CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Profile for *Peronospora viciae* (Berk.) Casp. Downy mildew of legumes

Pest Rating: C

Kingdom: Chromista, Phylum: Oomycota, Class: Oomycetes, Order: Peronosporales, Family: Peronosporaceae

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Comment Period: 08/31/2026 through 10/15/2026

Initiating Event:

This pathogen has not been through the pest rating process. It is an important pathogen for export certification of fava bean seed. The risk that *Peronospora viciae* poses to California is described herein, and a permanent rating is proposed.

History & Status:

Background: Peas, fava beans, lentils, vetches, and related legumes are grown in California for food, seed, forage, green manure, and cover crops. Fava beans are grown as vegetable crops during the cool season and as seed crops along parts of the central coast and in the northern Sacramento Valley. They are also widely planted as cover crops and green manure throughout the state. These uses provide cultivated hosts during the cool, moist periods that favor the development of downy mildew. The CDFA requires two field inspections of broad bean crops submitted for phytosanitary seed certification and lists *Peronospora viciae* as a pest of concern.

The species was originally described as *Botrytis viciae* by Berkeley and was transferred to *Peronospora* by Caspary in 1855. *Peronospora viciae* is an obligate biotrophic oomycete in the family Peronosporaceae. It grows intercellularly in living host tissue and produces haustoria that obtains nutrients from host cells. During moist conditions, sporangiophores emerge through stomata and produce large numbers of airborne sporangia. Thick-walled sexual oospores develop within infected tissue and can persist after crop residues decompose, providing soilborne primary inoculum for later crops (Stegmark, 1994; Van der Gaag and Frinking, 1997).

Downy mildew may occur as systemic seedling infection, localized foliar infection, or pod infection. Disease expression is strongly influenced by temperature, humidity, host age, cultivar susceptibility, and pathogen virulence. Numerous physiological races or pathotypes have been reported on legumes, and resistant cultivars may become susceptible when new virulence combinations arise (Stegmark, 1994).

The traditional concept of *P. viciae* includes downy mildews occurring on several genera of legumes. These pathogens have also been divided into host-specialized forms, including *P. viciae* f. sp. *pisi* on pea and *P. viciae* f. sp. *fabae* on faba bean. Molecular studies have demonstrated substantial genetic separation among isolates from different legume hosts and support recognition of multiple host-specialized lineages or species within the traditional *P. viciae* complex. García-Blázquez et al. (2008) found that lineages were strongly associated with particular host genera, subgenera, or species. This proposal evaluates *P. viciae* in the broad sense used in historical records and regulatory documents, while recognizing that some host records may represent distinct specialized taxa (Cunnington, 2006; García-Blázquez et al., 2008).

Hosts: Host records attributed to *P. viciae* in the broad historical sense are concentrated in the Fabaceae. The principal cultivated host is *Pisum sativum* (pea). Other hosts, including *Vicia faba* (fava or broad bean), *V. sativa* (common vetch), *Lens culinaris* (lentil), and species of *Lathyrus,* have been reported occasionally. Additional records include *Vicia hirsuta, V. villosa*, and other cultivated or wild species of *Pisum, Vicia,* and *Lathyrus* (CABI, 2026).

Symptoms: Systemically infected pea seedlings are pale green or yellow, stunted, and distorted. Internodes may be shortened, and leaves and stipules may become thickened, curled, or brittle. Grayish-white to violet sporulation may cover the lower leaf surfaces, stems, stipules, and tendrils. Severely affected seedlings may die or remain markedly smaller than healthy plants.

Localized leaf infection initially causes pale green or yellow, often angular areas on the upper leaf surface. Corresponding areas on the lower surface develop grayish-white, tan, or violet downy growth under humid conditions. Lesions enlarge, turn brown and necrotic, and may coalesce. Extensive infection can result in yellowing, premature leaf death, defoliation, and reduced plant vigor. Sporulation may be sparse or absent when humidity is low, and infections can remain latent until plants are exposed to prolonged high humidity (Stegmark, 1994; Marr et al., 2021).

