**California Pest Rating Proposal for**

*Solanum carolinense* L., horsenettle, Carolina horsenettle, bull nettle

Family: Solanaceae

Pest Rating: B


Photo credit: James H. Miller and Ted Bodner. Southern Weed Science Society. Bugwood.org

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**Comment Period: 02/14/2023 through 03/31/2023**

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**Initiating Event:**

*Solanum carolinense* has been assigned a B-rating by the California Department of Food and Agriculture (CDFA), Plant Health and Pest Prevention Services. *Solanum carolinense* is designated as a noxious weed as defined by the California Food and Agricultural Code (FAC) Section 5004 and is listed in Title 3, California Code of Regulations (CCR), Section 4500. A pest rating proposal is required to evaluate its current rating and status in the state of California.

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**History & Status**

**General Description**

*Solanum carolinense* is an herbaceous perennial plant with an extensive, creeping system of rhizomes or horizontal roots and deeper vertical roots. Stems can reach approximately one meter in length, have conspicuous sharp prickles, and are angled at the nodes, forming a zig-zag pattern. Plants can have up to 20 stems in colonial patches and stems become woody with age. Leaves are alternate, oblong to oval, and have white hairs and scattered sharp prickles along the central vein on the lower surface. The leaf surface bears star-shaped hairs, most densely on the lower surface. Flowers occur in raceme-like clusters at the stem tips. Flowers are star-shaped, approximately three centimeters (cm) in diameter, and have five white to violet petals and five prominent central yellow anthers. The fruit is a globose berry up to approximately 2 cm in diameter that is initially green and becomes yellow and wrinkled at maturity. Each fruit contains numerous yellow to orangish-brown glossy and flattened ovoid seeds approximately 1.5-2.5 mm in length (DiTomaso and Healy, 2007; NC State University, Cooperative Extension Gardener Plant Toolbox, 2022; Solanaceae Source, 2022).

**Worldwide Distribution**

*Solanum carolinense* is native to the eastern and central United States including the states of Connecticut, Indiana, Massachusetts, Michigan, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Illinois, Iowa, Kansas, Minnesota, Nebraska, Oklahoma, New Mexico, Texas, South Dakota, Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and Wisconsin (USDA GRIN, 2022). It is also reported to be native in Canada in extreme southern Ontario and Quebec (Solanaceae Source, 2022) and perhaps in some areas of northern Mexico. It is considered naturalized elsewhere in North America, where it occurs sporadically in several states in the western half of the U.S. (Invasive Plant Atlas of the United States, 2022; USDA GRIN, 2022) and has been introduced into Europe, Asia, and the Pacific.

*Solanum carolinense* is reported to occur in the European countries of Austria, Germany, Italy, and the Netherlands, in Asia and the Pacific in the countries of Bangladesh, China, India, Japan, Nepal, South Korea, Australia, and New Zealand (EPPO, 2020) and has also been reported as introduced into Croatia, England, France, Georgia, Haiti, Moldova, Norway, Turkey, and Ukraine and transiently in Brazil (Solanaceae Source, 2022).

**Official Control:**

*Solanum carolinense* is listed on CCR Section 4500 as a noxious weed defined by California FAC Section 5004. The Department is mandated by California FAC, Division 1, Chapter 3, Section 403 to prevent the introduction and spread of noxious weeds. *Solanum carolinense* is also listed as a noxious weed in the states of Arizona, Hawaii, Michigan, Nevada, Indiana, and Alaska (NPB, 2022). The species is listed as a harmful organism subject to phytosanitary exclusion by the countries of Armenia, Azerbaijan, Belarus, Chile, China, Colombia, Georgia, India, Israel, Kazakhstan, Korea, Kyrgyzstan, Mexico, Moldova, Peru, the Russian Federation, Tajikistan, Thailand, Turkmenistan, Ukraine, and Uzbekistan (USDA PCIT, 2022).

*Solanum carolinense* is listed as a prohibited noxious weed seed in California defined by California FAC Section 52258. It is also listed as a prohibited noxious weed seed in the states of Alaska, Arizona, Colorado, Connecticut, Hawaii, Iowa, Michigan, New Jersey, Nevada, and South Dakota. The species is

listed as a restricted noxious weed seed subject to established tolerances in agricultural seed in Alabama, Arkansas, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Nebraska, New Hampshire, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, and West Virginia (USDA AMS, 2022).

**California Distribution:**
*Solanum carolinense* has been collected with vouchered specimens from scattered localities in coastal counties of southern California and the San Francisco Bay Area, in the Central Valley, and in foothills of the Sierra Nevada (CCH, 2022). The CalFlora Database (2022) contains records of *Solanum carolinense* from Orange, Los Angeles, Ventura, Alameda, and Sonoma counties in coastal California, Fresno, Merced, San Joaquin, Yolo, Yuba, Butte, Glenn, and Shasta counties in the Central Valley, and Amador, El Dorado, Placer, and Nevada counties in the Sierra Nevada, and one record from Riverside County in inland southern California.

**California Interceptions**:
*Solanum carolinense* has been intercepted at the CDFA Needles Border Protection Station as a contaminant of hay bales being transported into California from Mississippi (CDFA, Pest and Damage Record Database, 2022).

**Consequences of Introduction**

***1)*** **Climate/Host Interaction:** Score is **High (3)**
*Solanum carolinense* prefers full sun and is tolerant of both wet and dry conditions. *Solanum carolinense* can grow in sandy, gravelly, or loamy soils and can become weedy and aggressive in disturbed sites. *Solanum carolinense* grows in grain and vegetable fields, orchards, pastures and nurseries. It can grow on roadsides, in waste areas, riverbanks and in gardens. Above ground portions of the plant of *Solanum carolinense* die back when exposed to freezing temperatures, and the entire plant may be killed by prolonged freezing (Bassett and Munro, 1986; DiTomaso and Healy, 2007).

