CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Profile for

Spiroplasma kunkelii Whitcomb 1986

Pest Rating: C

Kingdom: Bacteria, Phylum: Tenericutes,
Class: Mollicutes, Order: Entomoplasmatales,
Family: Spiroplasmataceae

Comment Period: 09/12/2024 through 10/27/2024

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from *Spiroplasma kunkelii* is described herein and a permanent rating is proposed.

History & Status:

Background:

A total of 370,000 acres of corn was planted in California in 2022. California is the top producer of sweet corn in the United States, growing 26% of the country's total, in four main sweet corn production areas: the southern desert, the south coast, the Central Valley, and the central coast. In addition, most counties produce some sweet corn for direct marketing (Smith et al., 1997). California also grows field corn for grain and silage. Silage corn acreage consistently exceeds grain corn acreage in California because many corn growers are associated with dairies that feed silage to their animals. Leading counties in corn grain production are Sacramento, Glenn, Solano, Sutter, and Stanislaus. Tulare, Merced, Stanislaus, San Joaquin, and Kings were the top five producing silage counties (https://corn.ucdavis.edu/about-california-corn : https://www.cdfa.ca.gov/Statistics/PDFs/2022-2023_california_agricultural_statistics_review.pdf).

Corn stunt disease was first reported as a stunting and striping syndrome of maize in the Rio Grande area of Texas (Altstatt, 1945). Initially, it was thought to be caused by a leafhopper-borne virus. Phase-contrast microscopic examination of plant sap revealed helical microorganisms (Granados, 1968). Although these organisms are very difficult to keep in cultures, they were shown to be helical, motile, wall-less procaryotes and were termed “spiroplasmas”. Their pathogenicity on corn was confirmed (Chen and Granados, 1970; Chen and Liao, 1975).

Spiroplasmas are single-celled, soft-skinned bacteria that lack an outer cell wall. They are named for their spiral (helix) shape that forms during certain phases of growth. *Spiroplasma citri* was the first mollicute of plant origin to be obtained in culture and the first cultured mollicute to be shown to have a helical morphology. There are only two other *Spiroplasma* species that cause plant diseases, *S. kunkelii*, which causes corn stunt, and *S. phoeniceum*, which infects periwinkle. There are dozens of species of *Spiroplasma* that can infect insects and ticks (Bové, 1997).

Corn stunt disease affects corn production in the Caribbean and the Americas, including the United States, Mexico, and Central and South America. The disease results in severely stunted plants that often produce multiple small ears with loose or missing kernels. *Spiroplasma kunkelii* is commonly known as the corn stunt spiroplasma (CSS) (Whitcomb et al., 1986). In some areas, CSS is transmitted in combination with Maize bushy stunt phytoplasma and/or Maize rayado fino virus, however, in California, only *S. kunkelii* has been confirmed (Purcell and Suslow 1984).

CSS is spread to healthy corn plants by the corn leafhopper, *Dalbulus maidis*, in a persistent-propagative manner. *Dalbulus maidis* is considered a serious pest in tropical climates because it is a good vector and CSS is associated with serious yield losses. Corn stunt disease has been observed every year in the Southern San Joaquin Valley since 1996. In 2001, an outbreak there was reported to have caused economic losses of more than $5M (Summers et al., 2004).

Hosts: Zea diploperennis (diploperennis teosinte), *Z. luxurians* (Guatemalan teosinte), *Z. mays* (corn, maize), *Z. mexicana* (Mexican teosinte), *Z. perennis* (perennial teosinte) (EPPO, 2024).

Symptoms: Leaves with red margins or leaves with chlorotic stripes sometimes signify the presence of the disease in the field. Severely infected plants, or those infected early in their development, top out at only 5 feet tall with very short internodes. Healthy corn is expected to be twice that height. The stalk may have as many as 6-7 ears on a single plant and can have a proliferation of secondary shoots, giving the plants a short and bushy appearance. The ears produced by infected plants are small and do not fill properly leaving blank spaces on the cob. The kernels that do develop are frequently "loose" leading to what is called "loose tooth ears ". Younger leaves near the top of the plant are yellow and as they age, the plants can take on a reddish to reddish-purple color (Davis, 2006).