Infected stems and tendrils may be thickened, distorted, or stunted. Pod infection produces pale yellow, brown, or purplish blotches. White or gray mycelium and sporulation may develop inside or outside the pod. Infected pods may be malformed, fail to fill normally, or contain small, discolored, or aborted seeds. Oospores may form abundantly in infected leaves, stems, and pods (Mence and Pegg, 1971; Stegmark, 1994).

Symptoms on fava bean and other legumes are generally similar and include chlorotic leaf lesions, downy sporulation on lower leaf surfaces, systemic stunting, stem distortion, and injury to flowers or pods. Symptom expression alone may not distinguish among specialized members of the *P. viciae* complex.

Transmission: The principal sources of primary inoculum are long-lived oospores in soil and infested crop residues. Oospores form in infected host tissue and are released as the tissue decomposes. Germinating oospores infect emerging roots or shoots and may produce systemic infection. Van der Gaag and Frinking (1997) demonstrated that oospores of *P. viciae* f. sp. *pisi* survived for extended periods in soil, although survival varied with temperature, soil moisture, and the age of the oospore population.

Secondary spread occurs through sporangia produced on infected leaves, stems, tendrils, and pods. Sporangia are dispersed by air currents and wind-driven rain and can move between fields or over substantially greater distances. Infection and sporulation are favored by cool temperatures, prolonged high relative humidity, dew, rain, dense crop canopies, and extended leaf wetness. Sporulation has been reported over approximately 4 to 24°C when relative humidity exceeds 90 percent, although optimum conditions vary among isolates and hosts (Pegg and Mence, 1970; Stegmark, 1994).

The pathogen may also be moved locally in infested soil, crop residue, infected transplants, and contaminated equipment. Volunteer hosts and susceptible cultivated or wild legumes can maintain living inoculum between commercial crops.

Mycelium and oospores have been detected in or on pea seed, but published experiments have not demonstrated transmission from contaminated pea seed to seedlings. The International Seed Federation therefore concludes that there is no evidence that pea seed is a pathway for *P. viciae*. This conclusion applies specifically to pea and does not eliminate the possibility of external contamination of seed lots or differing associations with other legume hosts (International Seed Federation, 2023).

Damage Potential: Downy mildew can reduce stand establishment, vegetative growth, photosynthetic leaf area, pod number, seed development, yield, and crop quality. Systemic infection of young plants is generally more damaging than late localized infection because affected plants may be severely stunted, fail to flower normally, or die. Foliar disease occurring after flowering can also reduce pod filling when a substantial portion of the upper canopy is damaged.

Yield loss is strongly dependent on disease timing, cultivar susceptibility, weather, and the prevalence of virulent pathogen races. Chang et al. (2013) found that even moderately severe downy mildew in field pea reduced pod numbers by approximately 65 percent and seed yield by approximately 75 percent under Alberta field conditions. Earlier studies summarized by Stegmark (1994) reported losses of approximately 30 percent in Sweden and 45 percent in the United Kingdom during severe systemic disease. These values demonstrate potential losses under highly favorable conditions and should not be interpreted as expected annual losses in California.

Pod infection can directly lower marketability of fresh peas or fava beans and reduce the quality of seed crops. Disease management may require resistant cultivars, extended rotation away from susceptible legumes, destruction or incorporation of residues, volunteer and weed control, improved field drainage, reduction of prolonged canopy moisture, and fungicide or seed-treatment programs. Resistance to phenylamide fungicides has developed in some *P. viciae* populations, reducing the

efficacy of formerly reliable seed treatments and increasing the need for alternative fungicides and resistant cultivars (Falloon et al., 2000).

California's dry summers may restrict disease development in many inland production areas. However, peas, fava beans, vetches, and related hosts are commonly grown during the cool season. Winter rainfall, coastal humidity, irrigation, dense foliage, and cool temperatures can provide favorable conditions for systemic infection, sporulation, and local epidemics. Soilborne oospores allow the pathogen to persist through hot or dry periods in the absence of active foliar disease.

Worldwide Distribution: *Peronospora viciae* is widely distributed in temperate and cool, humid production regions where susceptible legumes are grown. Reports include Africa: *Ethiopia, Kenya, Morocco, South Africa, Tanzania, Tunisia, Uganda,* and *Zimbabwe*. Asia: *Afghanistan, Bangladesh, China, Georgia, India, Israel, Pakistan, Syria,* and *Taiwan*. Europe: *Austria, Bulgaria, Cyprus, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Lithuania, Malta, Montenegro, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Spain, Sweden, Switzerland, the United Kingdom,* and *Ukraine*. North America: *Canada, Mexico,* and *the United States*. Central America and the Caribbean: *Jamaica*. South America: *Argentina, Brazil, Chile,* and *Uruguay*. Oceania: *Australia* and New Zealand (CABI, 2026).

