EPPO Datasheet: *Liriomyza sativae*

Last updated: 2024-01-04

IDENTITY

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Preferred name: *Liriomyza sativae*
Authority: Blanchard
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Diptera: Agromyzidae
Other scientific names: *Lemurimyza lycopersicae* Pla & de la Cruz, *Liriomyza canomarginis* Frick, *Liriomyza guytona* Freeman, *Liriomyza minutiseta* Frick, *Liriomyza munda* Frick, *Liriomyza propepusilla* Frost, *Liriomyza pullata* Frick, *Liriomyza subpusilla* (Frost), *Liriomyza verbenicola* Hering
Common names: cabbage leaf miner, leaf miner of vegetables, serpentine vegetable leaf miner, tomato leaf miner, vegetable leaf miner
view more common names online...
EPPO Categorization: A2 list
view more categorizations online...
EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: LIRISA

Notes on taxonomy and nomenclature

Recent molecular work suggests the presence of cryptic species within *Liriomyza sativae* (Scheffer & Lewis 2005) and the latter has also been shown to be capable of hybridizing with *L. trifolii* (Sakami *et al*., 2005).

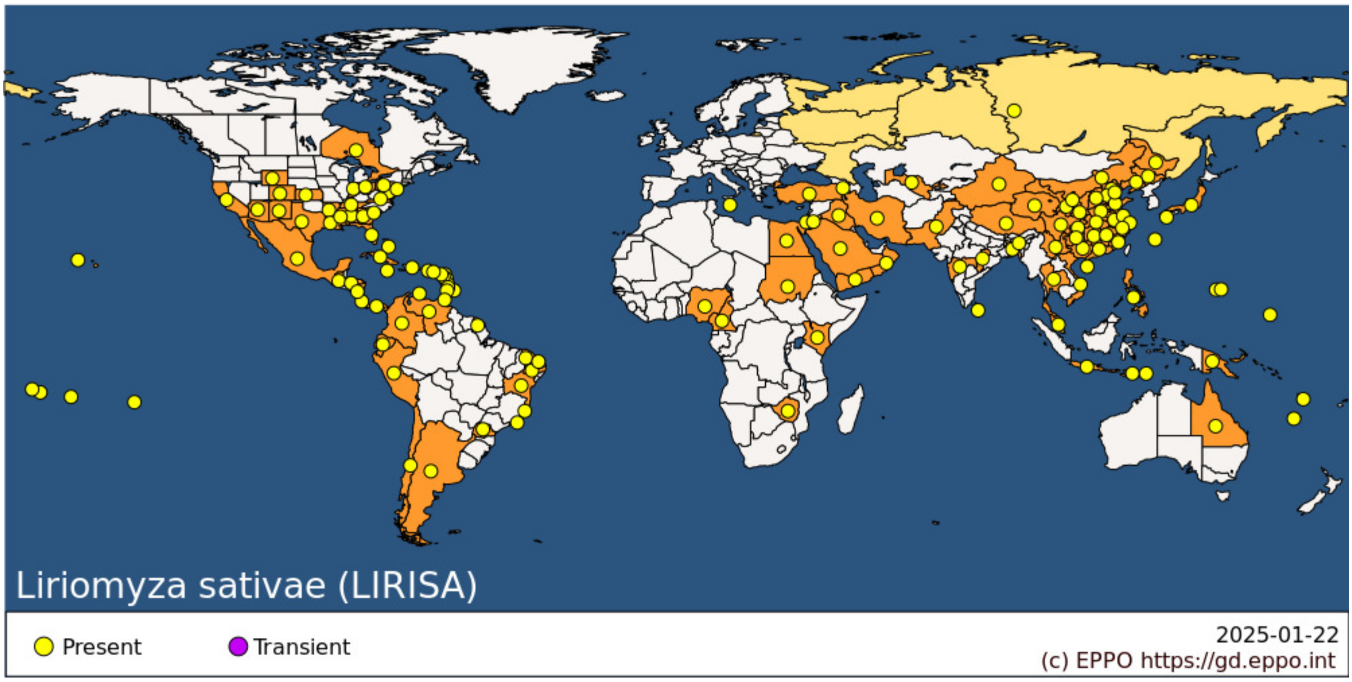
HOSTS

Agromyzidae are usually restricted to a limited number of host plants but a few species are highly polyphagous and have become important pests. *Liriomyza sativae* is one of these species and causes severe damage to vegetable crops and ornamentals. The most commonly affected hosts are tomatoes, celery and chrysanthemum. *L. sativae* has been reported on 14 different plant families.

