cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Arabis mosaic nepovirus

Current Pest Rating: none

Proposed Pest Rating: A

Realm: Riboviria, Kingdom: Orthornavirae,
Phylum: Pisuviricota, Class: Pisoniviricetes,
Order: Picornavirales, Family: Secoviridae,
Genus: Nepovirus

Comment Period: 02/12/2021 through 03/29/2021

Initiating Event:

Testing for Arabis mosaic nepovirus (ArMV) is often requested by trading partners prior to issuance of phytosanitary certificates for export of grape, stone fruit, and small fruit planting stock, and vegetable seed. ArMV is not known to be in the state. The risk to California from ArMV is described herein and a permanent rating is proposed.

History & Status:

Background: The genus Nepovirus contains **ne**matode-transmitted **po**lyhedral (isometric) viruses. This is a large genus and many members cause a range of symptoms from none (asymptomatic) to foliar patterns, leaf necrosis, severe shock, stunting and even death in annual or perennial plants including vegetables, flowering ornamentals, fruit trees and vines. Nepoviruses are transmitted from plant to plant by nematodes that acquire the virus by feeding and can transmit it for several months. It was reported that nepoviruses can be retained for several years in the vector nematodes when they are not feeding. ArMV is primarily transmitted by the European dagger nematode, *Xiphinema diversicaudatum*, which is an A-rated pest not known to be in California. The nematode has recently been reviewed (Scheck, 2020). *Xiphinema diversicaudatum* is a proven vector of Arabis mosaic (ArMV) (Brown et al., 1983). ArMV is of great concern in viticulture, as it is one of the viruses associated with fanleaf degeneration/decline disease of grapevines (Oliver and Fuchs, 2011).

Hosts: Principal hosts are *Fragaria x ananassa* (strawberry), *Humulus lupulus* (hop), *Vitis* spp. (grapevine), *Rubus idaeus* (raspberry), *Rheum rhabarbarum* (rubarb). and *Sambucus nigra* (black elder).

Other cultivated and wild species in multiple families have been reported as hosts including *Alstroemeria*, *Apium graveolens* (celery), *Armoracia rusticana* (horseradish), *Begonia*, *Beta vulgaris* (beet), *Crocus, Dianthus, Gladiolus*, *Hosta* (hostas), *Hyacinthus* (hyacinth), *Lactuca sativa* (lettuce), *Lilium* (lily), *Narcissus*, *Nerine, Olea europaea* (olive), *Prunus armeniaca* (apricot), *Prunus avium* (cherry), *Prunus domestica* (plum), *Prunus dulcis* (almond), *Prunus laurocerasus* (cherry laurel), *Prunus persica* (peach), *Rosa* (rose) and *Tulipa* (tulip).

Symptoms: The symptoms of ArMV on field-infected plants ranges from small yellow flecks to prominent foliar symptoms. The most common symptoms on strawberries are leaf mottling, stunting, and several forms of deformation, including fan-leaf and vein enations. The symptoms vary depending on the host plant but also on virus isolate, cultivar, season and year. Leaves and fruits can show abnormal shapes, colors, forms and patterns; whole plants can be dwarfed or stunted (e.g., on raspberries). Many infections with ArMV are latent, meaning the plants are infected but do not show symptoms. Often plants are found to be co-infected with other viruses making it difficult to assess the symptoms of an individual virus.

Grapes will have atypical growth including leaf deformation, yellowing, cupping or spotting, vein clearing, shortening of internodes, and reduced vigor. Infected leaves are malformed with abnormal veins, giving the leaf the appearance of an open fan, with exaggerated dentition of the leaf margin, mosaic patterns of dark green and light-yellow tissue on leaves, and bright yellow bands or ring/line patterns along major veins. Yellowing and flecking symptoms often disappear quickly with the onset of warmer summer temperatures (Oliver and Fuchs, 2011; Celebi-Toprak et al., 2013).

ArMV infection of hops is associated with several types of symptoms called bare-bine and nettlehead. There is weak shoot growth in the spring, curvature of shoots, and production of small, dark colored leaves. Later, oily yellow blotches appear between the leaf veins, resulting in the leaves splitting apart. The nettle head symptom describes how plants develop stiff, erect shoots with short internodes that do not climb their support strings, with upward rolling of the leaf margins, vein clearing or mottle, and vein enations on the lower surface (Pethybridge et al., 2008)

Transmission: Both adults and juvenile *Xiphinema diversicaudatum* nematodes acquire this virus after feeding on infected hosts for several hours. They can retain the virus in their bodies and transmit it for months, but the virus is not retained through the molts or passed to from the female to her eggs. ArMV is moved by its nematode vector over short distances only.

