EPPO Datasheet: *Comstockaspis perniciosa*

Last updated: 2023-10-26

IDENTITY

Preferred name: *Comstockaspis perniciosa*
Authority: (Comstock)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Hemiptera: Sternorrhyncha: Diaspididae
Other scientific names: *Aonidiella perniciosa* (Comstock), *Aspidiotus perniciosus* Comstock, *Diaspidiotus perniciosus* (Comstock), *Quadraspidiotus perniciosus* (Comstock)
Common names: Californian scale, San José scale, pernicious scale
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EPPO Categorization: A2 list
view more categorizations online...
EU Categorization: RNQP (Annex IV)
EPPO Code: QUADPE

more photos...

Notes on taxonomy and nomenclature

The classification of *Comstockaspis perniciosa* has changed over the years. Danzig (1993) placed it in the genus *Diaspidiotus*, Kosztarab (1996) in *Quadraspidiotus* and Normark *et al*. (2014) in *Comstockaspis*.

HOSTS

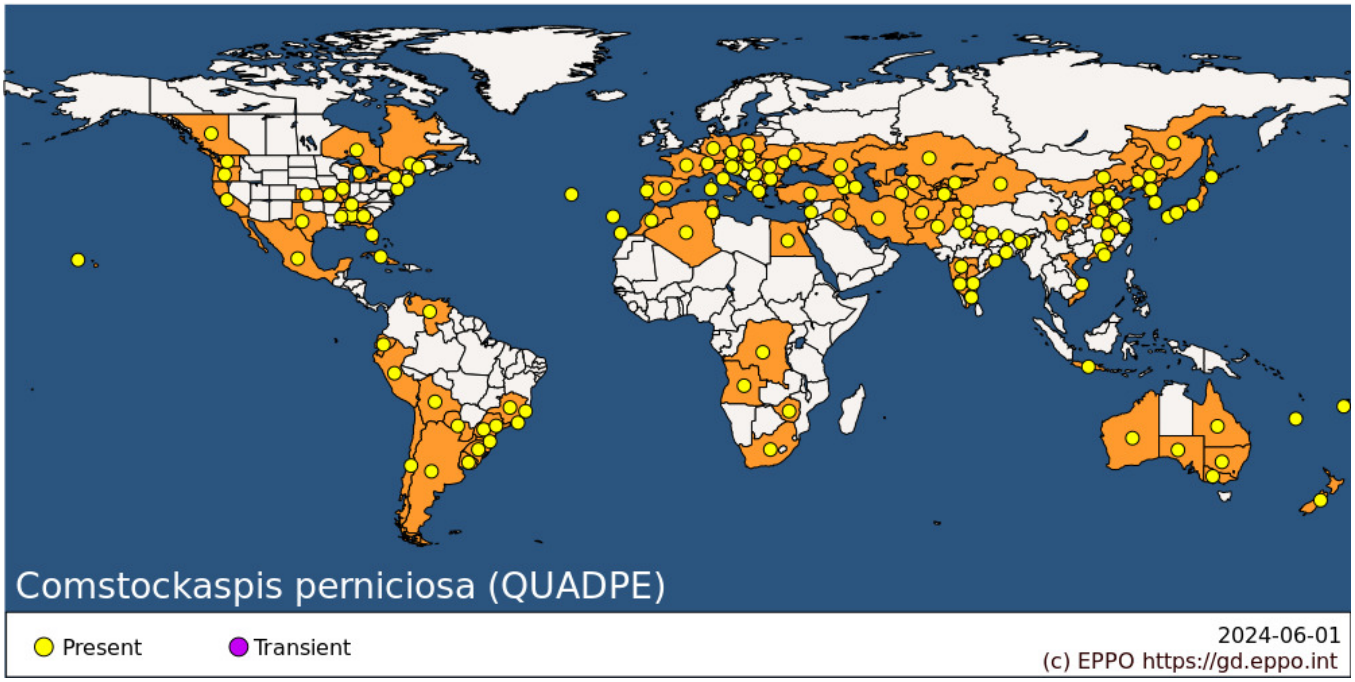
The main hosts belong to the Rosaceae family: apples, peaches, pears, plums and *Rubus*. *C. perniciosa* has also been reported in Chile on kiwifruits (Gonzalez, 1989). Its hosts include plants from over than 40 botanical families and about 80 genera, including: *Acacia*, *Acer*, *Amelanchier*, *Chaenomeles*, *Cotoneaster*, *Crataegus*, *Cydonia*, *Euonymus*, *Fagus*, *Juglans*, *Ligustrum*, *Maclura*, *Malus*, *Populus*, *Prunus*, *Ptelea*, *Pyrus*, *Ribes*, *Rosa*, *Salix*, *Sorbus*, *Symphoricarpos*, *Syringa*, *Tilia* and *Ulmus*. These host plants are widely cultivated throughout the EPPO region as fruit crops and ornamentals.

