CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Pantoea ananatis (Serrano 1928) Mergaert et al. 1993

Fruitlet rot of pineapple

Current Pest Rating: Z

Proposed Pest Rating: C

Kingdom: Bacteria, Phylum: Proteobacteria,
Class: Gammaproteobacteria, Order: Enterobacterales,
Family: Erwiniaceae

Comment Period: 09/26/2023 through 11/10/2023

Initiating Event:

The first official detection of *Pantoea ananatis* in California was made in 2017, from nursery stock produced in Solano County. It was isolated from necrotic areas on the pinnae of *Nephrolepis* sp. ferns by CDFA plant pathologist Sebastian Albu, who assigned a temporary Z-rating. There are reports of this pathogen infecting many monocots and dicots, and literature from plant pathologists at the University of California describes it as a pathogen of Sudan grass in Imperial County. This pathogen has not been through the pest rating process. The risk to California from *P. ananatis* is described herein and a permanent rating is proposed.

History & Status:

Background:

At one time, all plant pathogenic bacteria in the family Enterobacteriaceae belonged to a single genus, *Erwinia* (Winslow, 1920). Bacterial fruitlet rot of pineapple caused by *E. ananas* was first described in the Philippines by Serrano in 1928. In 1989, Gavini et al. proposed moving some species of *Erwinia* into a new genus, *Pantoea*. Mergaert et al. (1993) changed the name from *E. ananas* to *P. ananas*, which was later corrected to '*ananatis*' by Trüper and De'Clari (1997) to follow nomenclatorial rules.

Pantoea ananatis is an emerging pathogen with an increasing number of disease reports coming from previously unrecorded hosts in different parts of the world (Coutinho et al., 2006; Coutinho and

---

Venter, 2009). It affects both monocotyledonous and dicotyledonous plants and is associated with sporadic disease outbreaks within agricultural and horticultural systems, some resulting in significant economic losses. The symptoms of diseases caused by *P. ananatis* depend on the host plant and environmental conditions and include leaf wilting, discoloration, and necrosis, as well as the formation of foliar and stem lesions. In severe cases, growth is stunted, yield is reduced, and plant mortality has been reported. Epidemics of *P. ananatis* are sporadic, making it difficult to predict and manage outbreaks. There are reports of substantial economic losses from affected crops, often requiring extensive efforts to control the spread of the bacterium and mitigate its impact (CABI, 2023).

Pantoea ananatis adapts to its environment by colonizing diverse and unconventional ecological niches, sometimes functioning as an epiphyte, endophyte, pathogen, or symbiont. It even exhibits pathogenicity in humans, causing bacteraemia (De Baere et al., 2004). Though *P. ananatis* may colonize non-host plant surfaces asymptomatically as an epiphyte, this can serve as a potential source of inoculum, leading to disease outbreaks on susceptible plants in their vicinity.

Pantoea ananatis has ice nucleation activity and is of interest to the food industry. Extracellular ice nucleators derived from *P. ananatis* have been tested and applied in food-freezing processes to achieve desired textures (Zasypkin and Lee, 1999). These ice-nucleating strains have also shown potential in the freeze-drying of foods. They play a pivotal role in reducing the cold hardiness of mulberry pyralid larvae, with potential as biological agents against other insect pests (Watanabe and Sato, 1999).

Researchers have successfully engineered genetically modified 'yellow rice' using phytoene desaturase from *P. ananatis* to introduce the β-carotene biosynthesis pathway into rice (Beyer et al., 2002). This innovation holds the promise of addressing nutritional needs and enhancing crop productivity.

It is important to acknowledge that many studies reveal the presence of *P. ananatis* only as a saprophyte. The identification has often relied on partial sequencing of the 16S rRNA gene and the comparison of sequence similarities to those available in GenBank. Consequently, it is imperative to exercise caution when interpreting detections, and it cannot be asserted with absolute certainty that *P. ananatis* is acting as a pathogen (Brady et al., 2008).

