

EPPO Datasheet: *Lycorma delicatula*

Last updated: 2021-10-05

IDENTITY

Preferred name: *Lycorma delicatula*

Authority: (White)

Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta:
Hemiptera: Auchenorrhyncha: Fulgoridae

Other scientific names: *Aphaena delicatula* White

Common names: Chinese blistering cicada (US), spot clothing wax cicada, spotted lanternfly (US)

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EPPO Categorization: A1 list, Alert list (formerly)

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EU Categorization: A1 Quarantine pest (Annex II A)

EPPO Code: LYCMDE



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HOSTS

The wide reported host range of *Lycorma delicatula* (spotted lanternfly) is due to a combination of polyphagous feeding early in its development as well as literature listing egg laying substrates as hosts (Barringer and Ciafre, 2020). Herbaceous plants make up a large portion of the feeding hosts for early instars, but this lessens for larger instars and adults. Woody hosts can be utilized by all life stages, but more feeding sites become available during development as larger mouthparts allow access to thicker tissues on branches and trunks.

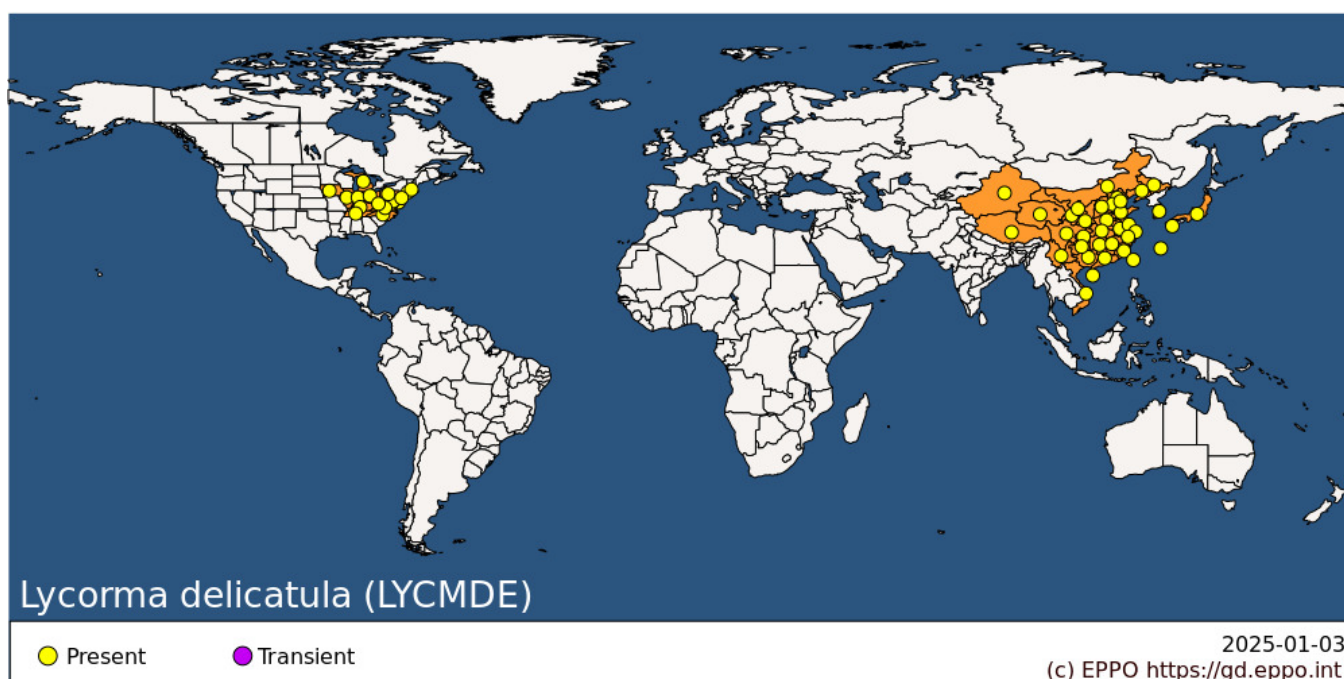
Certain hosts such as *Ailanthus altissima*, *Juglans*, *Acer*, *Vitis*, and *Salix* are strongly preferred by *L. delicatula* and can support populations all year-round. A distinction should be made when evaluating hosts records for *L. delicatula* as distinctions in the literature are not always clear between feeding hosts and egg oviposition hosts (Barringer and Ciafre, 2020).