Host list: *Acacia sp.*, *Acer campestre*, *Acer japonicum*, *Acer negundo*, *Acer platanoides*, *Acer saccharinum*, *Actinidia chinensis*, *Actinidia deliciosa*, *Aesculus hippocastanum*, *Akebia quinata*, *Akebia sp.*, *Alnus nepalensis*, *Alnus nitida*, *Alnus sp.*, *Aloe sp.*, *Amelanchier canadensis*, *Aronia melanocarpa*, *Betula pendula*, *Betula pubescens*, *Buxus sp.*, *Camellia sinensis*, *Camellia sp.*, *Canna indica*, *Cannabis sativa*, *Carpinus betulus*, *Carya glabra*, *Castanea crenata*, *Castanea dentata*, *Castanea sativa*, *Catalpa bignonioides*, *Ceanothus sp.*, *Cercidiphyllum japonicum*, *Chaenomeles japonica*, *Chaenomeles lagenaria*, *Citrullus lanatus*, *Citrus sp.*, *Citrus trifoliata*, *Citrus x aurantium var. unshiu*, *Cornus alba*, *Cornus sanguinea*, *Cornus sericea f. baileyi*, *Corylus avellana*, *Corylus maxima* , *Cotoneaster integerrimus*, *Cotoneaster microphyllus*, *Cotoneaster niger*, *Cotoneaster sp.*, *Crataegus coccinea*, *Crataegus crus-galli*, *Crataegus marshallii*, *Crataegus monogyna*, *Crataegus orientalis*, *Crataegus phaenopyrum*, *Crataegus rhipidophylla*, *Crataegus sp.*, *Cydonia oblonga*, *Diospyros kaki*, *Elaeagnus sp.*, *Eriobotrya japonica*, *Eucalyptus populnea*, *Eucalyptus sp.*, *Fagus sylvatica*, *Fraxinus excelsior*, *Fraxinus sp.*, *Gleditsia triacanthos*, *Hedera sp.*, *Hibiscus sp.*, *Hippophae rhamnoides*, *Hypericum sp.*, *Juglans ailanthifolia*, *Juglans regia*, *Juglans sp.*, *Ligustrum vulgare*, *Maclura pomifera*, *Malus asiatica*, *Malus baccata*, *Malus domestica*, *Malus sylvestris*, *Nerium sp.* , *Nyssa sp.*, *Olea europaea*, *Olea sp.*, *Osmanthus heterophyllus*, *Persea sp.*, *Photinia sp.*, *Pinus sp.*, *Pittosporum heterophyllum*, *Platanus sp.*, *Populus alba*, *Populus deltoides*, *Populus euphratica*, *Populus nigra var. italica*, *Populus nigra*, *Populus sp.*, *Populus tremula*, *Populus x canadensis*, *Prunus armeniaca*, *Prunus avium*, *Prunus caroliniana*, *Prunus cerasifera var. divaricata*, *Prunus cerasifera*, *Prunus cerasus*, *Prunus domestica*, *Prunus dulcis*, *Prunus hortulana*, *Prunus japonica*, *Prunus laurocerasus*, *Prunus mahaleb*, *Prunus mandshurica*, *Prunus maritima*, *Prunus padus*, *Prunus persica*, *Prunus pumila*, *Prunus salicina*, *Prunus serotina*, *Prunus serrulata*, *Prunus sp.*, *Prunus spinosa*, *Prunus virginiana*, *Prunus x yedoensis*, *Pseudocydonia sinensis*, *Ptelea sp.*, *Ptelea trifoliata*, *Pterocarya fraxinifolia*, *Pyracantha coccinea*, *Pyracantha rogersiana*, *Pyracantha sp.*, *Pyrus communis*, *Pyrus pyrifolia*