Hosts: Acanthospermum hispidum (bristly starbur), *Allium cepa* (onion), *Alocasia* spp. (elephant ears), *Ambrosia artemisiifolia* (common ragweed), *Ananas comosus* (pineapple), *Arachis hypogaea* (groundnut), *Avena sativa* (oats*), Brachiaria texana, Brassica rapa* subsp. *pekinensis* (napa cabbage), *Bromus catharticus* (prairiegrass), *Citrus reticulata* (mandarin), *Citrus sinensis* (orange), *Cucumis melo* (cantaloupe), *Cucumis sativus* (cucumber), *Cynodon dactylon* (Bermuda grass), *Cyperus esculentus* (yellow nutsedge), *Desmodium tortuosum* (Florida beggarweed), *Digitaria insularis* (sourgrass), *Digitaria sanguinalis* (large crabgrass), *Digitaria setigera* (East Indian crabgrass), *Dracaena reflexa* (song of India), *Eucalyptus* spp., *Eucalyptus grandis* (saligna gum), *Eucalyptus nitens* (shining gum), *Ficus elastica* (rubber fig), *Fragaria x ananassa* (strawberry), *Geranium carolinianum* (Carolina geranium), *Glycine max* (soyabean), *Gnaphalium* spp., *Nephrolepsis exaltata* (Boston fern), *Jacquemontia tamnifolia* (smallflower morningglory), *Mangifera indica* (mango), *Mollugo verticillate, Oryza sativa* (rice), *Paspalum urvillei* (Vasey grass), *Prunus persica* (peach), *Pyrus sinkiangensis*, *Richardia scabra*,

Rumex crispus (curled dock), *Senna obtusifolia* (sicklepod), *Solanum americanum*, *Solanum lycopersicum* (tomato), *Solanum tuberosum* (potato), *Sorghum bicolor* (sorghum), *Sorghum sudanense* (Sudangrass), *Stellaria media* (common chickweed), *Thlaspi arvense* (field pennycress), *Urochloa platyphylla* (broadleaf signalgrass), *Verbena bonariensis* (clusterflower vervain), *Xanthium strumarium* (common cocklebur), *Zea mays* (corn), *Zingiber officinale* (ginger) (CABI, 2023; EPPO, 2023; CDFA PDR Database, 2023).

Symptoms: The symptoms of *P. ananatis* are diverse and dependent on the host infected; they can include leaf blotches and spots, dieback, stalk, fruit, and bulb rot. On strawberries, it causes leaf blight-like symptoms (Bajpai et al., 2020). Other symptoms include fruitlet brown rot of pineapple, post-harvest brown rot on cantaloupe fruit and honeydew melons, leaf blight, stem stalk rot, bulb decay, center rot on onions, leaf blight, and shoot tip die-back on eucalyptus, necrotic spots and streaks on maize, and stem necrosis on rice (CABI, 2023). Leaf blotches and streaks have been reported on Sudangrass grown in Imperial County (Azad et al., 2000).

Transmission: Natural dispersal is primarily by rain and wind. *Pantoea ananatis* can enter the host through the flowers and/or wounds caused by mechanical injury (Serrano, 1928). It can move from plant to plant through contact during high winds (Azad et al., 2000). Wounds created by feeding insects such as thrips have been shown to allow entry of *P. ananatis* into host plants (Gitaitis et al., 2003).

Pantoea ananatis is both seed-borne and seed-transmitted in onions (Walcott et al. 2002), Sudangrass (Azad et al., 2000), and rice (Tabei et al., 1988). It is not clear what effect the pathogen has on seed quality, but pathogen transmission in/on seeds is of concern. It was hypothesized that seeds produced in South Africa were responsible for the first outbreak of onion center rot in the United States (Walcott et al., 2002). It can be transmitted with infected nursery stock and has been intercepted on nursery stock entering California from other states (CDFA PDR database, 2023).

Damage Potential: Pantoea ananatis has the potential to inflict significant economic losses across various crops. Sudangrass growing in the Imperial Valley was reported to have blighted foliage covering as much as 50% or more of the total leaf area (Azad et al., 2000). Onions can experience losses of up to 100% from center rot (Gitaitis and Gay, 1997). In Eucalyptus plantations affected by *P. ananatis*, trees can fail to survive or develop multiple stems (Coutinho et al., 2002). A significant concern is the pathogen's potential ability to infect a wide range of *Eucalyptus* species, hybrids, and clones in California. Without effective control measures, the disease can potentially escalate to epidemic levels under favorable environmental conditions, given its numerous susceptible hosts, and ability to survive as an epiphyte or saprophyte. *Pantoea ananatis* is responsible for post-harvest losses affecting cucurbit fruit (Bruton et al., 1991) and onions (Gitaitis et al., 2003).