Host list: *Acacia* sp., *Acer buergerianum*, *Acer negundo*, *Acer palmatum*, *Acer pictum* subsp. *mono*, *Acer platanoides*, *Acer pseudoplatanus*, *Acer rubrum*, *Acer saccharinum*, *Acer saccharum*, *Actinidia chinensis*, *Ailanthus altissima*, *Albizia julibrissin*, *Alcea rosea*, *Alcea* sp., *Alliaria petiolata*, *Alnus hirsuta*, *Alnus incana*, *Amelanchier canadensis*, *Amelanchier* sp., *Angelica dahurica*, *Aralia cordata*, *Aralia elata*, *Arctium lappa*, *Armoracia rusticana*, *Betula alleghaniensis*, *Betula lenta*, *Betula nigra*, *Betula papyrifera*, *Betula pendula*, *Betula platyphylla*, *Broussonetia papyrifera*, *Brucea javanica*, *Buxus microphylla*, *Buxus sinica*, *Callistephus chinensis*, *Camellia sinensis*, *Cannabis sativa*, *Carpinus caroliniana*, *Carya glabra*, *Carya ovata*, *Castanea crenata*, *Catalpa bungei*, *Cedrela fissilis*, *Celastrus orbiculatus*, *Celtis occidentalis*, *Cercis canadensis*, *Chamerion angustifolium*, *Colutea arborescens*, *Cornus controversa*, *Cornus florida*, *Cornus kousa*, *Cornus officinalis*, *Cornus* sp., *Corylus americana*, *Crataegus viridis*, *Cynanchum rostellatum*, *Diospyros kaki*, *Elaeagnus umbellata*, *Euphorbia pulcherrima*, *Fagus grandifolia*, *Ficus carica*, *Firmiana simplex*, *Forsythia* sp., *Fraxinus americana*, *Fraxinus* sp., *Gleditsia triacanthos*, *Glycine max*, *Hibiscus* sp., *Humulus lupulus*, *Humulus scandens*, *Juglans cinerea*, *Juglans hindsii*, *Juglans major*, *Juglans mandshurica*, *Juglans microcarpa*, *Juglans nigra*, *Juglans regia* var. *orientis*, *Juglans* sp., *Juniperus chinensis*, *Ligustrum lucidum*, *Lindera benzoin*, *Liquidambar styraciflua*, *Liriodendron tulipifera*, *Lonicera japonica*, *Lonicera* sp., *Luffa* sp., *Maackia amurensis*, *Magnolia kobus*, *Magnolia obovata*, *Mallotus japonicus*, *Malus domestica*, *Malus* sp., *Malus spectabilis*, *Melia azedarach*, *Monarda* sp., *Morus alba*, *Morus bombycis*, *Nicotiana* sp., *Nyssa sylvatica*, *Ocimum basilicum*, *Osmanthus* sp., *Ostrya virginiana*, *Parthenocissus quinquefolia*, *Paulownia kawakamii*, *Paulownia tomentosa*, *Phellodendron amurense*, *Philadelphus schrenkii*, *Phyllostachys heterocycla*, *Picrasma quassioides*, *Pinus strobus*, *Platanus occidentalis*, *Platanus orientalis*, *Platanus x hispanica*, *Platycarya strobilacea*, *Platyclusus orientalis*, *Populus alba*, *Populus grandidentata*, *Populus koreana*, *Populus simonii*, *Populus tomentosa*, *Prunus armeniaca*, *Prunus avium*, *Prunus cerasus*, *Prunus mume*, *Prunus persica*, *Prunus salicina*, *Prunus serotina*, *Prunus serrulata* var. *spontanea*, *Prunus serrulata*, *Prunus x yedoensis*, *Pseudocydonia sinensis*, *Pterocarya stenoptera*, *Punica granatum*, *Pyrus* sp., *Quercus acutissima*, *Quercus aliena*

, *Quercus prinus*, *Quercus rubra*, *Quercus sp.*, *Rhus chinensis*, *Rhus typhina*, *Robinia pseudoacacia*, *Rosa multiflora*, *Rosa rugosa*, *Rosa sp.*, *Rubus crataegifolius*, *Rubus sp.*, *Salix babylonica*, *Salix pierotii*, *Salix sp.*, *Salix udensis*, *Salvia sp.*, *Sassafras albidum*, *Sorbaria sorbifolia*, *Sorbus commixta*, *Styphnolobium japonicum*, *Styrax japonicus*, *Styrax obassia*, *Syringa vulgaris*, *Tamarix chinensis*, *Tetradium daniellii*, *Tetradium sp.*, *Thuja occidentalis*, *Tilia americana*, *Toona sinensis*, *Toxicodendron radicans*, *Toxicodendron vernicifluum*, *Ulmus pumila*, *Ulmus rubra*, *Ulmus sp.*, *Vaccinium angustifolium*, *Viburnum prunifolium*, *Vitis aestivalis*, *Vitis amurensis*, *Vitis labrusca*, *Vitis riparia*, *Vitis sp.*, *Vitis vinifera*, *Zanthoxylum bungeanum*, *Zelkova serrata*