Transmission: In corn fields, *S. kunkelii* is transmitted by leafhoppers, mainly by the corn leafhopper, *Dalbulus maidis* (Homoptera: Cicadellidae). Other species have been found capable of transmitting the pathogen in experimental conditions (Carloni et al., 2011). *Spiroplasma kunkelii* overwinters within the adult leafhopper, and as soon as the leafhoppers emerge from overwintering in early spring, they can be infective to new corn plantings. Disease symptoms appear about three weeks after the corn is infected. The disease is most severe in corn planted after July 1 but can occur in corn planted as early as March and April (Davis, 2006).

Pathways for moving *S. kunkelii* over long distances are very limited because *S. kunkelii* is not seed-transmitted, its insect vectors are not likely to be associated with plants other than corn, and corn is not vegetatively multiplied, it is only grown from seeds (CABI, 2024).

Damage Potential: Spiroplasma kunkelii is reported as a major disease limiting maize production and causing economic damage in Central and South America. In Argentina, it has been shown that *S. kunkelii* causes significant yield reductions annually (Cabrini et al., 2024). In the USA where the disease is considered sporadic, corn stunt has been observed to some degree every year in the central valley of California since 1996, and in 2001, some outbreaks have caused significant economic losses (Summer et al., 2004). *Dalbulus maidis* has a hemimetabolous lifecycle and only reproduces on species of *Zea*. Under optimal environmental conditions, *D. maidis* can colonize corn fields quickly and cause severe yield losses, thus resulting in drastic economic losses. As the leafhoppers feed, they excrete honeydew, which can make leaves appear shiny. The honeydew can also lead to the growth of black sooty mold, which can negatively impact plant health (Wilson, 2007).

Worldwide Distribution: Americas: Argentina, Belize, Bolivia, Brazil, Colombia, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, United States (*California, Florida, Louisiana, Michigan, Mississippi, Ohio*, and *Texas*), and Venezuela (EPPO, 2024; CABI, 2024).

Official Control*: Spiroplasma kunkelii* is on the EPPO's A1 list for the Asian and Pacific Plant Protection Commission (EPPO, 2024). It is on the USDA PCIT's list of harmful organisms for Honduras, Indonesia, and Thailand (USDA-PCIT 2024).

California Distribution: CSS has been identified by CDFA and UCCE in Kern, Tulare, Kings, Fresno, Stanislaus, San Joaquin, and Sacramento counties. Corn leafhoppers are most damaging in Fresno, King, Kern, and Tulare counties, but have been found in Madera, Merced, Stanislaus, San Joaquin, Sacramento, Yolo, Contra Costa, and Solano counties. (French, 1989; https://ipm.ucanr.edu/NEWS/corn_stunt_disease-news.html)

California Interceptions: none

The risk that *Spiroplasma kunkelii* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** The pathogen and the vector have been present in California for close to 50 years without any official control. They are likely fully distributed within the state**.**

   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:** The host range of CSS is limited to a few species of *Zea*.

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:** CSS relies on the corn leafhopper to survive in the absence of a living plant host. Corn leaf hoppers spread with wind and migrate to new areas when food is limited.

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:** Periodic yield losses have been reported.

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

Economic Impact: A, E

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:** With a limited host range, none are expected.

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 *Spiroplasma kunkelii:*

Add up the total score and include it here. **8**
-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* ***= 6***

Uncertainty:

Official surveys have not been done for this pathogen. It may occur in more counties than have been documented by CDFA or UCCE.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Spiroplasma kunkelii*** **is C.**

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***Comment Period: 09/12/2024 through 10/27/2024**

***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: C