, Pyrus sp., Pyrus ussuriensis, Quercus hartwissiana, Quercus marilandica, Quercus robur, Quercus serrata, Quercus sp., Rhododendron sp., Ribes aureum, Ribes nigrum, Ribes oxyacanthoides, Ribes rubrum, Ribes sp., Robinia pseudoacacia, Rosa bracteata, Rosa carolina, Rosa multiflora, Rosa rugosa, Rosa sp., Rosa virginiana, Salix acutifolia, Salix alba subsp. vitellina, Salix alba, Salix babylonica, Salix candida, Salix caprea, Salix discolor, Salix eleagnos, Salix humilis, Salix lucida, Salix pentandra, Salix repens, Salix sp., Sambucus sp., Simethis sp., Sorbus americana, Sorbus aria, Sorbus aucuparia, Sorbus domestica, Sorbus sp., Spartium junceum, Stevia triflora, Symphoricarpos albus, Symphoricarpos sp., Syringa persica, Syringa reticulata var. mandschurica, Syringa reticulata, Syringa vulgaris, Tamarix sp., Tilia americana, Tilia platyphyllos, Tilia sp., Ulmus americana, Ulmus glabra, Ulmus minor, Ulmus procera, Ulmus sp., Vernicia fordii, Viburnum lantana, Vitis sp., Vitis vinifera

GEOGRAPHICAL DISTRIBUTION

C. perniciosa is indigenous to Eastern Asia and has spread to many parts of the world: from China to Egypt, the Mediterranean Basin and North America, where it was first discovered in 1873 in California. At present, it is widely distributed in the Palearctic and Nearctic regions, being recorded in more than 60 countries in North and South America, Europe, southern Africa, Asia and Oceania.



EPPO Region: Albania, Algeria, Armenia, Austria, Azerbaijan, Bulgaria, Croatia, Czech Republic, France (mainland), Georgia, Germany, Greece (mainland), Hungary, Italy (mainland, Sardegna), Kazakhstan, Kyrgyzstan, Moldova, Morocco, Poland, Portugal (mainland, Azores, Madeira), Romania, Russia (Far East, Southern Russia), Serbia, Slovakia, Slovenia, Spain (mainland, Islas Canárias), Switzerland, Tunisia, Türkiye, Ukraine, Uzbekistan
Africa: Algeria, Angola, Congo, Democratic republic of the, Egypt, Morocco, South Africa, Tunisia, Zimbabwe
Asia: Afghanistan, China (Anhui, Guangdong, Hebei, Heilongjiang, Henan, Hubei, Jiangxi, Jilin, Liaoning, Neimenggu, Shandong, Shanxi, Sichuan, Xianggang (Hong Kong), Xinjiang, Zhejiang), India (Andhra Pradesh, Assam, Delhi, Himachal Pradesh, Jammu & Kashmir, Karnataka, Maharashtra, Meghalaya, Odisha, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal), Indonesia (Java), Iran, Iraq, Japan (Hokkaido, Honshu, Kyushu, Shikoku), Kazakhstan, Korea Dem. People's Republic, Korea, Republic, Kyrgyzstan, Lebanon, Nepal, Pakistan, Tajikistan, Turkmenistan, Uzbekistan, Vietnam
North America: Canada (British Columbia, Ontario, Québec), Mexico, United States of America (Alabama, California, Florida, Georgia, Hawaii, Illinois, Kansas, Maine, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, Oregon, Tennessee, Texas, Washington)
Central America and Caribbean: Cuba
South America: Argentina, Bolivia, Brazil (Espirito Santo, Minas Gerais, Parana, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, Sao Paulo), Chile, Ecuador, Paraguay, Peru, Uruguay, Venezuela
Oceania: Australia (New South Wales, Queensland, South Australia, Victoria, Western Australia), Fiji, New