-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:** Score is **High (3)**
*Solanum carolinense* can occur wherever general ecological conditions exist that are conducive to its survival.
- Low (1) has a very limited host range
- Medium (2) has a moderate host range
**- High (3) has a wide host range**

**3)** **Pest Dispersal Potential:** Score is **High (3)**
*Solanum carolinense* reproduces by seed and grows vegetatively by vertical and horizontal roots. Bassett and Munro (1986) report that each berry of *Solanum carolinense* can produce 40-170 seeds and a single plant can produce up to 5000 seeds. Studies have shown that seeds of *Solanum carolinense* can remain viable after passing through the digestive tract of calves (Oswald, 1908) and

that seeds can remain dormant in laboratory conditions for at least seven years (Bassett and Munro, 1986). The berries or seeds can be spread by birds or other animals and as a contaminant of agricultural seed lots and commodities such as hay.

Ilnicki *et al.* (1962) found that *Solanum carolinense* horizonal roots could spread up to one meter from the parent plant, then form new plants via development of new vertical roots and shoots. Root fragments as small as two mm have been found to be able to form new plants. Root fragments can survive desiccation and can be moved in soil or on agricultural equipment (Bassett and Munro (1986).

- 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:** Score is **High (3)**

In eastern and southeastern states, *Solanum carolinense* is frequently associated in fields planted in corn, alfalfa, potatoes, and tomatoes (Bassett and Munro, 1986). *Solanum carolinense* is a reported host for the plant pathogens *Septoria lycopersici,* which causes leafspot of tomato, *Verticillium albo-atrum*, which causes Verticillium wilt of eggplant, and mosaic viruses, which cause potato and tomato mosaic (DiTomaso and Healy, 2007; Ilnicki et al., 1962). Ilnicki et al. (1962) also reported that *Solanum carolinense* is a host for the insects *Paratrioza cockerelli*, which transmits psyllid yellows disease to potatoes and tomatoes, *Epitrix* sp. (potato flea beetles), *Leptinotarsa decemlineata* (Colorado potato beetle), *Trichobaris trinotata* (potato stalk borer), *Thrips tobaci* (onion thrips), and *Tetranychus telarius* (greenhouse red spider mite).

In 2019, California sweet corn was valued at $172 million and corn for grain production was valued at $46 million. Corn for silage was valued at $536 million in 2018. In 2018, approximately 400,000 acres of corn (for all purposes) was planted in California. The majority of California corn is produced in the Sacramento and San Joaquin valleys. Sweet corn is also produced in Imperial, Fresno, Contra Costa, Riverside, and Santa Clara counties (CDFA, Agricultural Statistics Review, 2020).

In 2019, California tomatoes, both processing and fresh, were valued at almost $1.2 billion. Tomatoes were planted on over 247,000 acres statewide, with most of the acreage in Fresno, Merced, Santa Barbara, Kings, Kern, Yolo, Fresno, San Joaquin, and San Benito counties (CDFA, Agricultural Statistics Review, 2020).

In 2019, California potatoes were valued at over $300 million. Potatoes were planted on over 42,000 acres statewide, with most of the acreage in Kern, San Joaquin, Modoc, Siskiyou, and Imperial counties (CDFA, Agricultural Statistics Review, 2020).

*Solanum carolinense* is toxic to humans and livestock such as cattle and sheep due to the accumulation of the alkaloid solanine in the plant tissue, especially berries (Bassett and Munro, 1986; Kingsbury, 1964). The solanine content of the foliage and berries increases substantially with maturation of the plant, and the dried berries are often implicated in poisoning. Symptoms of solanine poisoning in cattle include impaired vision, fast and weak heartbeat, jaundice, trembling, unsteadiness, hyperactivity, depression, coma and sometimes death. In calves, symptoms can

include edema, oozing of fluids from membranes, and rapid emaciation (UC ANR Publication, 2010).

In 2019, cattle, calves, sheep, and lamb production in California was valued at approximately $3.6 million dollars. The top five cattle and calf producing counties in California in 2019 were Tulare, Imperial, Fresno, Merced, and Kern. The top five sheep producing counties in California in 2019 were Fresno, Kern, Sonoma, Solano, and Merced (CDFA, Agricultural Statistics Review, 2020).

Shipments, including agricultural seed, that are found infested with *Solanum carolinense* are subject to rejection, treatment, reconditioning, or destruction, typically at the owner's expense.

**A. The pest could lower crop yield.**
**B. The pest could lower crop value (includes increasing crop production costs).**
**C. The pest could trigger the loss of markets (includes 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:
- 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:** Score is **Medium (2)**

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:
- 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 *Solanum carolinense* **High (14)**

Low = 5-8 points
**Medium = 9-12 points**
High = 13-15 points

**1) Post Entry Distribution and Survey Information**: Score is **Medium (-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) Final Score: Medium (14-2=12)**

**Conclusion and Rating Justification:**
Due to the economic impacts of *Solanum carolinense* on California's agricultural industry, including the rejection of infested agricultural seed shipments and toxicity to livestock, a B-rating is recommended.

**Uncertainty**

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**Responsible Party:** Robert Price, Primary State Botanist; California Department of Food and Agriculture; Seed Laboratory and Herbarium; 3294 Meadowview Road, Sacramento, CA 95832; (916) 738-6700; permits@cdfa.ca.gov.

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***Comment Period: 02/14/2023 through 03/31/2023**

***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.

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**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.

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**Pest Rating: B**

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