CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Stromatinia cepivora (Berk.) Whetzel 1945
≡ *Sclerotium cepivorum* Berk. 1841

White rot of onion and garlic

Current Pest Rating: B

Proposed Pest Rating: B

Kingdom: Fungi, Phylum: Ascomycota,
Subphylum: Pezizomycotina, Class: Leotiomycetes,
Order: Helotiales, Family: Sclerotiniaceae

Comment Period: 09/20/2022 through 11/04/2022

Initiating Event:

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

History & Status:

Background: California is the largest onion producing state in the US and is the only state to produce both spring and summer-harvested onions. Roughly half of California onions are grown for the fresh market, and about half for processing. Onions are grown throughout California on 43,000 acres. The counties with the top acreage are Fresno, Imperial, Kern, Siskiyou, and San Joaquin, with over a third of the state's acreage located in Fresno County. The high desert region of Antelope Valley in Los Angeles County and the Salinas Valley in Monterey County also include some fresh market onion acreage (Lazicki et al., 2016). The value of California's onion crop in 2020/21 was reported as $338M (CDFA Crop Statistics; https://www.cdfa.ca.gov/Statistics/PDFs/2021_Ag_Stats_Review.pdf).

California is also the nation's top producer of garlic, accounting for nearly 100% of domestic production. Garlic crops are produced on 24,000 acres with a farm value in 2021 of $260M. Although the city of Gilroy in Santa Clara County is known as the garlic capital of the world, most of the commercial garlic production is in the western San Joaquin Valley, which includes the counties of Fresno and Kern and represents 96.5% of the total state garlic acres. Fresno County has most of these

acres. Some garlic is grown in the southeastern desert counties of Riverside and San Bernadino. California garlic growers obtain most of their seed from growers in Nevada and Oregon, although there is a limited acreage of seed garlic in northern and eastern California (National IPM Database, CDFA Crop Statistics, CDFA Nursery Services).

White rot caused by *Stromatinia cepivora*, (anamorph *Sclerotium cepivorum*) is a damaging disease of *Allium* spp. including onion and garlic, but can also be found infecting chives, leeks, shallots, and some other members of Liliaceae. Classical taxonomy placed *S. cepivorum* in the genus *Sclerotium*, which broadly groups sterile sclerotial fungi with teleomorphs of various affinities. Whetzel (1945) recognized the similarity of *S. cepivorum* to the ascomycete genus *Sclerotinia*, and accordingly placed the undescribed teleomorphic stage of *S. cepivorum* in the ascomycete genus *Stromatinia*. This placement of *S. cepivorum* in the Ascomycota has since been confirmed by ribosomal DNA sequence data, which indicates a 98% similarity to other fungi of the genus (Carbone and Kohn, 1993).

Young plants are attacked before or shortly after emergence; plants may die. On infected older plants, the bottom of the bulb is covered with the white mycelium on which small black sclerotia can be found in very large numbers. Soils should be tested for sclerotia prior to planting and certified, clean planting material should be used. Even after 15 years or more without any *Allium* spp. in a field, viable sclerotia of the fungus may still be present to start a new epidemic. This time frame makes crop rotation an ineffective management method (Crowe et al., 1993). Sclerotia of *S. cepivorum* are stimulated to germinate by root exudates from the genus *Allium* (Coley-Smith and Holt, 1966). Experimentally, products such as dialllyl disulphide (an organosulfur compound derived from garlic) and *Allium* products such as onion powder, garlic powder, onion oil, garlic oil and *Allium* waste (onion and garlic) are known to be sclerotial germination stimulants. Adding them to fallow soils can trigger the sclerotia to germinate, and with no plants to infect, to die without reproducing. This significantly reduces but does not eliminate the incidence of white rot in the field (Elshahawy et al., 2019).

Hosts: Allium ascalonicum (shallot), A*. canadense* (Canada onion), *A. cepa* (onion), *A. fistulosum* (Welsh onion), *A. porrum* (chives), *A. sativum* (garlic), *A. schoenoprasum* (chives), *Allium* sp., *Belamcanda chinensis* = *Iris domestica* (blackberry lily), *Zephyranthes ajax* (ajax rain lily), *Z. candida* (autumn zephyr lily), *Z. grandiflora = Z. minuta* (pink rain lily) (Farr and Rossman, 2022).

Symptoms: Plants may be infected at any stage of growth provided environmental conditions are favorable, but in California, symptoms usually appear from mid-season to harvest. Seedling infection can occur; however, the first infections are normally in plants bearing three to five leaves. Initial stages of infection are confined to the host root system and bulb base plate (Scott, 1956). The first above-ground symptoms include a yellowing of leaves, beginning at the tips, and progressing downward. A gradual decline in the plant continues for some days or weeks and in the case of young plants may constitute a rapid wilt and collapse of aerial parts (Walker, 1924). Ultimately the entire plant is killed. On underground parts, the fungus is visible as superficial, fluffy white mycelium. The roots are gradually destroyed, and the fungus causes a soft, watery decay of the bulb commencing at the base plate (Walker, 1924). Black spherical sclerotia, normally 200-500 µm diameter, are formed on the bulb base and within decaying root and stem tissue.

Above-ground symptoms are not often noticed until the pathogen has colonized and partially rotted the stem and leaf sheaths. Allium roots frequently extend horizontally, providing a direct path for mycelial growth to spread to nearby plants. Infected plants tend to occur in clusters from a few, up to 40 or more, adjacent plants (Crowe and Hall, 1980).