The United States distribution includes California and numerous other states. Historical distribution records must be interpreted cautiously because many were based on morphology and broad host-based concepts that did not distinguish the host-specialized lineages now recognized within the *P. viciae* complex.

Official Control: *Peronospora viciae* on the USDA PCIT's harmful organism list for Brazil, Morocco, Panama, and the Republic of Korea (USDA PCIT, 2026). It is included on the EPPO's A1 list of regulated pests for Brazil (EPPO, 2026).

California Distribution: Colusa, Kern, Monterey, San Benito, Santa Barbara, Santa Clara, and Sutter counties (French, 1989). All CDFA PDR database records are from peas, not from fava beans.

California Interceptions: none

The risk that *Peronospora viciae* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** *Peronospora viciae* is established in California and is assumed to occur wherever suitable hosts can grow. Peas, fava beans, lentils, vetches, and related legumes are cultivated as vegetables, seed, forage, and cover crops. Cool-season production, winter rainfall, coastal humidity, and irrigation provide suitable conditions for infection and sporulation. Soilborne oospores permit survival through periods that are unsuitable for active disease.

Evaluate if the pest would have suitable hosts and climate to establish in California.

Score: **3**

- 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.**

2) **Known Pest Host Range:** The host range reported for *P. viciae* is concentrated in the Fabaceae and includes several cultivated genera, including *Pisum, Vicia, Lens,* and *Lathyrus*. The host family contains economically important vegetable, pulse, seed, forage, and cover crops. However, molecular evidence indicates that the traditional species includes strongly host-specialized lineages, and individual isolates may have substantially narrower host ranges.

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:** *Peronospora viciae* has high reproductive and dispersal potential. It produces numerous airborne sporangia during cool, humid conditions, and these propagules may disperse between fields or over long distances. Sexual oospores persist in soil and infested crop residues and can initiate systemic infection in later crops. The pathogen may also be moved with infested soil, crop residue, and infected plants.

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:** Downy mildew can reduce crop establishment, plant vigor, photosynthetic leaf area, pod number, seed yield, and marketability. Management may increase production costs through crop rotation, sanitation, resistant cultivars, changes in irrigation or field operations, field inspection, and fungicide applications. The pathogen is internationally regulated and can affect phytosanitary certification or access to seed markets.

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

Economic Impact: A, B, C, D

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: Susceptible legumes are widely grown as cover crops and in home and community gardens. However, no evidence was found that P. viciae significantly lowers biodiversity, disrupts natural communities, changes ecosystem processes, directly affects threatened or endangered species, or significantly affects ornamental plantings or home gardening at the population level.

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 *Peronospora viciae:* Medium

Add up the total score and include it here. **12**
-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.

Peronospora viciae is established in California and is assumed to occur statewide wherever suitable hosts are grown.

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 is 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* ***= 9***

Uncertainty:

The principal uncertainty concerns the taxonomic limits of *P. viciae*. Molecular studies indicate that the traditional broad species concept includes several host-specialized lineages, some of which may warrant recognition as separate species. Historical California host and geographic records are based solely on morphology and may therefore represent more than one taxon.

The current prevalence, pathotype composition, and economic effect of *P. viciae* in California are not well documented. Disease expression is highly dependent on host genotype, pathogen virulence, temperature, humidity, irrigation, and the timing of infection. The absence of symptoms under dry conditions does not necessarily indicate the absence of latent infection or soilborne oospores.

Mycelium and oospores have been observed in pea seed coats, but experimental evidence of transmission from pea seed to seedlings is lacking. The importance of seed contamination for other hosts within the broad *P. viciae* complex remains less certain.

Conclusion and Rating Justification:

Based on the evidence provided above, the proposed rating for ***Peronospora viciae*** **is C.**

References:

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***Comment Period: 08/31/2026 through 10/15/2026**

***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