cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Citrus yellow mosaic virus
(mosaic of citrus)

Current Pest Rating: None

Proposed Pest Rating: A

Kingdom: Viruses and viroids, Order: Ortervirales,
Family: Caulimoviridae, Genus: Badnavirus

Comment Period: 09/27/2021 through 11/11/2021

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from Citrus yellow mosaic virus is described herein and a permanent pest rating is proposed.

History & Status:

Background: A mosaic disease in citrus was described from observations in India in 1984 by Ahlawat et al. The disease was hypothesized to be caused by a virus as it was easily transmitted by bud and wedge grafting, with dodder, and mechanically with sap. With electron microscopy, bacilliform virions could be seen in negatively stained leaf dips and in partially purified preparations of samples from field infected trees. The symptoms on inoculated sweet orange seedlings were mild chlorosis, followed by severe mosaic patterns on the newly developed leaves. On mature leaves, chlorosis was severe, and the leaves became leathery in texture. The inoculated plants were stunted and less vigorous. Cultivars of the following citrus types were susceptible: sweet orange, limes, Rangpur lime, grapefruit, mandarin, lemon, and pummelo.

Badnaviruses (Family: Caulimoviridae) are non-enveloped bacilliform DNA viruses with a monopartite genome. They can be transmitted by mealybugs and/or aphids in a semi-persistent manner. They are one of the most important plant virus groups and are serious pathogens affecting the cultivation of crops in the tropics, especially banana, black pepper, cocoa, citrus, sugarcane, taro, and yam. Some badnaviruses can become endogenous, integrating into their host genomes. Some are later awakened through abiotic stress, leading to infective episomal forms (Kumar et al., 2015).

Hosts: Citrus yellow mosaic virus has been recorded mainly on oranges (*Citrus sinensis*), but also on bael *(Aegle marmelos*), Rangpur limes (*C. limonia)*, kumquats *(Fortunella* spp.), grapefruits (*C. paradisi*), lemons (*C. limon*), mandarins (C*. reticulata*) and pummelos (*C. maxima*). In artificial inoculation experiments by grafting found that Volkamer lemon (*C. volkameriana*), rough lemon, (*C. jambhiri*), sour orange (*C. aurantium)*, and calamondin (*C. mitis*) were susceptible, while sweet lime(*C. limettioides*), key lime (*C. aurantiifolia*), and cintron (*C. medica*) were more rarely infected and gave milder symptoms (Ahlawat et al., 1996a). There are non-citrus species that can be artificially inoculated and will develop chlorosis and test positive including *Canna indica*, sorghum, and maize (Aparna et al., 2007).

Symptoms: In the field, symptoms include stunting, chlorosis, and uniformly distributed yellow leaf mosaics, followed by a leathery texture of mature leaves. Field-infected orange and pummelo show bright-yellow mottling of the leaves and yellow flecking along the veins (Ahlawat et al., 1996b). Graft-inoculated *Citrus* spp. in greenhouses show more mild symptoms, possibly because some of the field symptoms are due to other causes or mixed infections with other viruses (the later situation is quite common in orchard trees in India).

Transmission: In India, this disease has been found in commercial nurseries and can be spread through contaminated budwood. It can also be spread by dodder infection (*Cuscuta reflexa*). Infectious virions can be mechanically transmitted in plant sap. Citrus mealybug (*Planococcus citri*) was shown to be able to transmit Citrus yellow mosaic virus under experimental conditions (Garnsey et al. 1998). This mealybug is common and widespread in California (PDR database, 2021).

Damage Potential: Citrus yellow mosaic virus in India is of great economic importance. It is capable of infecting major commercial citrus cultivars and rootstocks. Ahlawat et al.(1996a) reported the incidence of mosaic disease ranged from 10-70% in sweet oranges in the Hindupur region of Andhra Pradesh, leading to the abandonment of orchards with trees 4-10 years old because they were no longer productive. The reduction in fruit yield was as high as 77%, and fruits from affected trees had 10% less juice.

Worldwide Distribution: India (CABI-ISC, 2021).

Official Control: Citrus yellow mosaic virus is on the EPPO's A1 list for Argentina, Bahrain, European Plant Protection Organization, and Turkey. It is a quarantine pest in Morocco and a regulated non-quarantine pest in Egypt. It is on the USDA PCIT's harmful organism list for Ecuador, Georgia, Japan, Peru, Taiwan, and the United Arab Emirates. The USDA maintains a Federal Foreign Quarantine against citrus nursery stock. CDFA has a State Exterior Quarantine against citrus pests, and this includes any plant disease pest of citrus which does not occur, or is not generally established, in California (https://www.cdfa.ca.gov/countyag/postings/files/301_9.pdf).

California Distribution: None

California Interceptions: None

The risk Citrus yellow mosaic virus would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This disease is likely to occur in any climate where its hosts can establish. This includes any part of California suitable for citrus

   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 hosts are all in the family Rutaceae

   Evaluate the host range of the pest.

   Score: 2
   - 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 replicates inside its hosts. It can be dispersed with movement of infected planting material and potentially be vectored by citrus mealybugs.

   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:** This disease causes significant damage to citrus, including yield loss. It is a pathogen of quarantine significance and has insect vectors.

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

   Economic Impact: A, B, 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:** None have been reported but there are California natives in the family Rutaceae (CalFlora, 2021). Their susceptibility is unstudied. There are no treatments for infected trees. Certified disease-free budwood should always be used for propagation. As a quarantine pest, regulatory action would be taken if it is found in the United States.

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

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 Citrus yellow mosaic virus*:* High

Add up the total score and include it here. **13**
-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* ***= 13***

Uncertainty:

More information is needed on the biology of the virus (multiplication at different temperatures, damage at different temperatures) before its potential to cause losses in citrus orchards in California can accurately be estimated. Although the citrus mealybug has been shown to be a vector in experimental studies, its role in disease epidemiology in the field is unknown.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for Citrus yellow mosaic virus is A.

References:

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Responsible Party:

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*Comment Period: 09/27/2021 through 11/11/2021

*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