CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

# California Pest Rating Proposal for

## *Lelliottia nimipressuralis* (Carter 1945) Brady et al. 2013
## Wetwood of Elm

**Current Pest Rating: Q**

**Proposed Pest Rating: B**

Domain: Bacteria, Phylum: Proteobacteria,
Class: Gammaproteobacteria, Order: Enterobacteriales,
Family: Enterobacteriaceae

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**Comment Period: 06/20/2023 through 08/04/2023**

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## Initiating Event:

In April 2023, Orange County Agricultural Inspectors intercepted a high-risk shipment of bamboo from Gwinnett County, Georgia. It was addressed to a private residence in the city of Irvine. The bamboo had symptoms of soft rot disease on the shoots. CDFA Plant Pathologist Sebastian Albu isolated *Lelliottia* sp. aff. *nimipressuralis* and *Pantoea agglomerans* in culture and identified them with DNA sequencing. Previous records of this bacterium are from Alabama, Illinois, and Texas. The risk to California from *Lelliottia nimipressuralis* is described herein and a permanent rating is proposed.

## History & Status:

**Background:**

Originally placed in the genus *Enterobacter*, Hoffman et al. (2005), grouped *E. nimipressuralis, E. cloacae, E. asburiae, E. hormaechei,* and *E. kobei* together into what was known as the "*E. cloacae* complex" based on genotypic and phenotypic relatedness. Most species belonging to the "*E. cloacae* complex" are of clinical relevance, compared to the remaining species which are associated with plants, foods, and environmental sources (Heinle, et al., 2018).

Brady et al. (2013) created *Lelliottia* gen. nov. as a distinct genus from *Enterobacter* with descriptions based on Grimont and Grimont (2005), Izard et al. (1981), and Brenner et al. (1986), and based on multilocus sequence analysis and phylogenetics. *Lelliottia* is named after R. A. Lelliott for his contributions to the understanding of bacterial plant diseases. Cells are straight rods, motile by peritrichous flagella, gram negative, and facultatively anaerobic.

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*Lelliottia* species are most often isolated from elm trees exhibiting symptoms of “wetwood” disease (Khodaygan et al., 2012). They are also isolated from plants or plant parts with symptoms of soft rot, from water, and rarely from clinical samples. Brady et al. (2013) reclassified *Enterobacter nimipressuralis* as *L. nimipressuralis* comb. nov. (Carter 1945) Brenner, McWhorter, Kai, Steigerwalt and Farmer (1986), and this became the type strain for the genus *Lelliottia*. The name *nimipressuralis* denotes pertaining to “excessive pressure.”

*Hosts: Abies* (fir), *Fagus* (beech), *Nicotiana tabacum* (tobacco), *Populus* (poplar), *Ulmus* (elm), *Ulmus americana* (American elm), and *Ulmus pumila* (dwarf elm) (CABI, 2023).

*Symptoms*: Bacterial wet-wood or bacterial slime flux are common diseases that affect many shade and forest trees (e.g., box elder, fruitless mulberry, hemlock, magnolia, maple, and oak). Symptoms include a yellow-brown discoloration of the wood, generally confined to the central core of the tree. The affected wood is wetter than surrounding wood and is under high internal pressure. The gas pressure and high moisture content cause an oozing or bleeding of slime from pruning cuts, through bark cracks and branch crotches.

Brenner et al. (2005) indicated that the bacterium, *E. nimipressuralis* may be involved in the development of wetwood. Elm trees in Iran infected with *E. nimipressuralis* showed liquid exuding from wounds including branch stubs and barks, cracks, and vertical streaks of white to gray encrustations of dried effluent on bark surfaces (Khodaygan et al., 2012). Silver fir trees in Ukraine infected with *L. nimipressuralis* showed symptoms including cracks and cankers on the trunks, exfoliated rhytidome and exudated secretions, massive development of epicormic shoots, saturated xylem and phloem, and wet rot with a characteristic odor of fermentation (Kulbanska et al., 2022). On oaks in Ukraine, Kulbanska et al. (2021) describe *L. nimipressuralis* as the cause of “ulcers”of various shapes and sizes of, which release a dark, almost black, exudate, also causing dieback of individual branches in the crown.

Symptoms of bacterial soft rot begin as small water-soaked lesions that can enlarge rapidly in diameter and depth. The infected interior of plant parts become cream colored, soft, and mushy while the plant surfaces can become discolored and somewhat sunken. Tissues are slimy and disintegrate into a pulpy mass of disorganized plant cells and bacteria described as ‘mucoid ooze’. The outer surface of a structure such as a carrot taproot may remain intact while the entire contents have been changed to a turbid liquid until they crack, allowing the slimy mass to exude to the surface and into the soil or storage area (Agrios, 2005). If roots are rotted, shoots can wilt due to phloem necrosis and vessel plugging (Zhao et al., 2022).

Under ideal conditions for disease, fruits such as a strawberry, or bulbs such as onions may be transformed into a soft, watery, decayed mass within 3 to 5 days after initial infection. Infected structures generally remain almost odorless until they collapse. The foul odor often accompanying soft rot infections is produced by secondary bacteria and other saprotrophic microbe invaders that further decompose plant tissue. Onions almost always give off a repulsive odor. When carrots are affected in the field, their stems may also become infected and watery and can turn black and shrivel, causing the plants to wilt or become stunted and die (Agrios, 2005; Liu et al., 2016; He et al., 2017).

