

California Pest Rating Proposal for Blackberry leaf mottle-associated virus

Current Pest Rating: Z

Proposed Pest Rating: C

Realm: Riboviria, Kingdom: Orthornavirae,
Phylum: Negarnaviricota, Class: Ellioviricetes,
Order: Bunyavirales, Family: Fimoviridae,
Genus: Emaravirus

Comment Period: 04/11/2023 through 05/26/2023

Initiating Event:

In the summer of 2022, two plant pathology diagnostics labs that provide virus testing services for cane berries reported to the California Department of Food and Agriculture that they had detected Blackberry leaf mottle-associated viruses from multiple samples in two large blackberry production counties, Santa Cruz, and Ventura. Official samples were collected by these two counties and tested at CDFA's Plant Pest Diagnostics Center. Plant Virologist Tongyan Tian confirmed the presence of this virus in most of the samples and assigned a temporary Z rating. The risk to California from Blackberry leaf mottle-associated virus is described herein and a permanent rating is proposed.

History & Status:

Background: Less than 1% of the state's farmland is used by California's berry industry, which accounts for 5% of the state's agricultural sales. The berry sector consists of two significant subsectors: cane or bush berries like blueberries, raspberries, and blackberries, and strawberries. Although most growers replant cane berries after two to four years, the plants can continue to produce fruit for up to ten years. Berries are a crop with a high value and high risk, capable of earning over \$50,000 per acre, but with very significant land and labor costs (Goodhue and Martin, 2020). Oregon, California, and Washington account for most of U.S. production for both fresh market and processing blackberries.

Domestic production has more than tripled in the past decade, with most of that growth coming from California. Newer varieties and production methods are improving yields and extending the range of blackberry production into new climatic zones, including those farther south (Daugovish et al., 2021).

The genus *Rubus* in the family Rosaceae is divided into 15 subgenera with blackberries classified in the *Rubus* (formerly *Eubatus*) subgenus and as hybrids between the subgenera *Rubus* and *Idaeobatus*, which also holds the raspberries. *Rubus* species are propagated vegetatively and are subject to infection by viruses during development, propagation, and fruit production stages, and by vectors including insects and mites (Martin et al., 2013).

Blackberry yellow vein disease complex (BYVD) is an economically important disease of blackberries. BYVD is caused by an RNA virus complex, not by a single virus, and there is a synergistic negative effect when multiple viruses co-occur. This disease is a major constraint to blackberry production where it occurs. The complex may include Blackberry yellow vein associated virus, Blackberry chlorotic ringspot virus, Blackberry virus E, Blackberry virus Y, Blackberry leaf mottle-associated virus, Blackberry vein banding-associated virus, Impatiens necrotic spot virus, and Tobacco ringspot virus, among others. Blackberry vein banding-associated virus, Blackberry leaf mottle-associated virus, and Blackberry chlorotic ringspot virus are the most prevalent viruses in the disease complex (Hassan et al., 2017; Hassan et al., 2019; Martin et al., 2013).

In 2017, Hassan et al. described Blackberry leaf mottle-associated virus (BLMaV). It was characterized and a phylogenetic analysis revealed its close relationship to recognized members of the genus *Emaravirus* (Hassan et al., 2019). *Emaravirus* is the sole genus in the family Fimoviridae and encompasses plant viruses with multiple, negative-sense, single-stranded (ss) RNA genomes. Emaraviruses are reported to be associated with viral disease in multiple fruits (e.g., *Actinidia* species, blackberry, fig, grape, raspberry, jujube, and pear) plus roses (Fan et al., 2021). Plants were collected from several areas in the United States, and the incidence of BLMaV was greater than 40% in BYVD-affected material. Similar to other emaraviruses, BLMaV can be transmitted by eriophyid mites, although a specific mite species has not been published for BLMaV (I. E. Tzanetakis, University of Arkansas, pers. comm).

Hosts: Blackberries (*Rubus* subgroup *rubus*) are the only reported host, with both cultivated and wild blackberries proven to be susceptible (Hassan, 2017).

