California Pest Rating Proposal for

Cauliflower mosaic virus

Current Pest Rating: C
Proposed Pest Rating: C

Realm: Riboviria,
Kingdom: Pararnavirae, Phylum: Artververicota,
Class: Revtraviricetes, Order: Ortervirales,
Family: Caulimoviridae, Genus: *Caulimovirus*,
Species: *Caulimovirus tessellobrassicae*

Comment Period: 08/26/2026 through 10/10/2026

Initiating Event:

This pathogen has not been through the pest rating process. It is an important pathogen for export certification of crucifer seed. The risk to California from cauliflower mosaic virus (CaMV) is described herein, and a permanent rating is proposed.

History & Status:

Background:

California leads the nation in production of several cruciferous vegetables and has a substantial vegetable-seed industry (Matthews, 2009). California broccoli, cauliflower, and cabbage together accounted for 135,700 harvested acres in 2024 and approximately $1.66 billion in utilized production value (USDA NASS, 2026). Production is concentrated in coastal, inland-valley, and desert counties. Monterey is the principal broccoli- and cauliflower-producing county, with Santa Barbara, San Luis Obispo, Fresno, and Imperial counties also contributing substantially. Cabbage production is more distributed, with important production in Monterey, San Benito, San Luis Obispo, Santa Clara, Santa Barbara, Ventura, Imperial, and Riverside counties (Crop Profile for Cabbage in California, 2000; Geisseler and Horwath, 2016a, 2016b).

Cauliflower mosaic virus belongs to the genus *Caulimovirus*, family *Caulimoviridae*. Caulimoviruses are plant pararetroviruses with non-covalently closed, circular, double-stranded DNA genomes that replicate through reverse transcription of a pregenomic RNA. Two major capped and polyadenylated RNAs are produced. The 35S RNA functions as both the pregenomic RNA and a polycistronic messenger RNA, while the 19S RNA encodes P6, a multifunctional translation transactivator and viroplasmin.

Caulimoviruses are transmitted semi-persistently by aphids, with transmission dependent on the virus-encoded aphid transmission factor P2. Most are mechanically transmissible, and seed transmission has not been recorded for the genus (ICTV, 2026).

The current ICTV species name for cauliflower mosaic virus is *Caulimovirus tessellobrassicae*. Tompkins (1937) published the original description of CaMV as a transmissible mosaic disease of cauliflower. Severin and Tompkins (1948) subsequently reported that cauliflower was naturally infected with cauliflower mosaic in California and investigated its transmission by aphids.

CaMV became one of the best-studied DNA plant viruses and an important model system for plant molecular biology. California-affiliated researchers contributed substantially to this history. Shepherd, Wakeman and Romanko (1968) demonstrated the presence of DNA in CaMV, Gardner et al. (1981) reported the complete 8,031 base-pair sequence of an infectious CaMV clone, and Gronenborn et al. (1981) demonstrated the use of CaMV as a plant virus vector. The CaMV 35S promoter later became a foundational tool in plant biotechnology. Odell et al. (1985) characterized it as a strong plant nuclear promoter, and it remains one of the most extensively studied and widely used regulatory components for gene expression in plant cells (Amack and Antunes, 2020).

As a pathogen, CaMV is important because it infects economically significant cruciferous crops, including radish, turnip, canola, mustard, cauliflower, broccoli, and cabbage. Infection can cause chlorosis, mosaic, vein clearing, vein banding, stunting, leaf deformation, rugosity, and necrosis. In a survey of symptomatic crucifers across 10 Iranian provinces, Farzadfar et al. (2007) detected CaMV in 71 of 105 commercial fields and in several cultivated and weedy crucifers. The economic effects of CaMV depend on the host, cultivar, virus strain, environmental conditions, and the presence of other viruses. In Kenyan screenhouse experiments, CaMV alone did not significantly reduce cabbage yield, while simultaneous infection with Turnip mosaic virus and CaMV reduced the number and weight of marketable cabbage heads (Spence et al., 2007).

