California Pest Rating Proposal for

Clavibacter nebraskensis (Vidaver & Mandel 1974; Davis et al. 1984) Li et al. 2018

Goss's bacterial wilt and leaf blight of corn

Current Pest Rating: none

Proposed Pest Rating: A

Kingdom: Bacteria, Class: Actinobacteria,
Order: Micrococcales, Family: Microbacteriaceae

Comment Period: 03/19/2025 through 05/03/2025

Initiating Event:

This pathogen has not been through the pest rating process. *Clavibacter nebraskensis* is a pest of concern for CDFA export seed programs. The risk to California from *Clavibacter nebraskensis* is described herein and a permanent rating is proposed.

History & Status:

Background: Goss's wilt and leaf blight emerged as a serious and destructive bacterial disease of maize or corn during the 1970s in Nebraska, Iowa, South Dakota, Kansas, and Colorado (Schuster et al., 1972). It spread quickly to most of the U.S. corn-growing states before nearly disappearing in the mid-1980s. It unexpectedly re-emerged in the same areas in the early 2000s (Harveson, 2020) as well as in Canada (Harding et al., 2018). The re-emergence of the disease is thought to be favored by several factors, including new cultural practices such as continuous cropping, reduced tillage, and dramatic acreage increases with overhead sprinkler irrigation (Harveson, 2015). Beginning in 2012, severe blight symptoms on maize plants were found in Mexico (Flores-López et al., 2024). *Clavibacter nebraskensis* is included within the high-risk list of quarantine pathogens by several plant protection organizations and it is under quarantine control in many places around the world.

The genus *Clavibacter* was originally proposed by Davis et al. (1984) to accommodate all gram-positive, phytopathogenic coryneform bacteria containing B2g diaminobutyrate in the peptidoglycan. This genus originally included six plant pathogenic species, but over time this was reduced until there was only one species in the genus, *C. michiganensis*, which had multiple subspecies including *nebraskensis*. The

subspecies of *C. michiganensis* were all highly host-specific plant pathogens. Based on whole genome and MLSA data, Li et al. (2018) proposed the establishment of *Clavibacter nebraskensis* comb. nov.

Hosts: Maize or corn (*Zea mays*) is the only economic host of the pathogen. Several Poaceae species are reported to act as secondary hosts including *Andropogon gerardii* (big bluestem), *Digitaria sanguinalis* (hairy crabgrass), *Echinochloa crus-galli* (cockspur grass), *Eriochloa villosa* (hairy cupgrass), *Lolium multiflorum* (annual ryegrass), *Saccharum officinarum* (sugarcane), *Schizachyrium scoparium* (little bluestem), *Setaria faberi* (Japanese bristlegrass), *Setaria pumila* (yellow foxtail), *Setaria verticillate* (hooked bristlegrass), *Setaria viridis* (green foxtail), *Sorghum arundinaceum* (common wild sorghum), *Sorghum bicolor* (sorghum), *Sorghum halepense* (Johnson grass), *Sorghum x drummondii* (hybrid sudan), *Tripsacum dactyloides* (eastern gamagrass), *Zea mays* (corn), and *Zea mexicana* (Mexican teosinte) (EPPO, 2025).

Symptoms: *Clavibacter nebraskensis* infection can occur in maize plants at any stage of growth. Seedlings are more vulnerable to infection than older plants and early infection of susceptible genotypes may result in wilting and plant death. There are two distinct disease phases: a foliar blight phase and a systemic wilt phase. In the foliar blight phase, pale greenish-yellow stripes (occasionally reddish depending on the cultivar) with wavy and irregular margins follow the leaf veins. These lesions expand rapidly and quickly become necrotic, leaving a scorched appearance. Droplets of bacterial exudate may appear on the surface of the leaf lesions. Systemically infected plants may have discolored vascular bundles and bacterial pockets in the pith. The pith pockets are seen as discrete water-soaked lesions on the leaves called freckles. Bacterial ooze may prevent the emergence of tassels and cause the stalk to bend in the form of a loop or a “buggy whip”. On the ears of infected plants, bacterial ooze, and freckles may also be observed in the inner husks of corn. A dry or water-soaked to slimy-brown rot of the roots and lower stalk may also occur (Osdaghi et al., 2023; CABI, 2025).

