CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Profile for

Dickeya fangzhongdai

Tian, Zhao, Yuan, Yi, Fan, Xu, Hu, de Boer & Li 2016

Pest Rating: B

Domain: Bacteria; Phylum: Proteobacteria

Class: Gamma Proteobacteria; Order: Enterobacterales

Family: Pectobacteriaceae

Comment Period: 03/13/2020 through 04/27/2020

Initiating Event:

On November 18, 2019, a San Luis Obispo County agricultural official submitted samples of *Phalaenopsis* sp. orchids from a commercial greenhouse to CDFA's Plant Pest Diagnostics Center from a regulatory nursery inspection. The inspector reported symptoms of rapid cell collapse in the orchid leaves and suspected a soft-rotting bacterium. On December 5, 2019, CDFA Plant Pathologist Sebastian Albu identified the bacterium *Dickeya fangzhongdai* in culture and confirmed his identification with PCR, DNA sequencing, and phylogenetic analysis. This pathogen had been reported from *Phalaenopsis* and other hosts in Asia and in Europe, but only from interceptions of plants coming from Asia. At the time of the detection, there were no records of this pathogen in North America. On February 12, 2020, a first report of *D. fangzhongdai* causing soft rot of onion in New York state was published (Ma et al., 2020). Bacterial cultures from California were sent to the USDA-APHIS lab in Beltsville, Maryland and the identification was confirmed. The orchid plants were originally imported from Taiwan. The nursery is eradicating all infected plants and the County is conducting follow up surveys. A formal risk analysis for *D. fangzhongdai* is given herein and a permanent pest rating is proposed.

History & Status:

Background: The prokaryotic family Pectobacteriaceae has two genera of soft rot bacteria, *Pectobacterium* and *Dickeya*, both of which contain species that can be aggressive soft rotters of plants and have wide geographic distributions and host ranges. Their virulence is mainly due to the

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production and secretion of plant cell wall-degrading enzymes that cause maceration of plant tissues (Agrios, 2005).

The classification and taxonomy of these genera are complex and have evolved in recent years. The *Dickeya* genus was formed in 2005 by Samson et al. who reclassified strains of *Erwinia chrysanthemi* into six new *Dickeya* species. Recently more species and subspecies of *Dickeya* have been described, the including *Dickeya fangzhongdai* (Tian et al., 2016), which causes maceration-associated foliar, bulb, and trunk diseases, while *D. lacustris* and *D. undicola* were isolated from freshwater lakes (Hugouvieux-Cotte-Pattat et al., 2019; Oulghazi et al., 2019). The description of *D. fangzhongdai* was based on three isolates from pear trees in China with bleeding necrotic cankers, but its host range was extended by reclassifying earlier strains isolated from monocot plants from Japan (Shuarjo et al., 2014; Alič et al., 2017) and recent detections on orchids (Alič et al., 2017; Shen et al., 2019) and onions (Ma et al., 2020; Tsai et al., 2019).

Dickeya spp. were initially thought to be restricted to tropical and subtropical plant hosts and areas (Perombelon, 1990). This assumption was changed following the identification of *Dickeya* spp. from potato plants in temperate parts of Europe (Toth et al., 2011). It was postulated that *Dickeya* spp. were introduced to Europe via the international trade of potato seeds (van der Wolf et al., 2014). Chen et al. (2015) found strains of *D. solani* in potatoes and hyacinth, interpreting this as evidence of a possible recent shift of host range, which highlights the high capacity for adaptation and dissemination of *Dickeya* to new geographic areas and to new hosts.

In commercial nurseries in Guangdong Province, China, bacterial soft rot caused by *D. fangzhongdai* has become a devastating disease for the orchid industry (Zhang et al., 2018) and for pears (Zhao et al., 2018; Tian et al., 2016).

Hosts: Phalaenopsis spp. (orchids), *Pyrus pyrifolia* (pear), *Aglaonema* spp., *Artocarpus heterophyllus* (jackfruit), *Allium fistulosum* (Welsh onion), *Allium cepa* (onion) (Tian et al., 2016; Jaffar et al., 2018; Zhang et al., 2018; Alič et al. 2017, 2018; Ma et al., 2020).

Symptoms: On *Phalaenopsis*, the first symptoms of bacterial infection are water-soaked, pale to dark brown, round, pinpoint spots on leaves. The spots coalesce and expand quickly under high humidity and warm temperatures, becoming translucent when back lit. After several days, the lesions appear decayed and can exude liquid with a strong smell. The bacteria can infect the leaf sheath, resulting in the discoloring and degrading of the sheaths, and can result in leaf drop or even death of the entire plant. Over several weeks, the leaves that remain attached become dry and paper-like. Following inoculations under disease-conducive conditions, soft rot symptoms can be observed in as little as two days. The bacteria can enter the host using natural openings and multiply in intercellular spaces without causing major damage. This lack of early symptoms followed by a latent period may result in the accidental shipment of infected plants. Favorable disease conditions induce the production of aggression factors, such as pectinases, that break down the plant cell wall pectin, causing the macroscopic symptoms of soft rot (Reverchon and Nasser, 2013).

