CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Cucurbit aphid-borne yellows luteovirus

Current Pest Rating: None

Proposed Pest Rating: C

Kingdom: Viruses and viroids, Category: Riboviria,
Category: Orthornavirae, Phylum: Pisuviricota,
Class: Pisoniviricetes, Order: Sobelivirales,
Family: Solemoviridae, Genus: *Polerovirus*

Comment Period: 02/16/2022 through 04/02/2022

Initiating Event:

This pathogen has not been through the pest rating system. The risk to California from Cucurbit aphid-borne yellows virus (CABYV) is described herein and a permanent rating is proposed.

History & Status:

Background: A yellowing disease of melon, cucumber and zucchini squash was frequently observed in summer and autumn crops in France in the 1980s. Infected plants show yellowing and thickening of the older leaves; symptom intensity differs depending upon cultivar and season. The disease was associated with the presence of a virus with spherical particles c. 25 nm in diameter, which is readily transmitted in a persistent manner by the aphids *Myzus persicae* (the green peach aphid) and *Aphis gossypii* (the cotton/melon aphid) but not mechanically. Lecoq et al. (1992) proposed the name Cucurbit aphid-borne yellows virus (CABYV) and considered it as a new member of the Luteoviridae.

The family name Luteoviridae arises from the Latin *luteus*, which means 'yellow', descriptive of the common yellowing symptom. CABYV is a species of the *Polerovirus* genus, one of three genera in the family. The virions of *Polerovirus* are non-enveloped, and encapsidate single strands of (+) sense RNA with icosahedral and spherical geometries. These viruses only replicate within the host cell and not within the aphid vectors. It is not mechanically or seed-transmitted (Brunt et al., 1999).

In the summer of 1992, symptoms characteristic of CABYV were observed in cucumbers, honeydews, cantaloupes, zucchinis, and pumpkins grown in California's San Joaquin, Sacramento, and Salinas valleys. Positive ELISA reactions were made using antisera to a French isolate of CABYV. Both aphid vectors identified in France are common in California and were also shown to be vectors here, able to

transmit virus in a persistent circulative manner from naturally infected plants. In some fields, 100% of the plants were found to be infected. This initial survey and publication by Lemaire et al. (1993) was the first report of this virus in North America, but it indicated that CABYV was already widespread in California cucurbit production areas. Since then, the occurrence of the virus in California has been described as “erratic and unpredictable”, with *Aphis gossypii* transmitting the virus very efficiently, and *Myzus persicae* as a poor vector. *Macrosiphum euphorbiae* (potato aphid) is an additional known vector that is widespread in California (Kassem et al., 2013). The source of the virus is unknown, but it could have been wild cucurbits (Davis et al., 2008).

Hosts: *Abutilon theophrasti* (velvet leaf), *Amaranthus spinosus* (spiny amaranth), *Benincasa hispida* (wax gourd), *Beta vulgaris* (beetroot), *Bryonia cretica, Capsella bursa-pastoris* (shepherd's purse), *Chenopodiastrum murale* (nettleleaf goosefoot), *Cicer arietinum* (chickpea), *Citrullus colocynthis* (colocynth), *Citrullus lanatus* (watermelon), *Coccinia grandis* (scarlet-fruited ivy gourd), *Crambe abyssinica*, *Cucumis melo* (melon), *Cucumis sativus* (cucumber), *Cucurbita* (pumpkin), *Cucurbita maxima* (giant pumpkin), *Cucurbita moschata* (pumpkin), *Cucurbita pepo* (squash), *Ecballium elaterium*, *Eruca vesicaria* (purple-vein rocket), *Gossypium hirsutum* (Bourbon cotton), *Lactuca sativa* (lettuce), *Lagenaria siceraria* (bottle gourd), *Lamium amplexicaule* (henbit deadnettle), *Luffa aegyptiaca* (loofah), *Malva parviflora* (pink cheeseweed), *Momordica charantia* (bitter gourd), *Momordica dioica, Montia perfoliata* (miner's lettuce), *Papaver rhoeas* (common poppy), *Passiflora* (passionflower), *Passiflora edulis* (passionfruit), *Passiflora* spp., *Senecio vulgaris, Sinapis arvensis* (wild mustard), *Sisymbrium irio, Solanum americanum*, *Solanum lycopersicum* (tomato), *Solanum nigrum* (black nightshade), *Sonchus oleraceus* (common sowthistle), *Vicia faba* (faba bean) (Lecoq et al., 2020).

Symptoms: The symptoms of CABYV are nearly identical to many other biotic (caused by other pathogens) and abiotic (e.g., nutrient deficiency, such as magnesium deficiency) disorders as well as natural senescence. Cucurbit yellow stunting disorder virus, Cucurbit chlorotic yellows virus, and Beet pseudoyellows virus, all vectored by whiteflies, also cause very similar symptoms. Yellowing develops on intermediate and older leaves, while young leaves can remain symptomless. Leaves exhibit foliar mottling and interveinal chlorosis beginning near the crown and spreading outward along vines. The yellow mottling and interveinal chlorotic patches eventually coalesce, with leaves becoming yellow, thickened and brittle. Symptoms are generally limited to the older leaves, but differences are seen by cultivar with some developing only very mild symptoms on a few leaves while others developing a bright yellow color over the whole plant. Symptom severity is more pronounced in summer than in winter. Mixed infections with mosaic-inducing viruses are frequent in cultivated cucurbits and more severe CABYV symptoms are observed when the plants are co-infected with potyviruses (Bourdin and Lecoq, 1994).