Symptoms: Symptoms of blackberry yellow vein disease complex (which includes BLMaV positive plants) include vein yellowing/feathering, leaf mottling, oak-leaf pattern, and ringspots. In most cases, at the beginning of the year, the symptoms are observed in only a few leaves, and become more noticeable as the season progresses. Yellowing develops along the main veins of the leaflets, being barely noticeable early in the season, and progresses to cover most of the leaf blade. Depending on the season, affected areas may turn necrotic. In severe cases, BYVD may lead to plant death, although in general, the most severe aspect of the disease is a decline in fruit productivity. It is important to note that identical symptoms are observed in plants infected with different sets of viruses and grown under different environmental conditions. In general terms, symptom severity is closely associated with the number of viruses infecting the plants and worsen over years (Martin et al., 2013).

Transmission: For BLMaV, the principal means of long-distance spread is through movement of infected propagation material or nursery material. Systemic pathogens are spread readily by vegetative propagation. Once a plant is infected, most, if not all, subsequent progeny will also be infected. Once these pathogens are introduced into a new area, they can spread within a field and region by naturally occurring or invasive vector. Hassan et al., 2017, demonstrated that BLMaV can be transmitted and spread over shorter distances by a yet to be described eriophyid mite species that was found infesting blackberry plants in Arkansas.

Damage Potential: Blackberry plants systemically infected with the viruses that cause blackberry yellow vein disease complex exhibit phenotypes ranging from asymptomatic to severe decline and death. Symptoms depend on many factors, including virus species and strain, host genotype, environment, and presence of mixed infections with viral and non-viral pathogens. There are no economically feasible therapeutic procedures to cure any plants once infected with these systemic plant pathogens in nurseries or production fields. Therefore, effective control strategies are directed toward the production of healthy plants and the prevention of infection by mites (Martin et al., 2013).

Worldwide Distribution: United States (*Arkansas, California, Florida, Georgia, North Carolina, Maryland, Mississippi, Oklahoma, Oregon, and South Carolina*).

Official Control: None

California Distribution: There are official samples from Santa Cruz County. However, there have been multiple detections made by private labs from nursery stock and it is suspected to be widespread in California where blackberries are grown commercially.

California Interceptions: None

The risk Blackberry leaf mottle-associated virus would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** This is systemic virus that lives inside its host and mite vectors. It is likely to survive everywhere blackberries can grow. Much of coastal California is suitable for blackberry cultivation. Wild blackberries, including native species i.e., *Rubus ursinus* and nonnative species i.e., *Rubus armeniacus*, occur throughout the state and could be potential hosts (Calflora, 2023).

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.
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2) Known Pest Host Range: The host range is limited to blackberries

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 virus reproduces systemically inside its host's cells. It cannot move without help of a vector. The distribution of potential mite vectors is unknown.

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: As one of viruses that causes, Blackberry yellow vein disease complex, this disease can be very damaging to cultivated blackberries. It can be vectored by eriophyid mites.

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

Economic Impact: A, E

- 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: 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: There are native and naturalized blackberries in California including *R. allegheniensis*, *R. armeniacas*, *R. laciniatus*, *R. lasiococcus*, *R. pensilvanicus*, *R. ulmifolius* and *R. ursinus*. In the Southeastern United States, Hussan et al., 2017, reported that wild blackberries were found to be hosts of this virus, presumably vectored by eriophyid mites. The susceptibility of California wild blackberry populations is unknown. They could be a source of mite populations and viral inoculum for blackberry crops.

Evaluate the environmental impact of the pest to California using the criteria below

Environmental Impact: A, 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: 3

- 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 Blackberry leaf mottle-associated virus: Medium

Add up the total score and include it here. **10**

-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.

There are official records from Santa Cruz County, the largest blackberry production region, and it is described as widespread in that area (I. E. Tzanetakis, University of Arkansas, pers. comm).

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 = 8*

Uncertainty:

As high-throughput sequencing and Sanger sequencing of reverse transcription polymerase chain reaction (RT-PCR) products of viruses found in woody plants becomes more common, it's likely virologists will continue to identify new viruses in small fruits. Blackberry yellow vein disease complex is known to have close to a dozen viruses involved, often in symbiosis, and the role of each is difficult to elucidate. The mite vectors could already be widespread, making it difficult to control this virus. There are reports from private diagnostics labs of this virus detected in Santa Barbara, Ventura and Merced counties.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for Blackberry leaf mottle-associated virus is C.

References:

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Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, CDFA/PHPPS ECOPERS, 1220 N St Rm 221, Sacramento, CA 95814 Phone: (916) 654-1017, [permits\[@\]cdfa.ca.gov](mailto:permits[@]cdfa.ca.gov).

***Comment Period: 04/11/2023 through 05/26/2023**

***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.

Proposed Pest Rating: C