Host list: *Abelmoschus esculentus*, *Amaranthus viridis*, *Anoda cristata*, *Apium graveolens*, *Benincasa hispida*, *Bidens alba*, *Brassica juncea*, *Brassica oleracea var. botrytis*, *Brassica oleracea var. capitata*, *Brassica oleracea var. viridis*, *Brassica rapa subsp. chinensis*, *Brassica rapa subsp. pekinensis*, *Brassica rapa*, *Cajanus cajan*, *Calendula officinalis*, *Capsicum annuum*, *Cestrum diurnum*, *Cestrum nocturnum*, *Chrysanthemum x morifolium*, *Cicer arietinum*, *Citrullus lanatus*, *Cucumis melo*, *Cucumis sativus*, *Cucurbita maxima*, *Cucurbita moschata*, *Cucurbita pepo*, *Dahlia hybrids*, *Datura innoxia*, *Galinsoga quadriradiata*, *Glebionis coronaria*, *Glycine max*, *Helianthus annuus*, *Hydrocotyle umbellata*, *Lablab purpureus*, *Lactuca sativa*, *Lathyrus*, *Luffa acutangula*, *Luffa aegyptiaca*, *Macroptilium atropurpureum*, *Medicago lupulina*, *Medicago sativa*, *Melilotus albus*, *Momordica charantia*, *Ocimum basilicum*, *Passiflora pallens*, *Passiflora pallida*, *Phaseolus lunatus*, *Phaseolus vulgaris*, *Pisum sativum*, *Poissonia hypoleuca*, *Raphanus sativus*, *Ricinus communis*, *Senna occidentalis*, *Senna tora*, *Sida acuta*, *Solanum americanum*, *Solanum lycopersicum*, *Solanum melongena*, *Solanum nigrum*, *Solanum torvum*, *Solanum tuberosum*, *Sorghum bicolor*, *Spinacia oleracea*, *Symphyotrichum novi-belgii*, *Trifolium incarnatum*, *Tropaeolum majus*, *Verbesina helianthoides*, *Verbesina virginica*, *Vicia faba*, *Vigna luteola*, *Vigna radiata*, *Vigna unguiculata subsp. sesquipedalis*, *Vigna unguiculata subsp. unguiculata*, *Vigna unguiculata*

GEOGRAPHICAL DISTRIBUTION

Liriomyza sativae originates from the Americas and has spread to Africa, Asia and Oceania. It is considered to be the most damaging agromyzid in the USA and South America. In the EPPO region, its presence has been recorded in a small number of countries.



EPPO Region: Armenia, Israel, Jordan, Malta, Russia, Türkiye, Uzbekistan
Africa: Cameroon, Egypt, Kenya, Nigeria, Sudan, Zimbabwe
Asia: Bangladesh, China (Anhui, Beijing, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Neimenggu, Ningxia, Qinghai, Shaanxi, Shandong, Shanghai, Shanxi, Sichuan, Tianjin, Xinjiang, Xizhang, Yunnan, Zhejiang), East Timor, India (Chhattisgarh, Maharashtra, Meghalaya), Indonesia (Java, Nusa Tenggara), Iran, Iraq, Israel, Japan (Honshu, Kyushu, Ryukyu Archipelago), Jordan, Malaysia (West), Oman, Pakistan, Philippines, Saudi Arabia, Sri Lanka, Thailand, Uzbekistan, Vietnam, Yemen
North America: Canada (Ontario), Mexico, United States of America (Alabama, Arizona, Arkansas, California, Colorado, Florida, Georgia, Hawaii, Indiana, Kansas, Louisiana, Maryland, Mississippi, New Jersey, New Mexico, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, Wyoming)
Central America and Caribbean: Antigua and Barbuda, Bahamas, Barbados, Costa Rica, Cuba, Dominica, Dominican Republic, Guadeloupe, Guatemala, Honduras, Jamaica, Martinique, Montserrat, Netherlands Antilles, Nicaragua, Panama, Puerto Rico, Saint Lucia, St Kitts-Nevis, St Vincent and the Grenadines, Trinidad and Tobago, Virgin Islands (US)
South America: Argentina, Brazil (Bahia, Ceara, Espirito Santo, Parana, Pernambuco, Rio de Janeiro, Rio Grande do Norte), Chile, Colombia, Ecuador, French Guiana, Peru, Venezuela
Oceania: American Samoa, Australia (Queensland), Cook Islands, French Polynesia, Guam, Micronesia, New Caledonia, Northern Mariana Islands, Papua New Guinea, Samoa, Vanuatu

BIOLOGY

The principal biological characteristics which make certain *Liriomyza* spp. particularly successful pests are their rapid population growth and their ability to attack a wide range of different host plants (Reitz *et al*., 2013).