Caledonia, New Zealand

BIOLOGY

Most individuals of *C. perniciosa* overwinter as 1st instar-nymphs (‘black cap’ nymphs), and a few as gravid adult females. All other stages perish in winter, except in areas with very warm climates. First instar-nymphs are very cold resistant, and about 20% have been reported to withstand long periods at -30°C. The threshold temperature for the development of 1st instar-nymphs is around 9-10°C, although development at this temperature is extremely slow. Hibernation is broken in February to March (in Northern Hemisphere) when the nymph quickly moults, giving rise to the 2nd instar. At this point, the sexes can be distinguished, since the female scale cover remains round, while male scales take on an elongated shape. The female undergoes three stages and two moults (first- and second-instar nymphs and the adult), while the male undergoes five stages and four moults (first- and second-instar larvae, the pronymph, nymph and adult). For males, the 2nd stage lasts 10-12 days and is terminated by the 2nd moult, giving rise to a prepupal stage. A 3rd moult follows after another 6-10 days, giving the pupal stage, followed by a 4th moult 4-5 days later, from which winged males, lacking mouthparts, emerge. For females, after the 2nd moult they reach the adult stage and, as they mature, they gradually increase in size until the scale cover reaches about 2 mm in diameter; they remain stationary, feeding. Adult males, which have limited flight ability, are mostly carried by wind currents and can also attach to birds, insects, or other animals and be spread by them. They mate with the females, which are not parthenogenetic. Females are viviparous, and 30-40 days after copulation (end of May to mid-June) they give birth to 50-400 larvae over a period of 6 to 8 weeks. First-instar nymphs, also called crawlers (mobile stage), emerge within 1-2 min and crawl within a further 2 min to 24 h, to infest new host tissue. Concerning females, only this stage is capable of dispersing and colonising new areas. Crawlers can also be dispersed by wind, birds, other insects, or machinery. Once a suitable location is found, the crawler fixes itself to the host by deeply implanting its rostrum into the host tissue. This is the most vulnerable stage in the life cycle and mortality rates are high. Once attached, the crawlers form the scale cover. This secretion is initially white (white cap nymph), but becomes grey and then black (black cap nymph). The *C. perniciosa* cover is initiated by the first-instar larva as a filament secreted by integumentary glands. Loose material is glued together with liquid from the anal opening, and felted and shaped by movements of the insect beneath. The liquid hardens soon after contact with the air. At each moult, the cast exuviae are incorporated into the cover by addition of material to its margins.

C. perniciosa has 1-5 generations per year in different parts of the world. In Central Europe, the adults appear at the end of April and May, and in Northern Europe 1 or 2 months later. The crawlers continue to appear for 1-2 months. There are usually two complete generations per year in Central Europe (Czech Republic, Hungary and Poland), two generations and a partial one in Switzerland, three to four in more southern areas, and only one in the more northerly parts of the EPPO region. The development time of one generation depends on weather conditions, mainly on temperatures. The total life cycle is completed within 60, 42 and 30 days at 20-21°C, 25-26°C and 31-32°C, respectively. At 31-32°C, marked mortality of 1st and 2nd instar larvae occurs while, at 39-40°C, normal larval development ceases. A large proportion of the 2nd generation nymphs, born at the end of July to beginning of August, enter into diapause at the black scale stage and overwinter in this form. Temperatures below 25°C are reported to induce extended diapause. In general, in the field, high temperatures and low humidity lead to high mortality, while light rainfall and warm weather (25-30°C) favour population increase. Heavy rainfall washes very young nymphs off the leaves. The degree-day accumulation method can be used to predict the appearance of subsequent developmental stages. The low temperature threshold in many studies was set at 10.5 °C or 10.6 °C, however, other values were also reported, e.g., 7.3 °C and 10 °C. For the 1st generation nymphs, the development temperature sum (>7.3°C) is less than 500 degree-days (°C); for the 2nd generation, the temperature sum is 770 degree-days (°C).

