CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Profile for

Spinach curly top Arizona virus

Pest Rating: C

Realm: Monodnaviria, Kingdom: Shotokuvirae,
Phylum: Cressdnaviricota, Class: Repensiviricetes,
Order: Geplafuvirales, Family: Geminiviridae,
Genus: *Becurtovirus*, Species: *Becurtovirus spinaciae*

Comment Period: 10/05/2026 through 11/19/2026

Initiating Event:

In June 2026, CDFA plant virologist Tongyan Tian diagnosed Spinach curly top Arizona virus from Russian thistle (*Salsola tragus*) submitted in April from Fresno County by PCR and sequence analysis. The thistle sample was collected as part of the annual monitoring done by CDFA's Integrated Pest Management branch's Curly Top Program. Additional hosts that tested positive from follow-up surveys were salt bush (*Atriplex* spp.) and lambsquarters (*Chenopodium album*). This virus has not been identified from any tomatoes. This pathogen has not been through the pest rating process. The risk to California from Spinach curly top Arizona virus is described herein, and a permanent rating is proposed.

History & Status:

Background: The California Department of Food and Agriculture's Integrated Pest Control branch runs a Beet curly top virus control program. It was established in 1943 to help manage the economic impact of curly top virus throughout the State. The program is funded by assessments, and program activities reduce curly top virus outbreaks through monitoring and control of beet leafhoppers. Most operations are in the San Joaquin Valley, but virus damage and vector populations are monitored at multiple locations in the state. Although the occurrence of curly top disease is sporadic, it has the potential to cause significant economic losses, especially in tomatoes. Control methods include targeted insecticide treatments to prevent the movement of vectors (CDFA, 2026).

Spinach curly top Arizona virus (SpCTAV) is a monopartite, circular, single-stranded DNA virus in the family Geminiviridae. Its accepted species name is *Becurtovirus spinaciae*, in the genus *Becurtovirus* (ICTV, 2026). Despite the similarity of its common name to Beet curly top virus, SpCTAV is not a strain of Beet curly top virus and is not classified in the genus *Curtovirus* with Beet curly top virus (Varsani et al., 2014a; Varsani et al., 2014b; Zerbini et al., 2017).

Spinach curly top Arizona virus was discovered during an investigation of severely diseased spinach in a commercial field in south-central Arizona in 2009. The affected plants were severely stunted and exhibited leaf curling. Molecular analyses detected two previously uncharacterized geminiviruses in the same spinach samples. One was subsequently named Spinach severe curly top virus, and the second was named SpCTAV (Hernández-Zepeda and Brown, 2010; Hernández-Zepeda et al., 2013).

Spinach curly top Arizona virus can be distinguished from Spinach severe curly top virus. Spinach severe curly top virus is classified as *Curtovirus spinaciae* and was first described from symptomatic spinach collected in Texas in 1996. The two viruses belong to different genera and have substantially different genome organizations (Baliji et al., 2004; Hernández-Zepeda et al., 2013; Varsani et al., 2014b).

Spinach curly top Arizona virus has a genome organization that is similar to Beet curly top Iran virus, another geminivirus. Spinach curly top Arizona virus and Beet curly top Iran virus shared approximately 77% whole-genome nucleotide sequence identity, supporting their placement as separate species within the newly established genus *Becurtovirus* (Hernández-Zepeda et al., 2013; Varsani et al., 2014b).

Following its original discovery in Arizona, SpCTAV was detected in Idaho. A genome sequence was recovered from symptomatic red table beet in Idaho in 2022. The sequence had approximately 99.3% nucleotide identity with the Arizona reference isolate. The table beet was also infected with the pepper yellow dwarf strain of Beet curly top virus, so the symptoms could not be attributed specifically to SpCTAV (Ramachandran et al., 2023).

Spinach curly top Arizona virus sequences were detected in beet leafhoppers, *Circulifer tenellus*, collected during surveys in Idaho. Detection was most frequent among insects associated with Russian thistle and alfalfa. Detection of viral DNA in field-collected leafhoppers indicates that the insects had acquired the virus or virus-containing plant material but does not by itself demonstrate biological transmission (Strausbaugh et al., 2024a; Strausbaugh et al., 2024b).

In 2024, a complete SpCTAV genome was recovered from symptomatic sugar beet in Idaho. PCR and sequencing confirmed the virus in four of 15 additional symptomatic sugar beet samples. Iris yellow spot virus was also present, and the affected plants exhibited virus yellows-like symptoms. Because of the mixed infection, the contribution of SpCTAV to the observed disease remains undetermined (Ramachandran et al., 2025).

Spinach curly top Arizona virus remains a poorly characterized virus. Its natural host range, vector relationship, epidemiology, prevalence, independent pathogenicity in crop hosts, and economic

importance have not been adequately determined. Its effect on tomatoes is unknown, and to date, no detections have been made from tomatoes.

Hosts: Published natural detections of SpCTAV have been reported from 3 crops: table beet and sugar beet (*Beta vulgaris*) and spinach (*Spinacia oleracea*) (Hernández-Zepeda et al., 2013; Ramachandran et al., 2023; Ramachandran et al., 2025). This report shows the virus was detected from Russian thistle (*Salsola tragus*), salt bush (*Atriplex* spp.), and lambsquarters (*Chenopodium album*).