Details about the life history of *Liriomyza sativae* are summarized from Araujo *et al.* (2013), Costa-Lima *et al.* (2010), Haghani *et al.* (2007), Parrella 1987, Das *et al.* (2022), Spencer (1973a), Tokomaru & Abe (2003, 2005), Tran & Tran (2023).

After mating female flies puncture the leaf surface of the host plants with their ovipositor causing wounds which serve as sites for feeding or oviposition. Males can also take advantage of these feeding sites as they are less well equipped for puncturing plant tissue. *L. sativae* females are highly fertile and lay on average 26 eggs per day. A female can lay over to 600 eggs in her lifetime. The number of eggs laid depends on the host plant. Eggs are inserted in the upper surface of leaves. The duration of the egg stage varies from 2 to 4.5 days depending on the temperature and host plant. Female flies live longer than males.

There are three larval instars which, in total, last 4 to 7 days. Larval feeding forms irregular linear mines. Just before pupation, mature larvae cut semi-circular exit slits in the upper surface of the leaves. After a short period, larvae drop to the ground and then burrow just below the surface of the soil or in crop debris before pupating. The pupal stage lasts from 7 to 10 days.

DETECTION AND IDENTIFICATION

Symptoms

The most important damage caused by *Liriomyza* spp. is due to larval mining in the leaf tissue. Larval mining reduces the aesthetic value of ornamentals, decreases the photosynthetic capacity of leaves and can ultimately cause defoliation in severe cases (Spencer 1973a). Mines are irregular linear structures in the leaf tissue. They are off-white with trails of dark frass in their margins.

Liriomyza spp. adults cause two main types of damage to their host plants, feeding and oviposition punctures (Minkeberg & van Lenteren, 1986; Reitz *et al*., 2013). Adult feeding and oviposition punctures reduce the aesthetic value of ornamental plants and can lead to death of young plants by reducing photosynthetic capacity. Punctures can also be invaded by fungi and bacteria causing additional damage to host plants. Feeding punctures appear as uneven rounded white speckles on the leaf surface whereas oviposition punctures are smaller and more rounded. These symptoms are not used as a diagnostic character as there is no variation between *Liriomyza* spp.

Morphology

Detailed description of the morphology of immature and adult *L. sativae* is given in Spencer (1973a). The main diagnostic characters of the four regulated *Liriomyza* spp. (*L. bryoniae*, *L. huidobrensis*, *L. sativae* and *L. trifolii*) can be found in the IPPC diagnostic protocol for the genus *Liriomyza* (IPPC, 2017) and the EPPO Standard on diagnostics PM 7/53 (2) *Liriomyza* spp. (EPPO, 2022a). The following sections summarize this information.

Eggs

Oval and white, 0.25 mm long.

Larva

There are three larval stages that range from 0.5 mm in length for the first instar to 3.0 mm for the last one. Their shape is cylindrical and tapering towards the head. The posterior spiracles are tricorn-shaped with three pores located on projections. Newly emerged *L. sativae* larvae are translucent and turns yellow-orange in the later stages. Petitt (1990) describes characters that can be used to distinguish the larval instars of *L. sativae*.

Puparium

Oval cylinder in shape of about 2.0 mm, pale yellowish orange. The spiracles are still visible in the pupal stage.

Adult

Small 1-3 mm long mostly black flies, with a yellow frons and scutellum. The orbital setulae are reclinate, the costa extends to vein M_{1+2} and the femora are bright yellow. Male genitalia are characteristic of the genus.

Detection and inspection methods

There are more than 400 species of *Liriomyza* (GBIF, 2023) and their morphological identification relies on the male genitalia. Adult females can only be used for genus level identification. Likewise, there are no keys available for species level identification of the immature stages. *L. sativae* males can thus be separated from the very similar *L. bryoniae*, *L. huidobrensis L. trifolii* and *L. strigata* by the structure of their distiphallus (terminal part of the intromittent organ) which has one distal bulbs with a slight constriction between its apical and basal parts. The basal section of the bulb is not strongly curve (EPPO, 2022a; IPPC, 2017).

The mines caused by larval feeding can also be useful for detection but this character should be used in combination with other characters as mine pattern is influenced by environmental factors (EPPO, 2022a). Other flies as well as some Lepidoptera are known to have leaf-mining larvae and can potentially be confused with Agromyzidae. Nonetheless, the characteristic feeding punctures of *Liriomyza* spp. allows diagnosticians to differentiate them from other leafminers.

