lecomte, 2019). More than 120 different formae speciales have been identified based on specificity to host species across a wide range of plant families.

Fusarium oxysporum f. sp. *lactucae* (Fol), was first described as the causal agent of fusarium wilt of lettuce in 1955 in Tokyo by Matuo and Motohashi (1967). It was first found in California in Fresno County in 1990 (Hubbard and Gerik in 1993). Since that time, the pathogen has become established in all major lettuce producing regions on the central coast of California (Scott et al., 2012). Today, the pathogen has spread to most lettuce-growing regions in California, the United States, and throughout the world. Local spread and spread between California and Arizona was probably with infested soil on farming equipment (Materon and Koike, 2003; Matheron and Gullino, 2012). Fol is host-specific, and causes yellowing of the leaves, wilting, and brown or black streaks in the vascular system of lettuce. The colonization of melon, tomato, watermelon, cotton, broccoli, cauliflower, and spinach roots has also been reported (Hubbard and Gerik, 1993; Scott et al., 2012). Three races have been identified to date; race 1 is the only one known to be in California (Gilardi et al., 2017).

Hosts: Lactuca sativa (lettuce) and *Valerianella locusta* (lamb's lettuce) (EPPO, 2024)

Symptoms: Fusarium wilt causes infected seedlings to wilt and sometimes die. The inner tissues of affected seedlings are red or brown. In older plants, leaves turn yellow and can develop symptoms of tip burn. Internally, the vascular system is brown to black in the leaves, and a reddish-brown discoloration develops in the cortex of the crown and upper root. Plants may be stunted and fail to form heads. The pathogen causes a disease only in lettuce but may be sustained on the roots of many plants (Koike and Turini, 2017).

Transmission: Seed transmission is suspected to be the primary way that this pathogen has spread around the world. Garibaldi et al. (2004) found a low percentage of lettuce seed in Italy to be infested with Fol. In a 2010 study, 88 commercial lettuce seed lots were assayed for Fol by nested PCR and direct plating and the pathogen was not detected by either method (Mbofung and Pryor, 2010). Anything that moves contaminated crop debris and soil can move Fol. This includes equipment, machinery (especially cultivation machinery), containers, and water (Matheron and Koike, 2003).

Damage Potential: Fusarium wilt is favored by high soil temperatures. Infected plants are stunted and often die, resulting in significant losses. Once introduced into a field, it may remain indefinitely as resting chlamydospores (Gordon, 2017).

Worldwide Distribution: Argentina, Australia, Belgium, Brazil, France, Iran, Ireland, Italy, Japan, Republic of Korea, Netherlands, Norway, Portugal, Spain, Taiwan, United Kingdom, United States of America (Arizona, California, Florida) (EPPO, 2024; Farr and Rossman, 2024).

Official Control: None

California Distribution: Fresno, Monterey, Napa, San Luis Obispo, Santa Barbara, and Yolo counties (CDFA PDR database, 2024). Survey work by Paugh and Gordon (2020) shows the pathogen is present in all major lettuce producing regions in California.

California Interceptions: none

The risk that *Fusarium oxysporum* f. sp. *lactucae* would pose to California is evaluated below.

Consequences of Introduction:

- 1) **Climate/Host Interaction:** Fol is likely to be found wherever its hosts can grow.

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:** The host range is limited to lettuce and lamb's lettuce.

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:** Fol reproduces with multiple types of spores. It moves with infested soil, seeds, and crop debris.

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:** Fusarium wilt can have a large negative effect on yield. Fungal propagules can be moved with irrigation water.

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

Economic Impact: A, G

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:** If a field is infested with Fol, cultural practices that move soil should be minimized.

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 oxysporum* f. sp. *lactucae*: 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.
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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 = 8*

Uncertainty:

The primary management tool for *Fusarium* wilt of lettuce is the use of resistant or tolerant cultivars. Each race has a different set of susceptible and resistant cultivars. Only Race 1 is currently found in California. If other races become established, fewer lettuce cultivars will be grown.

Conclusion and Rating Justification:

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

References:

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Responsible Party:

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***Comment Period: 03/22/2024 through 05/06/2024**

***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).

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.
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Proposed Pest Rating: C