Symptoms: The spinach plants from which SpCTAV was originally detected were severely stunted and had curled leaves. However, the same plants were infected with Spinach severe curly top virus. The symptoms therefore cannot be assigned specifically to SpCTAV on the original field observations (Hernández-Zepeda and Brown, 2010; Hernández-Zepeda et al., 2013).

The Idaho red table beet record involved a mixed infection with a strain of Beet curly top virus. The Idaho sugar beet plants had yellowing and other symptoms resembling virus yellows, but they were also infected with Iris yellow spot virus. The specific symptoms caused by SpCTAV alone in beet crops remain unknown (Ramachandran et al., 2023; Ramachandran et al., 2025).

Transmission: The biological vector of SpCTAV has not been experimentally established. Beet leafhopper is the principal vector of Beet curly top virus and several related geminiviruses in western North America, and SpCTAV DNA has been detected in field-collected beet leafhoppers in Idaho. However, no published acquisition and transmission experiment has demonstrated that *Circulifer tenellus* transmits SpCTAV between plants (Varsani et al., 2014b; Strausbaugh et al., 2024a; Strausbaugh et al., 2024b).

Beet curly top Iran virus, the most closely related extensively studied becurtovirus, is transmitted by *Circulifer haematoceps*. This supports the plausibility of leafhopper transmission within the genus, but transmission of one becurtovirus cannot be assumed to establish the vector of another species (Heydarnejad et al., 2013).

Seed transmission has not been reported. Mechanical transmission, transmission through vegetative propagation, and transmission through pollen have not been demonstrated.

Damage Potential: Spinach curly top Arizona virus was originally associated with severe stunting and leaf curling in commercial spinach. However, Spinach severe curly top virus was present in the same plants, and the respective contributions of the two viruses were not resolved. Disease caused independently by SpCTAV has not been reproduced in spinach (Hernández-Zepeda et al., 2013).

Recent detections in red table beet and sugar beet demonstrate that the virus is associated with additional cultivated hosts. Both Idaho reports involved mixed infections, and neither study could demonstrate that SpCTAV caused the observed field symptoms. Quantitative data on incidence, yield loss, crop quality, plant mortality, or production costs attributable to this virus are unavailable (Ramachandran et al., 2023; Ramachandran et al., 2025).

The virus is therefore potentially damaging, particularly to young spinach or beet plants, but its actual economic importance remains unverified. Assigning it the extensive damage historically associated with Beet curly top virus would be inappropriate because the viruses are taxonomically distinct and their host ranges, vectors, virulence, and epidemiology may differ.

Worldwide Distribution: United States (Arizona, California, and Idaho) (Hernández-Zepeda et al., 2013; Ramachandran et al., 2023, CDFA PDR Database, 2026).

Official Control: none

California Distribution: Official samples have been collected from Fresno County (CDFA PDR database, 2026).

California Interceptions: none

The risk that Spinach curly top Arizona virus would pose to California is evaluated below:

Consequences of Introduction:

1) **Climate/Host Interaction:** Spinach, table beet, and sugar beet are grown in California, and the beet leafhopper occurs in the state. The virus has been detected in arid or semiarid agricultural regions of Arizona and Idaho. These facts suggest that environmental conditions and hosts suitable for infection could occur in parts of California.

   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 known natural host range is 3 crop plants and 3 weed species. Additional hosts may exist, but they have not been demonstrated.

   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:** Spinach curly top Arizona virus replicates systemically in infected plants. Its detection in beet leafhoppers suggests a potential mechanism for natural movement, but vector transmission has not been demonstrated experimentally. If beet leafhopper is confirmed as a

competent vector, dispersal could occur through movement of viruliferous adult leafhoppers among crop and non-crop hosts.

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: Spinach curly top Arizona virus could potentially lower the yield or market quality of spinach and beet crops if it independently causes stunting, leaf curling, yellowing, or other disease symptoms. These crops have commercial importance in California. Beet leafhopper control could require insecticide use.

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

Economic Impact: A, B
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: No infection of native California plants, threatened or endangered plants, ornamental plants, or ecologically important wild plants has been documented. The virus is not known to alter natural communities, ecosystem processes, or cultural practices.

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 Spinach curly top Arizona virus*:* medium

Add up the total score and include it here. **9**
-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 'low'.

Score: -1
-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 consequence 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* ***= 8***

Uncertainty:

SpCTAV is known from a few published studies and has not been comprehensively surveyed. Its apparent restriction to Arizona and Idaho may reflect limited testing rather than its true distribution. Plants are frequently co-infected with other viruses known to cause economic damage. Consequently, disease symptoms, virulence, yield losses, and economic effects attributable to SpCTAV alone remain unverified. SpCTAV DNA has been detected in beet leafhoppers, but acquisition, retention, inoculation, transmission efficiency, latent period, and vector specificity have not been determined. The beet

leafhopper is a plausible vector, but this remains an inference rather than a verified transmission relationship. The host range is likely incompletely documented. Russian thistle and alfalfa were associated with virus-positive beet leafhoppers, and California detections in salt bush and lambsquarters have increased the host list. Identification should be supported by sequence data capable of distinguishing *Becurtovirus spinaciae* from Beet curly top virus, Spinach severe curly top virus, and other geminiviruses.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for **Spinach curly top Arizona virus is C.**

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Responsible Party:

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***Comment Period: 10/05/2026 through 11/19/2026**

***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