In the absence of male adults for morphological identification, the following molecular tests can be used for *L. sativae* species identification: PCR RFLP targeting the COII gene (Kox *et al*. 2005), conventional multiplex PCR targeting the COI gene (Nakamura *et al*., 2013), an on-site LAMP test, multiplex real-time PCR (Sooda *et al*., 2017), and DNA barcoding based on the COI gene (EPPO, 2021). These molecular techniques are summarized in the EPPO and the IPPC diagnostic protocols for regulated *Liriomyza* species (IPPC, 2017; EPPO, 2022a). Recently, molecular identification based on next generation sequencing techniques are also being developed (Frey *et al.*, 2022).

PATHWAYS FOR MOVEMENT

Adults are capable of limited flight and can be dispersed by wind currents (see Malipatil *et al.* 2016 for references), but are unlikely to spread over long distances. The high degree of polyphagy of *L. sativae* as well as the concealed lifestyle of its larvae make its dissemination through the movement of plant material the most likely mean of colonizing new countries (EFSA, 2020; Parrela, 1987; Reitz *et al.*, 2013). *L. sativae* is regularly intercepted in trade, in particular on leafy vegetables (Europhyt, 2023).

PEST SIGNIFICANCE

Economic impact

Liriomyza spp. are highly polyphagous and invasive and cause severe damage to vegetable crops and ornamentals through adult feeding, oviposition and larval mining. *L. sativae* originates from the Americas and has spread to Africa, Asia and Oceania. It is considered to be the most damaging agromyzid in the USA and South America (CABI, 2021) and its introduction into mainland Europe would most likely cause serious agricultural losses (EFSA, 2020). The most commonly affected economically important plants are tomatoes, chrysanthemum and celery. 80% yield losses have been recorded in Florida and Argentina on celery and lucerne, respectively (Spencer 1973b). In the laboratory, *L. sativae* has been shown to cause 14-33% yield losses in cucumber (Alaei-Verki *et al*., 2020).

Control

The most common control strategy for *Liriomyza* spp. is the extensive use of chemical control methods. However, *Liriomyza* spp. are known to readily develop insecticide resistance (Reitz *et al*., 2013), unlike their local parasitoids, thus causing serious leafminer outbreaks. Some insecticides are effective against *Liriomyza* spp. (Schuster & Everett, 1983). These are translaminar and target the larvae inside the leafmines. Biological control methods are increasingly being used in horticultural industries and commercial vegetable production (Liu *et al*., 2009). There are more than 140 described species of *Liriomyza* parasitoids and these are the primary agents used in biological control strategies. In open fields, integrated pest management strategies promoting local parasitoid diversity are commonly used to control *Liriomyza* spp. In the more controlled greenhouse environments, commercially available parasitoids, such as species in the genus *Diglyphus*, are also reported to successfully regulate *Liriomyza* infestations. Predators and entomopathogenic nematodes and fungi are also known but there are a limited number of species and they are not considered as efficient control agents.

Phytosanitary risk

Liriomyza sativae is a highly polyphagous species, native to the Americas. In Europe, it is regularly intercepted on imported plant material (EFSA, 2020). Due to the similar climatic conditions in its native range it is believed to be capable of establishing in many parts of the EPPO region. The main dispersal mechanisms is through the trade related movement of plant material hosting the immature stages of *L. sativae* (EFSA, 2020). The latter are cryptic and can easily go undetected in plants for planting, soil, fruit and vegetables, cut flowers and branches with foliage.

PHYTOSANITARY MEASURES

It can be recommended that host plants for planting from countries where *L. sativae* is present are inspected over three months at regular intervals before export can take place, to verify the absence of the pest itself or any signs of its presence. General guidance on how to conduct inspections of places producing vegetable plants for planting under protected conditions can be found in the EPPO Standard PM 3/77 (EPPO, 2022b).

In the European Union, it is requested that herbaceous host plants for planting should either : (1) Come from a country free from *L. sativae*; (2) Originate from a place of production inspected monthly over a three-month period prior to export to verify the absence of the pest; or (3) Have been subject to an appropriate treatment, inspected, and found free from *L. sativae*. Consignments of specified hosts traded as cut flowers and leafy vegetables should also originate from a country free from *L. sativae* or should have been inspected and found free from the pest immediately before export (Commission implementing regulation (EU) 2021/2285).

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Datasheet history

This datasheet was first published in the first edition of 'Quarantine Pests for Europe' in 1992 and revised in its second edition in 1997, as well as in 2024. 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.

CABI/EPPO (1992/1997) Quarantine Pests for Europe (1st and 2nd edition). CABI, Wallingford (GB).

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