Hosts:
The natural host range of CaMV is primarily restricted to the Brassicaceae. Natural host ranges of caulimoviruses are generally narrow and restricted to a single plant family, although some isolates have been experimentally transmitted to plants in additional families (ICTV, 2026).
Brassica napus, *B. napus* var. *napobrassica* (swede), *B. napus* var. *napus* (rape), *B. napus* var. *oleifera*, *B. oleracea* (cabbages and cauliflowers), *B. oleracea* var. *botrytis* (cauliflower), *B. oleracea* var. *capitata* (cabbage), *B. oleracea* var. *gemmifera* (Brussels sprouts), *B. oleracea* var. *gongylodes* (kohlrabi), *B. oleracea* var. *italica* (broccoli), *B. oleracea* var. *viridis* (collards), *B. rapa* (field mustard), *B. rapa* subsp. *oleifera* (turnip rape), *B. rapa* subsp. *pekinensis* (Chinese cabbage), *B. rapa* subsp. *rapa* (turnip), *Capsella bursa-pastoris* (shepherd's purse), *Erysimum cheiri* (wallflower), *Lepidium sativum* (garden cress), *Matthiola incana* (stock), *Raphanus raphanistrum* (wild radish), *R. sativus* (radish), *Rapistrum rugosum*, *Sinapis alba* (white mustard), *S. arvensis* (wild mustard), *Sisymbrium irio*, *S. loeselii*, and *S. officinale* (hedge mustard) (CABI, 2026; Farzadfar et al., 2007).

Symptoms:
CaMV causes systemic symptoms in susceptible cruciferous hosts. Symptom expression and susceptibility vary with the host species, cultivar, virus strain, plant age, and environmental conditions. In experimental comparisons of *Brassica* species, variants of *Brassica rapa* were highly susceptible and accumulated relatively high virus concentrations, *B. oleracea* variants generally had lower susceptibility and virus accumulation, and *B. nigra* and allotetraploid *Brassica* species had intermediate responses (Saunders et al., 1990).

Reported symptoms include chlorosis, mosaic, vein clearing, vein banding, mottling, necrotic spotting, leaf deformation, rugosity, yellowing, and stunting. In a field survey of crucifer crops, symptoms associated with natural CaMV infection included banded mosaic and vein clearing on cauliflower, mosaic on radish, leaf deformation, rugosity, stunting, and vein clearing on Chinese cabbage, mosaic and vein banding on broccoli, and necrotic spots and vein yellowing on turnip (Farzadfar et al., 2007). Severe CaMV strains may cause substantial stunting or plant death, while mild strains may cause few symptoms during chronic infection (Shepherd, 1981). Mixed infection with Turnip mosaic virus can increase effects on crop yield and marketability (Spence et al., 2007).

Transmission:
CaMV is transmitted by aphids in a non-circulative, semi-persistent manner. Palacios et al. (2002) found that CaMV was preferentially acquired from the phloem by two of its principal aphid vectors, *Brevicoryne brassicae* (cabbage aphid) and *Myzus persicae* (green peach aphid). Both species are widespread pests of crucifer crops. Aphids can acquire and transmit the virus after short feeding periods, and there is no latent period in the vector. Seed transmission has not been reported for CaMV or other members of the genus *Caulimovirus* (Shepherd, 1981; ICTV, 2026).

Transmission requires interactions among the viral P2 helper protein, P3 virion-associated protein, virus particles, and the cuticular surface of the aphid stylet. Uzest et al. (2007) demonstrated the presence and location of a receptor involved in non-circulative CaMV transmission at the tip of the aphid stylet. Virus particles are retained temporarily in the mouthparts rather than circulating through or replicating within the aphid.

CaMV is also mechanically transmissible, but seed transmission has not been recorded (ICTV, 2026).

Damage potential:
Cauliflower mosaic virus infects economically important cruiferous crops grown on a large commercial scale in California. The availability of susceptible crops throughout overlapping production seasons permits continued virus and vector activity. Disease damage is associated primarily with systemic symptoms that reduce plant vigor, crop uniformity, appearance, and marketability. Early infection and infection by severe virus strains may cause greater stunting and yield effects than late infection or infection by mild strains (Shepherd, 1981; Spence et al., 2007).

The direct economic impact of CaMV alone appears variable and may be less severe than that of some other brassica viruses. Mixed infections, however, can increase losses. In Kenya, CaMV alone did not significantly affect cabbage yield, while simultaneous infection with Turnip mosaic virus and CaMV reduced both the number and weight of marketable cabbage heads. Twenty-five percent of heads were non-marketable in the simultaneous-infection treatment (Spence et al., 2007).

