cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Allorhizobium vitis (Ophel and Kerr 1990) Mousavi et al. 2016

Crown gall of grapevine

Current Pest Rating: Z

Proposed Pest Rating: C

Domain: Bacteria; Phylum: Proteobacteria
Class: Alphaproteobacteria; Order: Rhizobiales
Family: Rhizobiaceae

Comment Period: 04/30/2021 through 06/14/2021

Initiating Event:

The pathogen that causes crown gall disease on grape has undergone multiple taxonomic revisions and name changes. It was known for decades as *Agrobacterium vitis*. The current preferred name is *Allorhizobium vitis* (Mousavi et al., 2016) and it has not been given a formal pest rating. The risk to California from *Al. vitis* is described herein and a permanent pest rating is proposed.

History & Status:

Background:

In the early 1890s, USDA plant pathologist Erwin F. Smith showed that crown gall disease was caused by a bacterium. It was thought to be similar or related to cancerous tumors of humans and animals. In the late 1970s and in the 1980s, detailed studies were made to better understand the mechanisms of presumed “plant cancer”.

Bacterial infections caused by crown gall pathogens result in the production of undifferentiated cells in galls (tumors), partially organized teratomas, or hairy roots on plants. Research showed this bacterium, known at the time as *Agrobacterium tumefaciens* sensu lato induces tumor formation in plants by transferring a single-stranded segment of T-DNA into plant cells via the Ti plasmid. The T-DNA becomes incorporated into the plant genome and is transcribed by the infected plant cell. The T-DNA contains several genes related to plant growth regulators, including one that codes for an auxin and another

that codes for a cytokinin. When these genes are expressed by the plant cell, the growth regulators they produce lead to uncontrolled enlargement and division of affected plant cells, resulting in the galls. The integrated T-DNA also contains genes that code for substances known as opines. Transformed plant cells produce opines, which are used by the intercellularly growing bacteria as a unique and specific source of food for themselves alone (Agrios, 2005; Cato, 2001).

Although crown gall tumors have certain histological similarities to cancers in humans and animals, many fundamental differences exist, and it is no longer considered to be similar enough to be called plant cancer. However, the discovery that *Rhizobium radiobacter* (syn = *A. tumefaciens*) acts as a type of natural "genetic engineer" of plants led to the use of this bacterium as a tool for the transfer of DNA segments coding for desirable characteristics into plants. This formed the basis of powerful biotechnology for a better understanding of plants and host-pathogen interactions (Agrios, 2005; Cato, 2001).

The genus *Agrobacterium* contains 11 species of soil-inhabiting bacteria. Most are plant pathogens capable of inducing tumorigenic reactions in a wide range of host plant species. *Agrobacterium. radiobacter* was a species indistinguishable phenotypically from *A. tumefaciens* except it was non-pathogenic and lacked the Ti plasmid, which is associated with tumor induction in plants (Sawada et al., 1993). These *Agrobacterium* species were reclassified into the genus *Rhizobium* based on comparative 16S rRNA gene analyses almost 20 years ago (Young et al., 2001). The new combinations are *R. radiobacter* syn. *tumfaciens, R. rhizogenes, R. vitis, R. rubi,* and *R. undicola*. This new taxonomy has not been universally accepted and the *Agrobacterium* names are still widely used.

The genus *Allorhizobium* was originally designated for one species, *Al. undicola* (de Lajudie et al., 1998), which is a nitrogen fixing species that nodulates *Neptunia natans*, a tropical legume. Studies showed that strains of *Rhizobium vitis* clustered closely with *Al. undicola* and were distant from others in the genera *Rhizobium* and *Agrobacterium*. In 2015, Mousavi et al. proposed a transfer of *Rhizobium vitis* to *Allorhizobium vitis.* This replaces the basonym of *A. vitis* given by Ophel and Kerr in 1990 for strains that were pathogenic on grapevine. This work was based on multilocus sequence analysis of the 16S rRNA, placing *Al. vitis* in Clade E of the family Rhizobiaceae.

Hosts: Vitis vinifera, Vitis spp. (CABI-CPC, 2021).

Symptoms: Grapes infected by *Al. vitis* will develop crown galls and or root necrosis. Galls can form on canes, trunks, roots, and cordons and may grow to several inches in diameter. Internally, galls are soft and have the appearance of disorganized tissue (Smith et al., 2014).

Transmission: Allorhizobium vitis systemically infects grapevine wood and the vines can remain asymptomatic. The pathogen can survive in living and dead vine debris buried in the soil for several years and can be an inoculum source for infections of newly planted vines. Galls develop at wound sites. These can be disbudding sites on rootstocks, sites where suckers have been removed or where the vine has been cut and a field graft joined (Smith et al., 2014). It can be spread to new areas with infected planting materials (Burr et al., 1998)

Damage Potential: Galls may girdle the vine and disrupt the flow of nutrients, thus restricting vine growth. Gall formation may push the bud shield or graft union off the vine. Injuries caused by cultivation or pruning may trigger gall formation. Infected vines may have galls on roots caused by the cracking of woody root tissue during growth. Galls frequently appear where the vine tissue has been damaged by freezing temperatures, thus vineyard site plays a role in disease severity (Smith et al., 2014). The older vines generally survive the infection, although they can show stress symptoms, whereas young vines that develop a tumor at their graft union often die (Sul and Burr, 1989; Burr et al., 1998). Control of crown gall on grapes is based on viticultural biosecurity as well as on the indexing and certification of propagation material, but biological control is another option (Habbadi et al., 2017)

Worldwide Distribution: Afghanistan, Australia, Brazil, Canada, China, Chile, Egypt, France, Germany, Greece, Hungary, Israel, Italy, Japan, Jordan, Morocco. North Korea, Russia, South Africa, South Korea, Spain, Tunisia, Turkey, United States (CABI CPC, 2021; Burr et al., 1998).

Official Control: *Allorhizobium vitis* is on the EPPO's A2 list for Jordan and Turkey and is a regulated non-quarantine pest in Egypt. It is on the USDA PCIT's harmful organism list for India, Jordan, Taiwan, and Turkey.

California Distribution: Kern, Lake, Monterey, Riverside, Sacramento, San Luis Obispo, Santa Barbara, Stanislaus, and Tuolumne counties (French, 1989; CDFA PDR database, 2021)

California Interceptions: none

The risk *Allorhizobium vitis* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This pathogen lives in close association with its host, often infecting systemically. Some reports state that its more damaging in colder climates, but California detections include southern counties

   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:** The host range is limited to *Vitis* spp.

   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 pathogen spreads short distances with infected soil and contaminated water inside vineyards. Longer distance spread is with infected planting material.

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:** Biosecurity and good phytosanitary practices are very important to prevent spread of this pathogen. It can cause damage to vines and is very difficult to eradicate from soil.

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

Economic Impact: A, B, C, D, G
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:** Residential grapevine plantings could be affected.

Environmental Impact: 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: 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 *Allorhizobium vitis:* Medium

Add up the total score and include it here. **11**
-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'. Grape crown gall has been detected in Kern, Lake, Monterey, Riverside, Sacramento, San Luis Obispo, Santa Barbara, Stanislaus, and Tuolumne counties

Score: -3
-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 *Allorhizobium vitis* is C.

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Responsible Party:

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***Comment Period: 04/30/2021 through 06/14/20211**

***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