Worldwide Distribution: Africa: *Benin, Burkina Faso, Egypt, Morocco, Nigeria, South Africa, Togo, Zimbabwe*. America: *Argentina, Brazil, Canada, Ecuador, Guatemala, Guyana, Haiti, Mexico, United States of America* (Arkansas, California, Colorado, Georgia, Michigan, New York, Texas), *Uruguay, Venezuela*. Asia: *Cambodia, China, India, Japan, Republic of Korea, Malaysia, Philippines, Taiwan, Thailand, Turkey*. Europe: *Austria, Belgium, Italy, Poland, Russia, Russia, Spain.* Oceana: *Australia*.

Official Control: *Pantoea ananatis* is on the North American Plant Protection Organization's Alert list (EPPO, 2023), and the USDA PCIT's Harmful Organisms list for Colombia, Ecuador, Honduras, Nicaragua, Panama, and Thailand (USDA, 2023).

California Distribution: Imperial County on Sudangrass, and on nursery stock in Los Angeles and Solano counties (CDFA PDR database, 2023; Azad et al., 2000).

California Interceptions: On *Dracaena reflexa* nursery stock from Hawaii, and *Ficus elastica* nursery stock from Alabama (CDFA PDR database, 2023).

The risk *Pantoea ananatis* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This pathogen could likely survive wherever its hosts are grown, even in desert climates not normally associated with bacterial leaf pathogens.

   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 be established 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 large, including monocots and dicots, woody and herbaceous plants.

   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:** Bacteria can multiply at extremely fast rates under favorable conditions and are spread with rain, wind, and irrigation.

   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 pathogen affects crop yield and seed health. It is a quarantine pest for some trading partners.

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

   Economic Impact: A, G
   A. The pest could lower crop yield.
   B. The pest could lower crop value (including increasing crop production costs).
   C. The pest could trigger the loss of markets (including 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: **2**
   - 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.

   Evaluate the environmental impact of the pest on California using the criteria below.

   Environmental Impact:
   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: 1
   - 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 *Pantoea ananatis:* 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.

7) **The final score is** the consequences of the 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:

Distinguishing between species in the genus *Pantoea* can be difficult. 16S rDNA gene sequences reliably place suspect strains within the genus, *Pantoea*, but speciation often requires sequencing of at least one other gene (usually rpoB). To distinguish among strains of closely related species, a diagnostician should generate a phylogenetic tree based on a multilocus sequence analysis of several housekeeping genes such as initiation factor B (infB), atpD, and gyrB (S. Albu, CDFA, pers. comm).

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Pantoea ananatis*** **is C.**

References:

Azad, H.R., Holmes, G.J. and Cooksey, D.A., 2000. A new leaf blotch disease of Sudangrass caused by *Pantoea ananas* and *Pantoea stewartii*. Plant Disease, 84(9), pp.973-979.

Bajpai, S., Shukla, P.S., Adil, M., Asiedu, S., Pruski, K. and Prithiviraj, B., 2020. First report of bacterial leaf blight of strawberry caused by *Pantoea ananatis* in Nova Scotia, Canada. Plant Disease, 104(1), pp.276-276.

Beyer, P., Al‐Babili, S., Ye, X‐D., Lucca, P., Schaub, P. Welsch, R., and Potrykus, I. 2002 Golden rice: introducing the beta‐carotene biosynthesis pathway into rice endosperm by genetic engineering to defeat Vitamin A deficiency. J. Nutr. 132, 506S–510S

De Baere, T., Verhelst, R., Labit, C., Verschraegen, G., Wauters, G., Claeys, G. and Vaneechoutte, M. 2004. Bacteremic infection with *Panteoa ananatis*. J. Clin. Microbiol. 42, 4393–4395.

Brady, C., Cleenwerck, I., Venter, S., Vancanneyt, M., Swings, J. and Coutinho, T., 2008. Phylogeny and identification of *Pantoea* species associated with plants, humans, and the natural environment based on multilocus sequence analysis (MLSA). Systematic and Applied Microbiology, 31(6-8), pp.447-460.