GEOGRAPHICAL DISTRIBUTION

Lycorma delicatula is an Old World tropical species native primarily to China and South-East Asia. *L. delicatula* introductions were detected in other countries starting with the Republic of Korea in 2004 (Kim and Kim, 2005, Han *et al.*, 2008) where it is now widespread, and Japan in 2008 where its distribution is limited (Kim *et al.*, 2013; Han *et al.*, 2008; Lee *et al.*, 2019). The first populations in the United States were detected in 2014 in the state of Pennsylvania (Barringer *et al.*, 2014). Since then, it has spread through the northeast Mid-Atlantic region of the United States via natural dispersal mechanisms and human assisted transportation.



Asia: China (Anhui, Beijing, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Neimenggu, Ningxia, Qinghai, Shaanxi, Shandong, Shanghai, Shanxi, Sichuan, Tianjin, Xinjiang, Xizhang, Yunnan, Zhejiang), Japan (Honshu, Kyushu, Ryukyu Archipelago), Korea, Republic, Taiwan, Vietnam

North America: United States of America (Connecticut, Delaware, District of Columbia, Illinois, Indiana, Iowa, Kentucky, Maryland, Massachusetts, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia)

BIOLOGY

Lycorma delicatula is a univoltine species that overwinters as egg masses in both its native and introduced ranges. These cryptic egg masses are laid on or near suitable hosts and can often be found on inanimate substrates or non-host material. Egg masses are covered with a waxy exudate secreted by the female which helps to protect against desiccation and acts to camouflage the egg mass by masking its appearance with a mud like covering. Nymphs hatch in the spring and disperse into the environment, exhibiting a cyclic behaviour of dropping off hosts and climbing up nearby new hosts or structures (Kim *et al.*, 2011).

The host range of *L. delicatula* during the nymphal stage is the broadest, including many herbaceous species though these hosts become decreasingly preferred as the instar mature and effectively obsolete during adulthood. The smaller plants are unable to support the feeding demand of the larger life stages. Early instars, 1st to the 3rd, are black with white spots. The 4th instar has a striking change in colouration with a large section of red covering the head, thorax, abdomen, and wing pads. This colouration is thought to be aposematic as *L. delicatula* nymphs at this stage start showing a preference for feeding on hosts with defensive chemical compounds such as *Ailanthus altissima*. These chemicals contribute to a decreased palatability to certain insect predators (Kang *et al.*, 2011).

The adult life stage has a distinct colouration compared to the nymphs. Large grey wings are held sloped downward over the body with black spots basally with apical third covered in black reticulation. The body is a light brown to dark brown with darker legs. The hindwings are vividly coloured with alternating bands of black and white, with a red section. Adults are capable of short bursts of flight of one to 2 metres when disturbed and longer dispersal flights of 10-40 meters (Baker *et al.*, 2019; Domingue and Baker, 2019). Adults are also able to move short distances in large groups when areas are depleted of hosts, and often move into cultivated crops in the autumn, especially orchards and nurseries.

Adults are generally found on woody hosts such as trees and large vines due to feeding requirements. Host trees trend towards those with high sugar contents in their phloem and/or contain defensive chemicals for uptake (Song *et al.*, 2018). Aggregation behaviour on host trees results in an uneven distribution of the population, with certain trees appearing more attractive than similar adjacent trees (Domingue *et al.*, 2020). Common feeding hosts for adults include *Ailanthus altissima*, *Acer*, *Betula*, *Juglans*, *Salix*, *Vitis*, and *Zelkova serrata* (Barringer and Ciafre, 2020).

DETECTION AND IDENTIFICATION

Symptoms

Symptoms of *L. delicatula* feeding are most apparent with 4th instar nymphs and adults. The feeding on phloem tissue can lead to branch flagging and wilting, weeping wounds on tree trunks and branches, and in very heavy infestations, fungal mats at the base of a tree resulting from large accumulations of honeydew (sugary by-product excretions from *L. delicatula* feeding). Sooty mould can develop on the leaf surfaces below the feeding area and on understory plants as honeydew is excreted in large quantities. This mould coats leaves reducing photosynthesis and results in early leaf drop and dieback. Understories under heavily fed upon trees can be stunted or killed and there may be a blackened, burned looking surface on the ground. Fruit crops can experience reduced harvest, sugar and nutritional content, and mould accumulation, especially in vineyards.