*Transmission:* Wetwood disease is typically transmitted from tree to tree through wound sites, such as those created by pruning, storm damage, or insect infestations. The bacteria can enter the tree through these wounds and colonize the wood. The bacteria are soil-inhabiting, and they can be absorbed by roots via the water in xylem vessels (transpiration stream or xylem elements). Once inside the wood, the bacteria produce and release pectolytic enzymes (pectolases) which damage the middle lamellae between wood cells and fibers in the parts of main branch or trunk

Soft-rot bacteria may survive in infected tissues, in infected fleshy organs in storage, and if left in the soil, in debris, on roots or other parts, and in contaminated equipment and containers. They are spread by direct contact, hands, tools, soil, water, and insects. Some can overwinter in insects, in irrigation ponds and streams, and occasionally in the soil. They enter plants or plant tissues primarily through wounds or natural openings such as lenticels and hydathodes. Within the tissues they cause maceration and softening. This is accomplished by multiplying profusely in the intercellular spaces where they produce degradative enzymes, such as pectinases, proteases, lipases, and cellulases, that dissolve the middle lamella and separate the cells from one another. The plant cells first lose water and then their contents shrivel; finally, parts of their walls are dissolved, and the cells are internally invaded by the bacteria (Agrios, 2005).

*Damage Potential:* Wetwood is a chronic disease that can contribute to general decline, especially of old trees and trees of low vigor, and causes losses of wood for forest products. It causes unsightly and often foul-smelling bleeding. It prevents callus formation over wounds, increasing susceptibility to fungal decomposers. It causes losses of wood in forest products. Requiring increased drying time and downgrading wood appearance (Riffle, 1986). Wetwood contributes to tree dieback and even death. The bacteria destroy the internal tissues of trees by fermentation action, blocking the movement of nutrients. The trees become more susceptible to attack by saprophytes and opportunist pathogens (Alizadeh, 2017). Wetwood caused by *L. nimipressuralis* is a common disease of elms in Iran, limiting tree growth and longevity (Alizadeh et al., 2017).

Bacterial soft rots cause a greater total loss of produce than any other type of bacterial disease. The formation of soft rot usually starts with the secretion of a series of exoenzymes, mainly pectinases and cellulases, which depolymerize the plant cell wall. Through the secretion of pectate lyase enzymes, polygalacturonases, pectin lyases, pectin methylesterases, cellulases, and proteases, infections can result in the maceration of parenchyma cells.

Maceration is the most common symptom of rotten tubers and fleshy roots. It is dependent on outdoor temperature and humidity. Different soft rotting species occur worldwide and cause serious losses in the field, in transit, and especially in storage. Nearly all fresh vegetables are susceptible to some type of bacterial soft rot, which may develop within a few hours in storage, or during transit. Although there is limited information on *L. nimipressuralis*, related soft rotting bacterial species are known to reduce yield, quality, and the market value of crops, greatly increasing expenses for implementing preventive measures such as altered storage conditions, field irrigation, and crop rotations (Agrios, 2005).

**Worldwide Distribution**: China, Iran, Mexico, Singapore, South Africa, Ukraine, United States (Alabama, Illinois, Texas) (CABI, 2023).

**Official Control:** None

**California Distribution:** None

**California Interceptions:** One interception has been made from an incoming shipment from Georgia (see 'Initiating event')

The risk *Lelliottia nimipressuralis* 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)* – In general, soft-rotting bacteria require wet soils or wet plant surfaces to multiply and infect. These conditions occur in greenhouses, in storage, and in irrigated agriculture statewide. If causing wet wood disease, the pathogen could be found wherever its hosts are able to grow.

2) **Known Pest Host Range:** 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.**

*Risk is High (3)* – The host range for wetwood is a large number of trees, including conifers and hardwoods. Soft rot could occur on many types of fruits, storage organs, and roots. The host range will likely increase over time.

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 pathogen is highly likely to spread primarily through infested soil and or water. It may have a seed pathway, either as a true seed borne pest or as a seed contaminant. It could be spread with infected nursery stock.

**4) Economic Impact:** There is an economic cost to bacterial wetwood disease. It is not known what effect *Lelliottia nimipressuralis* could have on agronomic crop yield. Also, it remains to be determined if management of the bacterium would change certain cultural practices to reduce/eliminate incidences and causes of spread. In general, the control of bacterial soft rotters is difficult and depends on using proper sanitation, avoiding injuries, keeping storage tissues dry and cool, practicing good insect control, and employing crop rotation. Bacteria can be spread with irrigation and run-off.

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

**Economic Impact: A, B, 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**.

*Risk is High (3) –Under suitable, wet climates, the pathogen could lower plant growth, fruit production and value and trigger the loss of markets.*

**5) Environmental Impact:** There is information on the effect of *Lelliottia nimipressuralis* on forest trees where it causes wetwood disease. Control of similar bacteria requires strict attention to sanitation.

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

**Environmental Impact: A**

**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) – The pathogen could cause wetwood in forest species.*

## Consequences of Introduction to California for *Lelliottia nimipressuralis:* 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:

The host range of this pathogen could expand once more information is available on its mode of spread and if testing is done for other plant species. For wetwood and soft rot diseases, *L. nimipressuralis* is often isolated with other species that cause similar symptoms, making it difficult to assess the contribution of one over another to pathogenesis.

## Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Lelliottia nimipressuralis*** **is B.**

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## Responsible Party:

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***Comment Period: 06/20/2023 through 08/04/2023**

***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.

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## 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.

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## Proposed Pest Rating: B

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