Transmission: Clavibacter nebraskensis is seedborne and seed transmission occurs in maize. It has been detected both externally and internally in seed, although transmission rates are very low (Biddle et al., 1990). In the areas where the pest is present, the main source of inoculum is infected plant debris which persists in the field between crops, but not through long non-host rotations (Block et al., 2019). It can also be spread by wind and water, with stomata or trichomes likely serving as entry points for the bacterium. Injury from wind or sand provides additional avenues for infection (Rocheford et al., 1985, CABI, 2025).

Damage Potential: Necrotic lesions of the leaf blight phase kill leaf tissues, reducing photosynthesis. Systemically infected plants may die quickly, especially if infected young. *Clavibacter nebraskensis* can colonize and survive epiphytically on the surface of symptomless maize leaves (Smidt and Vidaver, 1986). Reported losses to Goss’s wilt are minor over large areas, but may be severe in individual fields (Wysong et al., 1973). Maize hybrids susceptible to Goss’s wilt have sustained yield losses of up to 50% (Claflin, 1999). The estimated total yield loss due to Goss's wilt, from 2012 to 2015, was more than 500 million bushels in the USA and Canada (Mueller et al., 2016).

Worldwide Distribution: Africa: *South Africa*. America: *Canada, Mexico, United States of America* (Colorado, Illinois, Indiana, Iowa, Kansas, Louisiana, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Texas, Wisconsin, Wyoming) (EPPO, 2025).

Official Control*: Clavibacter nebraskensis* is on the EPPO's A1 list for Brazil, Chile, and Egypt, the A2 list for the Asia and Pacific Plant Protection Commission (APPPC) and the Comité de Sanidad Vegetal del Cono Sur (COSAVE). It is a quarantine pest for China, Israel, and Mexico, and is on the EPPO's alert list (EPPO, 2025). It is on the USDA PCIT's harmful organisms list for Argentina, Brazil, China, Colombia, Egypt, Guatemala, Honduras, India, Israel, Japan, Mexico, New Zealand, Panama, Peru, Taiwan, Thailand, and The Republic of Korea (USDA-PCIT, 2025).

California Distribution: none

California Interceptions: none

The risk that *Clavibacter nebraskensis* poses to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** Infection is favored by warm weather (26–32 °C) (Smidt and Vidaver, 1986) and high relative humidity (Mallowa et al., 2016). Warm and dry conditions can limit the development of Goss's wilt and leaf blight (Jackson et al., 2007).

   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 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:** Maize (*Zea mays*) is the only economic host. Several Poaceae species are reported to act as secondary hosts for *C. nebraskensis*.

   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 Reproductive Potential:** This pathogen has a high reproductive potential. It can be seedborne, and survive on crop debris. Under favorable conditions, it reproduces rapidly and is spread with wind and rain.

   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:** Goss's wilt is included on the quarantine lists of several countries. Although most reports of the disease are limited to North America, it remains a potential threat anywhere maize is cultivated. The disease causes severe leaf blighting, systemic infection, and stunting, reducing crop yields.

   Evaluate the economic impact of the pest on 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 (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: **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:** The host range includes many species in Poacaea and the pathogen could be surviving as an epiphyte between maize crops, allowing it to persist in the absence of a maize crop.

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

   Environmental Impact: A, 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: 3
   - 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 *Clavibacter nebraskensis:* 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 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* ***= 13***

Uncertainty:

none

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Clavibacter nebraskensis*** **is A.**

References:

Block, C. C., Shepherd, L. M., Mbofung-Curtis, G. C., Sernett, J. M., Robertson, A. E., 2019. Re-evaluation of seed transmission of *Clavibacter michiganensis* subsp. *nebraskensis* in *Zea mays*. Plant Disease, 103(1) 110-116.

Biddle, J.A., McGee, D.C. and Braun, E.J., 1990. Seed transmission of *Clavibacter michiganense* subsp. *nebraskense* in corn. Plant Disease, 1990, Vol. 74, No. 11, 908-911

CABI Compendium. 2025. *Clavibacter nebraskensis* (Goss's bacterial wilt and leaf blight) https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.15339 Accessed 2/28/2025

Claflin, L.E. 1999. Goss's bacterial wilt and blight. In: White, D.G. (Ed.) Compendium of corn diseases, 3rd edition. St. Paul, MN: American Phytopathological society, pp. 4– 5.