Transmission: CABYV can spread rapidly in cucurbit crops when there is an abundance of CABYV reservoirs around cultivated fields, and if there is high population of *A. gossypii*, which has a persistent mode of transmission (Lecoq and Katis, 2014). Several weed species are hosts of CABYV in natural conditions. Some belong to Cucurbitaceae (*B. dioica, E. elaterium*) and others belong to diverse botanical families (*C. bursa-pastoris, L. amplexicaule, S. vulgaris*). Some of these species can overwinter under California conditions and are alternative hosts for two other major cucurbit viruses, Cucumber

mosaic virus and Watermelon mosaic virus (Lecoq et al., 1992). It is not known to be mechanically transmitted or seed-borne.

Damage Potential: The annual value of cucurbit crops in California is close to $500M (CDFA statistics, 2020). The impact of CABYV infections on yield depends on the host species and cultivar. A significant reduction (50%) in fruit number per plant was observed in cucumber and a 40% reduction in fruit was observed in melon. However, in melon this reduction was compensated by larger fruits, which is not always a favorable commercial character. No effect of virus infection on fruit flesh sugar content was noticed (Lecoq et al., 1992). According to the UC Pest Management Guidelines (Davis et al., 2008), even though the growth and yield of infected plants may be reduced, the occurrence of this virus is erratic and unpredictable, and specific control of this disease is not attempted.

Worldwide Distribution: Africa: *Algeria, Egypt, Libya, Korea, Mauritius, Morocco, Sudan, Tanzania, Tunisia, Uganda. Asia: Azerbaijan, China, India, Iran, Lebanon, Nepal, Pakistan, Philippines, Saudi Arabia, Sri Lanka, Taiwan, Thailand, Turkey, Uzbekistan.* Americas: *Brazil, United States* (Alabama, California, Oklahoma, Texas) Europe: *Bulgaria, Cyprus, Czechia, France, Germany, Greece, Italy, Montenegro, Poland, Serbia, Slovakia, Slovenia, Spain, Ukraine*. Oceania: *Papua New Guinea, Timor-Leste* (Lecoq et al., 2020)

Official Control: Cucurbit aphid-borne yellows virus is on the USDA PCIT's harmful organism list for Honduras (USDA, 2022). It is on the EPPO's A1 list for Jordan (EPPO, 2022).

California Distribution: This virus has been in the Sacramento, San Joaquin, and Salinas valleys for 30 years (Lemaire et al., 1993). It has been described as "common" in the Central Valley (Mondel et al., 2021).

California Interceptions: There are no official records of CABYV intercepted from incoming plant material shipments to California.

The risk **Cucurbit aphid-borne yellows virus** would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:**

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.

Risk is Medium (2): CABYV is established in the Central Valley, Sacramento Valley and on the Central Coast. Its further spread to non-infected sites is limited only by the distribution of its vector. There are no records from the southern desert counties.

2) Known Pest Host Range:

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.

Risk is Medium (2) – The natural host range mainly Cucurbits in the family Cucurbitaceae (which are grown extensively in the lower Sacramento Valley and in San Joaquin, Monterey, and Imperial Counties). Additional hosts include plants in several very widespread families (e.g., Amaranthaceae, Asteraceae, Brassicaceae, Malvaceae, Solanaceae) other than Cucurbitaceae that can serve as source plants for the aphid vectors which then can carry the virus back to cucurbits.

3) Pest Reproductive Potential:

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.**

Risk is High (3) – The virus can thrive in climates that are favorable for its vectors and hosts. Its potential for spread is always dependent on the distribution of its vector and susceptible plant materials. Therefore, factors that increase movement and activity of the vector and infected plants will also influence that of the virus**.**

4) Economic Impact:

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.

Risk is High (3) – CABYV infections could lower crop yield and value, increase production costs, trigger loss of market, and the virus is vectored by common aphids which would require implementation of management strategies to minimize the risk of the introduction and establishment of the virus in non-infected regions within California.

5) **Environmental Impact:**

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

Environmental Impact: D
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.

Risk is Medium (2) – Infestations of cucurbits and non-cucurbit host plants resulting in the imposition of additional official or private treatment programs to prevent spread of the virus and virus-carrying aphid vector.

Consequences of Introduction to California for Cucurbit aphid-borne yellows virus*:* Medium

Add up the total score and include it here. 12
-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.

Evaluation is Medium (-2). CABYV is established in two suitable climate/host region (Central Valley and Coastal) in California.

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* ***= 10***

Uncertainty:

While CABYV has been established in several of the main cucurbit growing areas of the state since the early 1990s, there have been no further reports of its spread to other intrastate regions including the desert. Targeted surveys for the pathogen have not been conducted in other cucurbit production sites. The distribution and establishment of the virus is largely dependent on the distribution and established infestations of virus-carrying aphids.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for **Cucurbit aphid borne yellows virus is C**.

References:

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Responsible Party:

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***Comment Period: 02/16/2022 through 04/02/2022**

***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: C