cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Soil-borne wheat mosaic virus

Realm: Riboviria, Kingdom: Orthornavirae,
Phylum: Kitrinoviricota, Class: Alsuviricetes,
Order: Martellivirales, Family: Virgaviridae,
Genus: Furovirus

Current Pest Rating: none

Proposed Pest Rating: C

Comment Period: 12/17/2020 through 01/31/2021

Initiating Event:

On August 9, 2019, USDA-APHIS published a list of "Native and Naturalized Plant Pests Permitted by Regulation". Interstate movement of these plant pests is no longer federally regulated within the 48 contiguous United States. There are 49 plant pathogens (bacteria, fungi, viruses, and nematodes) on this list. California may choose to continue to regulate movement of some or all these pathogens into and within the state. In order to assess the needs and potential requirements to issue a state permit, a formal risk analysis for Soil-born wheat mosaic virus is given herein and a permanent pest rating is proposed.

History & Status:

Background:

Soil-borne wheat mosaic virus (SBWMV) was first described as "rosette disease" by H. H. McKinney in Illinois in 1919. It was one of the earliest known wheat viruses and the first soil-borne wheat virus described, causing severe stunting and mosaic in susceptible wheat, barley, and rye cultivars (Koehler et al., 1952). SBWMV is the type member of the Furovirus genus with rigid rod-shaped particles and a positive sense RNA genome. It mainly occurs in North America. The vector of the virus, *Polymyxa graminis*, is a species of plasmodiophorid cercozoans, which are endoparasitic slime molds in the family Plasmodiophoromycota. Although it is an obligate parasite of plant roots, it does not cause disease on its own. Its ability to vector SBWMV was show by Brakke et al. in 1965. *Polymyxa graminis* produces viruliferous resting spores that can remain dormant in soil for up to 30 years, able to infect a

susceptible host under favorable environmental conditions (Cadle-Davidson and Gray, 2006; Kroese et al., 2018)

Hosts: Wheat - *Triticum aestivum*, *T. compactum*, *T. turgidum, T. durum, T. dioccum, T. spelta, T. polonicum, T. monococcum*; barley - *Hordeum vulgare*; and rye - *Secale cereale* (CABI-CPC, 2020)

Symptoms: The disease is generally more severe on autumn-sown wheat (a.k.a. winter wheat), although spring planted varieties are also susceptible. Symptoms are primarily seen in the early spring on the leaves and can include yellow streaks, splotches, and mosaic patterns, but the most important symptom is stunted growth. The new leaves and leaf sheaths first appear to have a mild green to yellow mottle and later develop dashes and streaks of yellow in parallel to the veins. The most highly susceptible varieties show rosetting, where leaves and tillers are short, bunchy, or compact, and they have excessive tillering. In warmer climates, symptoms can also be expressed in the late autumn or early winter (Cadle-Davidson and Gray, 2006; Kroese et al., 2018).

From a distance, affected areas of fields appear yellow or light green (Brakke, 1971). In late spring, chlorotic patches may become less apparent as plants appear to recover from infection because virus replication decreases at warmer temperatures above 20° C (Ohsato et al., 2003). SBWMV can be confused with wheat spindle streak mosaic, which also causes stunting and chlorosis. Patches of symptomatic plants can occur in low-lying wet areas of the field where swimming zoospores of the viral vector are more common. In humid climates or in wetter soils patches may occur anywhere. Symptomatic patches are often observed running parallel to tillage and seeding patterns (Kroese et al., 2018).

Transmission: The virus is sap-transmissible and the slime mold *P. graminis* is the vector. It can transmit several other soil-borne grass viruses, including Barley yellow mosaic virus (Kanyuka et al., 2003). It is a common soil-dweller and although it is an obligate pathogen of living plant roots, it is not classified as a pathogen. It can be spread by soil movement, such as by farm vehicles or wind. It is not known to be seed-borne. Because the slime mold produces long-lasting spores, it can remain in the soil for many years in the absence of a susceptible host crop and so has the potential to transmit disease many years after infection. Systemic viral infection is temperature dependent. When temperatures are less than 20° C, the virus moves from the roots to the leaves. When temperatures are higher, movement is reduced (Cadle-Davidson and Gray, 2006).

Damage Potential: Yield losses from SBWMV vary with cultivar, viral strain, and environmental conditions. One factor dictating yield loss is temperatures in early spring, with temperatures below 17° C experiencing the largest losses. In the central plains, studies have documented yield losses from 10 to 80% (Bever and Pendleton, 1954). In irrigated winter wheat production in the Pacific Northwest, yield losses of 70% have been reported for susceptible wheat varieties (Flowers et al., 2012). It is mainly controlled by the use of resistant varieties.

Worldwide Distribution: Brazil, Canada, China, France, Egypt, Germany, Italy, Japan, Russia, United States of America (Florida, Illinois, Indiana, Kansas, Maryland, Missouri, Nebraska, North Carolina, Oklahoma, Oregon, Virginia, and Washington), and Zambia (Bockus et al., 2010).

Official Control: USDAs harmful organism list for Colombia (USDA-PCIT, 2020), and EPPO's A1 list for East Africa (EPPO, 2020)

California Distribution: None

California Interceptions: None

The risk Soil-borne wheat mosaic virus would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** Spread of the virus depends on the ability of its vector, a slime mold, to survive in the soil. Hot or cold soil temperatures and dry soil conditions limit spread of the vector.

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 host range is limited to plants in the family Poaceae. It mainly affects winter wheat but could also affect winter-sown spring wheat.

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:** The virus is not seed-borne. It requires a living slime mold vector, and the slime mold requires a living host to reproduce. It is spread by movement of soil. Once infected, the vector can survive in the soil for long periods of time as viruliferous spores.

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:** Resistant varieties are widely used to reduce the impact of the disease.

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

Economic Impact: A

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: **1**

- 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:** Hosts of SBWMV are not grown on large acreages in California but they are a part of cover crops or forage mixes and could naturalize, creating a reservoir of virus in soil populations of slime mold.

Environmental Impact: A

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 Soil-borne wheat mosaic virus*:* Low

Add up the total score and include it here. **8**

-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 'not established'. There are no records of SBWMV in California

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 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: None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for Soil-borne wheat mosaic virus is C.

References:

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Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, CDFA/PHPPS ECOPERS, 2800 Gateway Oaks Suite 200, Sacramento, CA 95833 Phone: (916) 654-1017, permits[@]cdfa.ca.gov.

***Comment Period: 12/17/2020 through 01/31/2020**

***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: C