For further information, see also Vasseur & Schvester (1957), Gentile & Summers (1958), Mathys & Stahl (1964), Freitas (1966; 1975), Huba (1969), Kosztarab & Kozar (1988), Rychla (2014), Golan (2020), Golan *et al.* (2023).

DETECTION AND IDENTIFICATION

Symptoms

C. perniciosa feeds on plant sap. All surface parts of young host plant tissue can be infested. Attacks generally take

place on the bark but, in severe infestations, leaves and fruits may also be affected. Within 24 h of the nymph attaching itself to the plant, a characteristic violet-red halo appears around the insect rostrum inserted in host plant tissues. Haloes increase in size as the nymphs mature and may coalesce. The red cortical tissue swells with accumulating sap. This red coloration is not specific to *C. perniciosa*; it has also been reported on *Ligustrum* infested by *Diaspidiotus ostreaeformis*. Bark often cracks and exudes gum, resulting in a dark-brown gelatinous area surrounding the area where the nymph is attached. Heavy infestation causes cessation of growth and loss of yield. Uncontrolled infestation can kill young trees within 2 to 3 years.

Morphology

Positive identification of *C. perniciosa* requires microscopic observation, in particular of the female pygidium. The most important feature that distinguishes this species from similar armored scale insects e.g. *D. ostreaeformis, D. marani* or *D. pyri* is the lack of perivulvar pores on the body of adult females (Kosztarab & Kozar, 1988; Golan, 2020).

Larva

First instar nymphs include three successive forms: crawlers – mobile, about 0.3 mm long, yellowish, oval, with three pairs of legs, antennae, and simple eyes; scale covering white or black. Second instar nymphs have a grey cover; round to elongated depending on their sex. The scale of the female is circular, slightly convex, exuviae subcentral. The scale of the male is slightly elongate, exuviae toward one end.

Adult

Female: the adult female is circular, slightly convex, grey and about 1.5-2.2 mm in diameter, exuviae central or subcentral. Removing the scale reveals the pyriform insect body which bears characteristic ornamentations on the posterior part (pygidium). These consist of two pairs of lobes (one median and one lateral) and three short, largely spaced (exterior, lateral and median) combs. There are no glands around the vulva.

Male: the adult male only has forewings, the hind pair being reduced to slender halteres linked to the wing bases by hooklets; mouthparts are absent. The characteristic dark band across the back (dorsum) differentiates them from other species of Diaspididae.

For further information, see also Bustshik (1958), Mathys & Stahl (1964), Boehm (1972), Stoetzel & Davidson (1974), Geoffrion (1976), Kosztarab & Kozar (1988); Kozar *et al*. (1996).

Detection and inspection methods

C. perniciosa can be detected on twigs and branches as greyish scales during pruning, and on fruits during harvest or packing. The observation of red spots on the fruits can also indicate the presence of *C. perniciosa*. Scouting trees during the dormant period can detect infested plants and determine the level of infestation. Common monitoring methods used to look for crawlers and immobile instars on twigs, leaves and fruits involve a magnifying glass or stereomicroscope and sticky tape traps to evaluate crawler activity and density. Pheromone traps are commonly used to determine the time of first male captures. Assessing the numbers of *C. perniciosa* allows an estimate to be made of the degree of orchard infestation, to inform decisions about the timing of pesticide applications and can provide feedback on the efficacy of applied treatments.

PATHWAYS FOR MOVEMENT

The 1st instar crawlers are the main dispersal phase but are not normally carried more than a few kilometres by the wind. Crawlers mainly move vertically on the tree and are active for several hours after emergence covering distances of up to 3 m, but often settle within 1 m of their sessile mother. Although males have some flying ability and can be carried by wind, females are not dispersed in this way. International spread is liable to occur through human transport of planting material of host trees and shrubs, or fruits.