Bruton, B.D., Wells, J.M., Lester, G.E. and Patterson, C.L., 1991. Pathogenicity and characterization of *Erwinia ananas* causing a postharvest disease of cantaloup fruit. Plant Disease, 75(2), pp.180-183.

Coutinho, T.A., Wingfield, M.J., Oberholster, A.M., Berger, D.K., Kunert, K.J., Marais, G., Labuschagne, N., Korsten, L., Aveling, T.A.S., Van der Waals, J.E. and Steenkamp, E.T., 2005. Forestry and Agricultural Biotechnology Institute, Biennial Report 2005/2006.

Coutinho, T.A., Preisig, O., Mergaert, J., Cnockaert, M.C., Riedel, K.H., Swings, J. and Wingfield, M.J., 2002. Bacterial blight and dieback of Eucalyptus species, hybrids, and clones in South Africa. Plant disease, 86(1), pp.20-25.

Coutinho, T.A. and Venter, S.N., 2009. *Pantoea ananatis*: an unconventional plant pathogen. Molecular plant pathology, 10(3), pp.325-335.

Gavini, F., Mergaert, J., Beji, A., Mielcarek, C., Izard, D., Kersters, K. and De Ley, J. 1989. Transfer of *Enterobacter agglomerans* (Beijerinck 1888) Ewing and Fife 1972 to *Pantoea* gen. nov. as *Pantoea agglomerans* comb. nov. and description of *Pantoea dispersa* sp. nov. Int. J. Syst. Bacteriol. 39, 337–345. [Google Scholar]

Gitaitis, R. D., Walcott, R.R., Wells, M.L., Diaz Perez, J.C., Sanders, F.H., 2003. Transmission of *Pantoea ananatis*, causal agent of center rot of onion, by tobacco thrips, *Frankliniella fusca*. Plant Disease, 87(6):675-678; 39 ref.

Gitaitis, R.D. and Gay, J.D., 1997. First report of a leaf blight, seed stalk rot, and bulb decay of onion by Pantoea ananas in Georgia. Plant disease, 81(9), pp.1096-1096.

Mergaert, J., Verdonck, L. and Kersters, K. 1993. Transfer of *Erwinia ananas* (synonym, *Erwinia uredovora*) and *Erwinia stewartii* to the Genus *Pantoea* emend. as *Pantoea ananas* (Serrano 1928) comb. nov. and *Pantoea stewartii* (Smith 1898) comb. nov., respectively, and description of *Pantoea stewartii* subsp. *indologenes* subsp. nov. Int. J. Syst. Bacteriol. 43, 162–173.

Serrano, F.B. 1928. Bacterial fruitlet brown rot of pineapple in the Philippines. Philippine J. Sci. 36, 271-324.

Tabei H, Azegami K, Fukuda T, 1988. Infection site of rice grain with *Erwinia herbicola*, the causal agent of bacterial palea browning of rice. Annals of the Phytopathological Society of Japan, 54(5):637-639

Trüper, H.G. and De'Clari, L. 1997. Taxonomic note: necessary correction of specific epithets formed as substantives (nouns) 'in apposition'. Int. J. Syst. Bacteriol. 47, 908–909. [Google Scholar]

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Pantoea ananatis*. Accessed 9/1/23.

Walcott, R.R., Gitaitis, R. D., Castro, A.C., Sanders, F. H. Jr, Diaz-Perez, J. C., 2002. Natural infestation of onion seed by *Pantoea ananatis*, causal agent of center rot. Plant Disease, 86(2):106-111; 24 ref.

Watanabe, K. and Sato, M. 1999. Gut colonization of an ice nucleation active bacterium, Erwinia (Pantoea) ananas, reduces the cold hardiness of mulberry pyralid larvae. Cryobiology, 38, 281–289.

Zasypkin, D.V. and Lee, T-C. 1999. Extracellular ice nucleators from *Pantoea ananas*: effect of freezing on model foods. J. Food Sci. 64, 473-478.

Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, CDFA/PHPPS ECOPERS, 1220 N St Rm 221, Sacramento, CA 95814 Phone: (916) 654-1017, permits[@]cdfa.ca.gov.

***Comment Period: 09/26/2023 through 11/10/2023**

***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:

  Contains 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