Movement of infected vegetative propagative plant material is the most effective means of spread, with long distance movement of infected planting material possible. This virus can also be seed borne in some hosts. Seed transmission is a common feature and was reported in at least 15 species in 12 plant families with up to nearly 100% of the progeny being infected (Murant, 1970). But this type of spread is of little importance in crops that are propagated vegetatively like strawberries, raspberries, hops, and grapes.

Spread of ArMV by plant to plant or sap contact in the field seems to be very rare. Some evidence exists for pollen transmission of ArMV in hops (Eppler, 1983), but plant infection from pollen seems to also be rare. In non-cultivated weeds, spread occurs initially by seed and, secondarily, over shorter distances by nematode transmission (McNamara, 1980).

Damage Potential: Strawberries and raspberries can be severely affected and, in some cultivars and with some strains, plants may even be killed by the virus. In cherries, mixed infections of ArMV with prune dwarf ilarvirus or prunus necrotic ringspot ilarvirus induce 'European rasp leaf'. In the UK, the virus is associated with several diseases of hop which can lead to a considerable reduction in yield. In grape, berry set is reduced with yield losses up to 80% and clusters may abort into tendrils with just two or three berries each (Oliver and Fuchs, 2011; CABI, 1990, 2020; EFSA, 2013).

Worldwide Distribution: Africa: *Egypt, South Africa*. Asia: *India, Iran, Japan, Kazakhstan, Lebanon, Syria, Turkey*. Europe: *Austria, Belarus, Belgium, Bulgaria, Croatia, Czechia, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Moldova, Netherlands, Norway, Poland, Romania, Russia, Serbia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom*. North America: *Canada, Mexico, United States* (Michigan, Minnesota, Missouri, Nebraska, New York, Ohio, South Carolina). Oceania: *Australia, New Zealand*. South America: *Chile* (CABI, 2020).

Official Control: ArMV is of quarantine significance for the North American Plant Protection Organization (NAPPO). It is on the EPPO's A1 list for Bahrain and Brazil; A2 list for China, Egypt, Jordan, Turkey and is a quarantine pest for Israel, Norway and the United States (EPPO, 2021). It is on the USDA's harmful organisms list for these countries: Albania, Brazil, Canada, China, Colombia, Ecuador, Egypt, European Union, Georgia, Guatemala, Holy See (Vatican City State), Honduras, India, Indonesia, Iran, Japan, Korea, Monaco, Namibia, Nicaragua, Panama, Peru, San Marino, Serbia, South Africa, Syrian Arab Republic, Taiwan, Timor-Leste, Tunisia (USDA PCIT, 2021). It is listed as a pest of concern for tomato and tomatillo export seed programs in California (CDFA Phytosanitary field manual, 2020).

California Distribution: None

California Interceptions: None

The risk Arabis mosaic nepovirus would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** Arabis mosaic virus systemically infests its hosts. In California, is likely to establish in climates suitable for the growth of its host plants. Since these host plants are widespread within the state, it is likely that the virus could also become established over a widespread area Additionally, this virus can survive with its vector, *Xiphinema diversicaudatum*, in weeds and even when no host plants are available

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:** Arabis mosaic virus has a large host range including many families of herbaceous and woody plants, and many important crop species.

Evaluate the host range of the pest.

Score: 3

- 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:** Arabis mosaic virus has high reproductive potential within plants. However, its primary vector, *X. diversicaudatum*, is not known to be in California. It is also spread through the movement of infested planting stock to non-infested sites and can be transmitted mechanically by inoculation and by seed.

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:** Arabis mosaic virus is a regulated pathogen and a target of phytosanitary inspection for export plants for planting and for export seeds.

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

Economic Impact: A, C, 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: 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:** Home, urban, private, and commercial ornamental, fruit, and vegetable gardens may be significantly impacted by Arabis mosaic virus, which could trigger development of additional official or private treatment programs.

Environmental Impact: D, 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 Arabis mosaic virus*:* High

Add up the total score and include it here. 14
-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".

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* ***= 14***

Uncertainty:

The affect of this virus on California native plants is an uncertainty. Both the pathogen and its vector have a large host range, so it appears likely that nematodes could spread the virus to plants outside of a cultivated area.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for **Arabis mosaic nepovirus is A**.

References:

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Responsible Party:

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***Comment Period: 02/12/2021 through 03/29/2021**

***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.

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: A