Davis, M.J., Gillaspie Jr, A.G., Vidaver, A.K. and Harris, R.W., 1984. *Clavibacter*: a new genus containing some phytopathogenic coryneform bacteria, including *Clavibacter xyli* subsp. *xyli* sp. nov., subsp. nov. and *Clavibacter xyli* subsp. *cynodontis* subsp. nov., pathogens that cause ratoon stunting disease of sugarcane and bermudagrass stunting disease. International journal of systematic and evolutionary microbiology, 34(2), pp.107-117.

EPPO Database. *Clavibacter nebraskensis*. https://gd.eppo.int/taxon/CORBNE Accessed 2/28/2025

Flores-López, L.F., Olalde-Portugal, V., Vidaver, A.K., Morales-Galván, Ó., Hernández-Rosales, M. and Huerta, A.I., 2024. Unlocking a Mystery: Characterizing the First Appearance of *Clavibacter nebraskensis* in Mexican Cornfields. Plant Disease, 108(5), pp.1374-1381.

Harding, M. W., Jindal, K., Tambong, J. T., Daayf, F., Howard, R. J., Derksen, H., Reid, L. M., Tenuta, A. U., and Feng, J. 2018. Goss's bacterial wilt and leaf blight of corn in Canada - disease update. Can. J. Plant Pathol. 40:471 - 480.

Harveson, R.M., Schwartz, H.F., Urrea, C.A. and Yonts, C.D. 2015. Bacterial wilt of dry-edible beans in the central High Plains of the US: past, present, and future. Plant Disease, 99, 1665–1677.

Harveson, R.M. 2020. The curious re-emergence of Goss' wilt of corn and bacterial wilt of dry beans in the central High Plains. A Century of Plant Pathology in Nebraska, 2020, 70–72.

Jackson, T.A., Harveson, R.M. and Vidaver, A.K. 2007. Reemergence of Goss's wilt and blight of corn to the central High Plains. Plant Health Progress, 8, 44.

Li, X., Tambong, J., Yuan, K., Chen, W., Xu, H., Lévesque, C.A. and De Boer, S.H., 2018. Re-classification of *Clavibacter michiganensis* subspecies on the basis of whole-genome and multi-locus sequence analyses. International Journal of Systematic and Evolutionary Microbiology, 68(1), pp.234-240.

Mallowa, S.O., Mbofung, G.Y., Eggenberger, S.K., Den Adel, R.L., Scheiding, S.R. and Robertson, A.E., 2016. Infection of maize by *Clavibacter michiganensis* subsp. *nebraskensis* does not require severe wounding. Plant disease, 100(4), pp.724-731.

Mueller, D.S., Wise, K.A., Sisson, A.J., Allen, T.W., Bergstrom, G.C., Bosley, D.B., Bradley, C.A., Broders, K.D., Byamukama, E., Chilvers, M.I., Collins, A. 2016. Corn yield loss estimates due to diseases in the United States and Ontario, Canada from 2012 to 2015. Plant health progress. 2016;17(3):211-22.

Osdaghi, E., Robertson, A.E., Jackson-Ziems, T.A., Abachi, H., Li, X., and Harveson, R.M. 2023. *Clavibacter nebraskensis* causing Goss's wilt of maize: Five decades of detaining the enemy in the New World. Molecular Plant Pathology 24(7), 675-692.

Rocheford, T. R., Vidaver, A. K., Gardner, C. O., and Armbrust, D. L., 1985. Effect of wind-generated sand abrasion on infection of corn (*Zea mays* L.) by *Corynebacterium michiganense* ssp. *nebraskense*. Phytopathology, 751378.

Schuster, M.L., Hoff, B., Mandel, M. and Lazar, I. 1972. Leaf freckles and wilt, a new corn disease. In: 27th Annual Corn and Sorghum Research Congress Chicago, Illinois, USA, Vol. 27, pp. 176–191

Smidt, M. and Vidaver, A.K. 1986. Population dynamics of *Clavibacter michiganense* subsp. *nebraskense* in field grown dent corn and popcorn. Plant Disease, 70, 1031–1036.

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Clavibacter michiganensis* subsp. *nebraskensis.* Accessed 2/28/2025.

Wysong, D.S., Vidaver, A.K., Stevens, H., and Stenberg, D. 1973. Occurrence and spread of an undescribed species of *Corynebacterium* pathogenic on corn in the western corn belt. Plant Disease Reporter, 57(4):291-294

Responsible Party:

Heather J. Martin, 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: 03/19/2025 through 05/03/2025**

***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: A