Bleeding cankers on pear tree trunks were first observed in China in the early 1970s and were diagnosed as being caused by an *Erwinia* sp. (Yin & Xu, 1973). In the initial stage of the disease, there are no obvious symptoms on the surface of the bark, but during disease development, the bark turns brown. Bacterial ooze mixed with tree sap, usually with a strong yeasty smell, oozes from the putrid bark, which oxidizes to a red colour, hence the name, "bleeding canker". If seriously infected, the trees can wilt and die rapidly (Tian et al., 2016). On field onions in New York State, symptoms developed following rainy, hot, humid weather and included chlorosis, maceration of leaves, browning, and plant collapse within a few days. Bulbs from diseased plants appeared normal, but inner tissues were macerated. In inoculation studies, disease symptoms progressed very rapidly; after 72 hours all inoculated plants had collapsed completely, and foliage was water-soaked (Ma et al., 2020).

Transmission: The dissemination of *Dickeya* bacteria from one plant to another or to other parts of the same plant is primarily by the movement of water from rain (by its washing or spattering effect) or with irrigation. People may also carry and spread bacterial plant pathogens locally by handling plants with unsanitary cultural practices and over long distances by transporting infected transplants or plant parts (Agrios, 2005). *Dickeya* spp. that primarly infect potatoes have been recovered in surface water in river systems in Australia (Cother and Gilbert, 1990) and Scotland (Cahill et al., 2010). In Florida, large populations of *Dickeya* spp. able to infect *Dieffenbachia* spp. were detected in irrigation ponds containing recycled water (Norman et al., 2003).

Damage Potential: Ališ et al. (2017) reported high virulence and extreme maceration potential of their *D. fangzhongdai* isolates and said they were a serious limitation to the production of *Phalaenopsis* orchids and other horticultural plants. Likewise, the effect on pears has been called "devastating" (Tian et al., 2016).

Worldwide Distribution: China, Malaysia, Taiwan, Scotland, Slovenia, St. Lucia, United States (New York, California) (CABI- CPC, 2019, Tsai et al., 2019; Ma et al., 2020)

Official Control: *Dickeya fangzhongdai* is a federally reportable pest and a Q-rated pest in California. *Dickeya* spp. are on the harmful organism list for Chile.

California Distribution: *Dickeya fangzhongdai* has been found infecting *Phalaenopsis* orchids imported from Taiwan into San Luis Obispo County (see initiating event). A detection of *Dickeya* from *Sansevieria* plants imported from Guatemala into San Luis Obispo County was made in 2017. 16S sequences from the *Sansevieria* isolates were greater than 99% similar to *D. dadantii,* but the determination was changed to *D. fangzhongdai* in February 2020, based on updated phylogenetic analyses of 16S and rpoB sequence alignments that included the type strain of *D. fangzhongdai*. These two species are now known to be closely related, but in 2017, *D. fangzhongdai* had only recently been described and corresponding sequence data were not available online at the time of the detection from *Sansevieria*.

California Interceptions: None.

The risk *Dickeya fangzhongdai* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** *Dickeya fangzhongdai* is most often associated with hot, wet, and humid weather. Although these conditions would be infrequently found in field situations in California, they would be very common inside greenhouses.

   Evaluate if the pest would have suitable hosts and climate to establish in California.

   Score: **1**
   - **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 primarily orchids, pears, and onions. However, this is highly likely to expand as identities of strains are determined using molecular identification techniques and taxonomic re-classification continues between species of *Erwinia* and *Dickeya*.

   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 Dispersal Potential:** Soft rotting bacteria spread over long distance as latent infections in planting stock and over shorter distances with water. *Dickeya* spp. have been demonstrated to spread in surface water and irrigation ponds.

   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:** *Dickeya fangzhongdai* is described as a devistating pathogen capable of rapid plant damage and even death. It is a federally reportable pest.

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

   Economic Impact: A, B, C, 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:** Infected growing areas must improve phytosanitary methods to prevent the spread of the pathogen by movement of diseased plants or contaminated water.

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 *Dickeya fangzhongdai* is Medium:

Add up the total score and include it here.
-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': The detection of *Dickeya fangzhongdai* in San Luis Obispo county is transient, actionable, and under eradication.

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* **= 11**

Uncertainty:

Dikeya fangzhongdai is an emerging pathogen. It should be expected that its host list and geographic distribution will increase as researchers and diagnosticians apply new identification methods and perform taxonomic revisions of bacterial strains in existing culture collections.

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Dickeya fangzhongdai* is B.**

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Responsible Party:

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***Comment Period: 03/13/2020 through 04/27/2020**

***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.

Pest Rating: B