Identification is commonly based on the examination of adult specimens, however molecular identification on all life stages can be carried out using conventional PCR followed by Sanger sequencing analysis (EPPO, 2020).

Morphology

Egg

The eggs of *L. delicatula* are laid in cryptic egg masses of approximately 30-50 eggs per mass. The individual eggs are small (1 mm in length) brown ovals and laid in 3-5 rows (Dara *et al.*, 2015). The outward surface has an operculum, a darker, narrow oval that will be used as an exit for the emerging nymph. The entire egg mass is covered by a waxy substance secreted by the female, completing the ootheca. This waxy coating is initially whitish-grey and darkens over time to a dark grey. The waxy covering will degrade over time, given the covering a dried mud like appearance, with cracks in the surface and possibly flaking. Egg masses are typically laid on flat surfaces in natural environments such as tree trunks, flat rocks, under bark, and other protected spaces. Man-made structures also provide suitable substrates such as patio furniture, fence posts, rusted metal, outdoor structures (Liu, 2019). Egg mass remnants can be observed over a year after hatching.

Larva

The nymphs have two distinct appearances depending on the instars. The first, second and third instars are black with

white spots on the body and appendages. Visually, the only differences between each life stage is the overall length with the 1st instar approximately 3.5-4.5 mm, the 2nd approximately 5-6.5 mm, and the 3rd instar approximately 7-9.5 mm (Dara *et al.*, 2015). The larger fourth instar is approximately 11-15 mm in length and has a brightly coloured form with red patches on the head, thorax, wing pads, and abdomen. White spots are still present on the legs and body. All stages are mobile with excellent jumping abilities which enable them to avoid predation (Kang *et al.*, 2017).

Adult

Adults of *L. delicatula* superficially resemble moths when at rest. The wings are held sloped downward over the body. The thorax and head are a light brown with the legs dark brown. The forewings are greyish with black spots on the basal two-thirds with the apical third covered in reticulated venation over smaller dark bands. The hind wings are banded with black and white with large red posterior area, spotted with black. The abdomen is black dorsally and ventrally, with yellow integument laterally. The yellow integument will swell with feeding and egg development, separating abdominal sclerotized sections and showing yellow bands between tergites. Females can be distinguished by the red posterior caudal structures and their generally larger size (females range between 24-27 mm in length whereas males are 21-22 mm (Dara *et al.*, 2015).

Detection and inspection methods

Visual detection of *L. delicatula* varies depending on the life stage being investigated. Egg masses are cryptically coloured and camouflaged and can be laid in protected areas making detection difficult. The protective wax covering of the egg mass resembled dried mud, that takes on a dried, cracked mud like appearance as it ages. The mud colour patches, roughly 2.5-5 cm long, can be laid on a variety of materials such as shipping containers, quarried stone, pallets, vehicle undercarriages and wheels, and other man-made materials involved in commerce. In the outdoor environment, detection of egg masses is complicated by eggs being laid on similar coloured tree trunks, in sheltered spaces under rocks or tree bark, or high in tree canopies.

The early instars, 1st to 3rd, do not typically produce any detectable symptoms or damage as their feeding pressure typically does not cause obvious symptoms. The 4th instars can, in large enough numbers, cause wilting on smaller plants and flagging of branches.

Current trapping methods include placing several traps on trunks of host trees to exploit the lanternfly's climbing behaviour (Francese *et al.*, 2020). The traps include sticky paper bands and modified pecan weevil traps (circle trunk traps) which have various advantages and disadvantages. Sticky traps, while easy to install, are less useful against the later instars and adults. Circle trunk traps are effective against all life stages and are reusable but require more investment in materials per tree.

PATHWAYS FOR MOVEMENT

The distribution of *L. delicatula* is facilitated by natural and human mechanisms. Natural methods of spread rely on two strategies that result in slow localized spread. The first dispersal method is spread of nymphs after hatching as they move through the environment feeding on different hosts and their cyclic feeding patterns (Kim *et al.*, 2011, Keller *et al.*, 2020). The second dispersal method is dispersal flights or migratory flights by adults. These are due to either population density pressures or depletion of local resources by heavy feeding. Under ideal conditions females could advance upwind distances greater than three kilometres with repeated sustained flights in a short time frame (Wolfen *et al.*, 2020). Typically, field observations of flight were much shorter, under 30 metres, for durations insufficient to travel several kilometres.

In international trade, the pathways with a risk of introduction are woody plants for planting (except seeds), round wood and sawn wood, wood packaging material as well as man-made items and inert objects (such as stones, containers, used vehicles). In addition, wood pieces and bark (above a certain size) may also present a risk (EPPO, 2016).