Naturally infected brassicaceous weeds and volunteer crop plants may provide reservoirs from which aphids can acquire CaMV and transmit it to commercial crops. Farzadfar et al. (2007) identified naturally infected *Rapistrum rugosum*, *Raphanus raphanistrum*, and *Sisymbrium loeselii* in and around crucifer production areas. Such reservoirs may allow the virus to persist between crop cycles and contribute inoculum to subsequent plantings.

Worldwide Distribution:
CaMV is widely distributed in temperate regions where crucifer crops are grown. Reported distribution includes Africa: Egypt, Sierra Leone, South Africa, Tanzania, Zambia, and Zimbabwe. Asia: Azerbaijan, China, Hong Kong, India, Iran, Israel, Japan, Taiwan, Turkey, Uzbekistan, and Yemen. Europe: Bulgaria, Czechia, Denmark, France, Germany, Hungary, Italy, Lithuania, the Netherlands, Portugal, Romania, Russia, Spain, and the United Kingdom. North America: Canada and the United States, including California, Georgia, Idaho, Kentucky, Michigan, New Jersey, New York, Pennsylvania, Vermont, Washington, and Wisconsin. Oceania: Australia and New Zealand. South America: Argentina and Brazil (Shepherd, 1981; CABI, 2026).

Official Control:
CaMV is on the USDA PCIT Harmful Organisms list for Guatemala, Japan, the Philippines, Taiwan, and Venezuela (USDA PCIT, 2026). CaMV is included on Jordan's A1 list (EPPO, 2026).

California Distribution:
Alameda, Imperial, San Benito, San Diego, San Luis Obispo, Santa Barbara, Santa Clara, and Yolo counties (CDFA PDR database, 2026). Statewide where hosts are grown (French, 1989).

California Interceptions:
none

The risk that Cauliflower mosaic virus would pose to California is evaluated below.

Consequences of Introduction:

1) Climate/Host Interaction:

CaMV has been documented in multiple California counties where cruciferous crops are grown, demonstrating that suitable hosts, aphid vectors, and environmental conditions occur in several principal production areas (Severin and Tompkins, 1948; French, 1989; CDFA PDR database,

2026). Commercial and weedy cruciferous hosts are widely available and may support continued virus transmission (Farzadfar 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:

CaMV has a moderate host-range score because its natural host range is primarily restricted to the Brassicaceae. This family includes economically important vegetable, oilseed, ornamental, and weed hosts, but the natural host range is not broad across numerous plant families (ICTV, 2026; Farzadfar et al., 2007).

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:

CaMV has moderate reproductive and dispersal potential. The virus reproduces efficiently in susceptible plants and is naturally transmitted by aphids in a non-circulative, semi-persistent manner. It is also mechanically transmissible. The score is not higher because its natural host range is relatively narrow and seed transmission has not been reported (Palacios et al., 2002; ICTV, 2026).

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:

CaMV can reduce crop quality and marketability through systemic symptoms such as mosaic, chlorosis, vein clearing, leaf deformation, necrosis, rugosity, and stunting. Early or severe infections may reduce plant vigor and yield, and economic effects may increase in mixed infections. CaMV is vectored by multiple aphid species (Farzadfar et al., 2007; Palacios et al., 2002; Spence et al., 2007).

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

Economic Impact: **A, B, 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: 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:

CaMV has documented brassicaceous weed hosts that may contribute to local virus persistence and serve as inoculum reservoirs (Farzadfar et al., 2007). However, no evidence was found that CaMV significantly lowers biodiversity, disrupts natural communities, changes ecosystem processes, affects threatened or endangered species, or significantly affects ornamental plantings or home gardens.

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

Environmental Impact: None
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 Cauliflower mosaic virus: Medium

Add up the total score and include it here. 10
-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 'high'.

Score: -3

-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 plus the Post-Entry Distribution and Survey Information score: (Score)

Final Score: Score of Consequences of Introduction + Score of Post-Entry Distribution and Survey Information = 7

Uncertainty:

Published information on the economic effects of CaMV alone under California commercial production conditions is limited. Disease severity and crop losses may vary with cultivar, virus strain, environmental conditions, plant age at infection, and the presence of other viruses. The current frequency of symptomatic disease and yield loss in California commercial fields is uncertain.

Conclusion and Rating Justification:

Based on the evidence provided above, the proposed rating for Cauliflower mosaic virus is C.

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***Comment Period: 08/26/2026 through 10/10/2026**

***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.

Proposed Pest Rating: C