PEST SIGNIFICANCE

Economic impact

Since 1873, when *C. perniciosa* was discovered in California (USA), it has been considered to have become the most serious pest of fruit trees in Europe and several other countries in the world. In Europe, the population of *C. perniciosa* started to gradually increase at the end of the 1990s. Its expansion is greatly influenced by the progressing warming, the cumulative occurrence of host plants, as well as removal of non-selective pesticides in integrated pest management programmes. *C. perniciosa* damages trees by injecting toxic saliva and, in the absence of control, young apple and pear trees, for example, can be killed within 2-3 years. Fruit quality and marketability are greatly reduced by scale attacks. In the EPPO region, the San José scale is currently of significant economic importance in Bulgaria, Hungary, Italy, Moldova, Portugal, Russia, Spain, Türkiye, Ukraine, and since 2015 in Poland. In the Far East, where the scale is indigenous and has only one generation per year, it causes little harm. Detailed information about its distribution and importance in different parts of the word can be found in many local publications. Studies on pears in Oregon (USA) indicated that an infestation level of 1% infested spurs in late April or 4% in July would result in harvest damage in excess of 2% infested fruit, the latter being about the maximum tolerable economic loss for the scale on pears (Westigard & Calvin, 1977). Studies conducted in Portugal (Torres *et al.*, 2001) demonstrated that pre-bloom sprays reduced damage by *C. perniciosa* from 19% to 29%, while with post-bloom sprays, the lower level of infestation obtained was of 61%.

Control

In orchards, chemical control can be achieved with applications of mineral oils or mixtures of mineral oils with pesticides at the end of the dormant season against the overwintering stages, and with applications of pesticides targeting crawlers during the growing season. The registration and use of pesticides can vary significantly from one region to another, and it is essential to consult the national list of registered pesticides or the relevant authorities to determine which products may be used in a particular country. For summer treatments, sex pheromone traps can be used to monitor the level of male adults, and therefore to determine the timing of applications. To control emerging crawlers, insecticide sprays should be synchronized with the crawler activity. The latter can be determined based on degree-day timing model or crawler catch on two-sided sticky tape traps wrapped around branches. Both pre-bloom and post-bloom applications against crawlers are necessary to protect fruits adequately. Several applications of insecticides are often needed during the first generation of crawler activity to reduce damage. The most effective control is obtained by applying two sprays against each crawler generation, one at the beginning and another 10 to14 days later. Good pruning practices can help to reduce spring and summer populations of *C. perniciosa* and allow better spray coverage in treetops. Biological control with the hymenopteran parasitoid *Encarsia perniciosi* (Hymenoptera: Aphelinidae) has also been used in orchards and private gardens. Surrounding infested vegetation can be a source for re-infestation of orchards and tree plantations, however it can also be a refuge for natural enemies.

Phytosanitary risk

Many abiotic and biotic factors affect the spread and rate of development of *C. perniciosa*, but temperature seems to be the most relevant. In more northern zones, the San José scale can be present, but is not likely to cause much damage, as its reproductive potential and development are much reduced at low temperatures (Gentile & Summers, 1958). The main risk remains to countries in Europe, where the species is absent or has a limited distribution at present. *C. perniciosa* is a polyphagous pest which can attack crops of economic importance (e.g. fruit trees). Severe infestations may lead to economic crop losses, as well as losses in market access.

PHYTOSANITARY MEASURES

Many countries have specific regulations against *C. perniciosa*. It had been the object of quarantine regulations in the European Union, however in the past few years due to its spread over most of the EU Member States, *C. perniciosa* is a regulated non-quarantine pest (RNQP), as it is still important to prevent its spread on plants for planting. Countries may prohibit importation of plants for planting (of host plants) from areas where the pest occurs during specified periods, as for example in summer, when treatment is not suitable because of the risk of phytotoxicity. Countries may require that consignments come from a field found to be free from *C. perniciosa* during the last two growing seasons and may also require appropriate treatment of the consignment. However, under certain

conditions, countries may accept a tolerance for this pest on fruits.

Cold storage of apple consignments in standard or controlled-atmosphere storage for at least 4 months resulted in over 90% mortality of the scale insects in the overwintering stage and loss of vigour and complete loss of reproductive capacity in surviving individuals transferred to a temperature of 22°C (Dickler, 1976).

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Datasheet history

This datasheet was first published in the EPPO Bulletin in 1981 and revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 1997, as well as in 2023. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', ‘Hosts’, and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

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