Transmission: Sclerotia produced in rotted tissue survive in soil and germinate to produce mycelium to infect the roots or bulb base (Alexander and Stewart, 1994). Sclerotia can spread throughout a field, or from field to field, via flood water, equipment, or plant material, such as wind-blown bulb scales. The pathogen can be spread long distance on infected bulbs used as planting material.

Damage Potential: On a global basis, *S. cepivora* is probably the most serious threat to *Allium* crop production of any disease. It is present in almost all *Allium*-producing regions. While some regions have been able to continue production despite infestation, the disease has never been completely successfully managed anywhere. As few as one sclerotium per liter of soil can cause measurable crop loss and at a level of 20 sclerotia per liter in the field, essentially all plants will be infected over time (Schwartz and Mohan, 2008). In several regions, the disease has been responsible for the complete collapse of the *Allium* production industry (CABI- CPC, 2022). In California, it is a serious threat to garlic production in Mono County, an area that is regulated to prevent introduction of this pathogen.

Worldwide Distribution: Africa: *Egypt, Libya, South Africa, Uganda, Zimbabwe*. Asia: *China, India, Iran, Japan, Korea, Oman, Philippines.* Europe: Austria, *Bulgaria, Cyprus, Czechia, Denmark, England, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Portugal, Poland, Romania, Russia, Scotland, Serbia, Spain, Sweden, Switzerland.* Americas: *Argentina, Bolivia, Brazil, Canada, Chile, Colombia, Guyana, Mexico, United States* (California, Florida, Hawaii, Idaho, Kentucky, Louisiana, Montana, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Puerto Rico, Texas, Virgin Islands, Virginia, Washington), *Uruguay, Venezuela.* Oceania: *Australia, New Zealand* (Farr and Rossman, 2022).

Official Control: *Stromatinia cepivora* is on the EPPO's A1 list for Bahrain, the A2 list for Turkey and the InterAfrican Phytosanitary Council, and is a quarantine pest in Canada, Israel, Mexico, and Norway, and a regulated non-quarantine pest in the United Kingdom (EPPO, 2022). It is on the USDA's harmful organism list for Australia, Israel, Nauru, and United Arab Emirates (USDA PCIT, 2022).

CDFA has a State Miscellaneous Ruling, 3559 GARLIC PRODUCTION IN MONO COUNTY. This ruling establishes a quarantine area for maintaining the pest cleanliness of garlic plantings for stem and bulb nematode (*Ditylenchus dipaci*), white rot fungus (*Sclerotium cepivorum*), Garlic yellow stripe virus, and pink root (*Pyrenochaeta terrestris*), which are not known to occur in the garlic production areas of Mono County. Under this regulation, no garlic plant or part thereof shall be planted or maintained in any state of cultivation in the quarantine area unless a written application has been received and a permit has been issued by the Secretary of Agriculture or the Agricultural Commissioner for Mono County. Such permit shall be issued provided the garlic is the progeny of plants meet the requirements of "California Certified Seed Garlic," or is accompanied by a certificate issued by a State or county agricultural regulatory official verifying the garlic is of equivalent pest status as garlic produced under

said provisions; and provided the Secretary or commissioner determines the garlic covered by the permit is free of the pests specified, and other serious pests of garlic.
http://pi.cdfa.ca.gov/pqm/manual/pdf/450.pdf

California Distribution: There have been official detections in Del Norte, El Dorado, Fresno, Humboldt, Inyo, Lassen, Modoc, Mono, Shasta, and Yolo counties.

California Interceptions: none

The risk *Stromatinia cepivora* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** Disease development is favored by cool, moist soil conditions; the same conditions that are favorable for onion and garlic growth are also ideal for white rot development. The soil temperature range for infection is 50° to 75°F, with an optimum of 60° to 65°F. At soil temperatures above 78°F, the disease is markedly inhibited (Swett et al., 2019).

   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:** The known natural host range is limited to *Allium* spp., but some other members of Lilliaceae are experimental hosts.

   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:** This is a monocyclic disease meaning it only has one reproductive cycle per season. This fungus does not produce any spores of importance to the life cycle; instead, it grows and infects with mycelium, and it overwinters as sclerotia. Sclerotia can remain dormant for decades and only germinate in response to stimulating chemicals released by alliums. Even while limited to mycelium and sclerotia, this pathogen can quickly reach epidemic levels in field production systems.

   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:** White rot can cause total crop losses when sclerotia levels are high in soil and environmental conditions favorable for disease development. It is a quarantine pest in many countries, and California has regulations in place to protect movement of the pathogen into Mono County. Sclerotia can be spread by water.

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

Economic Impact: A, B, C, D, G

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 white rot has infested a field, there are no highly effective treatments. Even a small number of surviving sclerotia can cause new epidemics, and usually fields are not used for *Allium* production again.

Evaluate the environmental impact of the pest to 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 *Stromatinia cepivora:* 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 'Medium'.

Score: -2
-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: (Score)

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= 9***

Uncertainty:

This pathogen could easily be confused in the field with *Sclerotinia sclerotiorum* or *S. rolfsii*, both white-rotting fungi that produce sclerotia and attack *Allium* spp. and that are widely distributed in California (CDFA PDR Database, 2022).

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Stromatinia cepivora* is B.

References:

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Responsible Party:

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***Comment Period: 09/20/2022 through 11/04/2022**

***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