PEST SIGNIFICANCE

Economic impact

The economic impact of *L. delicatula* was recently studied by Harper *et al.* (2019). The effects of quarantine requirements for *L. delicatula* have led to millions of dollars (US) of impact to agricultural businesses in infested and adjacent regions. The authors also examined impacts on the total economy. Indirect costs may also be considered in quality-of-life issues as sooty mould from feeding can also contribute to economic impacts for homeowners (Urban 2019).

The pest has been present in the Republic of Korea since 2004 and increasing spread and damage has been observed (Kim and Kim, 2005). Grapevines have been particularly affected with increasing hectares of crops damaged through direct feeding and sooty mould damage (Han *et al.*, 2008; Park, 2009; Lee, 2010; Lee *et al.*, 2011). Kim *et al.* (2011) mention that the density of *L. delicatula* is high in urban areas on *A. altissima*.

Control

Chemical control has been shown to be effective in controlling *L. delicatula* in both residential, commercial, and industrial settings. A variety of chemical controls such as contact sprays, residual sprays, and systemic insecticides have all been effective at killing *L. delicatula* (Kim *et al.*, 2010; Shin *et al.*, 2010; Leach *et al.*, 2019; Clifton *et al.*, 2020). Cultural controls such as exclusion netting, sticky tree bands and circle trunk traps can be used to control or exclude *L. delicatula* with varying levels of success. Exclusion netting can work well for vineyards, excluding *L. delicatula* from the fruit or the entire plant.

At present, there are no biological control agents available for *L. delicatula*. Natural enemies have been identified in China, but are not yet used in biocontrol (e.g. *Dryinus browni* (Yan *et al.*, 2008); *Dryinus lycormae* (Dong, 1983, 1987; Yang, 1994); *Anastatus orientalis*, (Yang *et al.*, 2015a; Kim *et al.*, 2011b; Choi *et al.*, 2014)); *Dryinus sinicus* (Xin *et al.*, 2020). *Ooencyrtus kuvanae* has been documented parasitizing *L. delicatula* eggs in North America but is not host specific limiting is possible benefits (Liu, 2017). *Anastatus orientalis* is under investigation both in the Republic of Korea and the USA as a potential biological control agent, because of high rates of parasitism of eggs (Broadley *et al.*, 2020). Exploratory work in China has suggested an additional candidate for further investigation: *Dryinus sinicus* (Xin *et al.*, 2020).

Phytosanitary risk

Lycorma delicatula is considered a phytosanitary risk due to its polyphagous feeding habits and economic damage associated with feeding. It is a quarantine pest for Canada and Morocco. It has caused economic impacts in its introduced ranges, in both the Republic of Korea and the United States of America. Feeding damage has been found on commodities such as grapes and orchard fruits and several valuable hardwoods. Repeated heavy feeding pressure can result in reduced or no yields in crops and can stunt growth and possibly lead to mortality in preferred hosts over long periods. As *L. delicatula* can be moved over long distances easily in the egg mass stage it poses a significant risk of introduction to the EPPO region.

PHYTOSANITARY MEASURES

In order to prevent entry or spread of *L. delicatula*, imported materials coming from infested regions should be inspected for the presence of egg masses. Unless fresh plant material is present, there is little to no risk of nymphs or adults being present due to feeding needs.

Suggested phytosanitary measures are specified in the EPPO PRA (EPPO, 2016) and are as follows:

Woody plants for planting (except seeds) of known hosts should originate from areas free from the pest or from a pest free production site and be stored and transported in conditions preventing egg-laying (through pest free areas, or outside of the pest flying period, or enclosed). Alternatively, woody hosts should be grown under complete physical isolation and packaging should be free from the pest and stored and transported as above or plants should be transported with stems/branches with a diameter < 1 cm.

For roundwood and sawn wood, the commodity should originate from a pest free area and stored and transported in conditions preventing egg-laying (as above). Or it should be treated (heat treatment or irradiation) or squared (to remove the wood surface) and stored and transported in conditions that prevent egg laying.

For woodchips, hogwood, processed wood residues and bark: chips or bark should be cut to a size below 2.5 x 2.5 cm in two dimensions or originate from a pest free area and transported in conditions that prevent egg-laying or heat treated and stored and transported in conditions preventing egg-laying.

Early detection of populations may allow for steps to be taken to prevent spread of *L. delicatula* from its introduction point. This could include removal of host material in the area, chemical treatment of trap trees, and other mitigation efforts.

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Datasheet history

This datasheet was first published online in 2021. It is 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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