# EPPO Datasheet: *Liriomyza trifolii*

Last updated: 2024-01-04

## IDENTITY

**Preferred name:** *Liriomyza trifolii*
**Authority:** (Burgess)
**Taxonomic position:** Animalia: Arthropoda: Hexapoda: Insecta: Diptera: Agromyzidae
**Other scientific names:** *Agromyza phaseolunata* Frost, *Liriomyza alliovora* Frick, *Liriomyza phaseolunata* (Frost), *Oscinis trifolii* Burgess
**Common names:** American serpentine leaf miner, chrysanthemum leaf miner
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**EPPO Categorization:** A2 list
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**EU Categorization:** PZ Quarantine pest ((EU) 2019/2072 Annex III)
**EPPO Code:** LIRITR

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### Notes on taxonomy and nomenclature

*L. trifolii* has been shown to be capable of hybridizing with *L. sativae* (Sakami *et al.* 2005) and recent molecular work suggests that cryptic species may be present within *L. trifolii* (Scheffer & Lewis, 2006).

## HOSTS

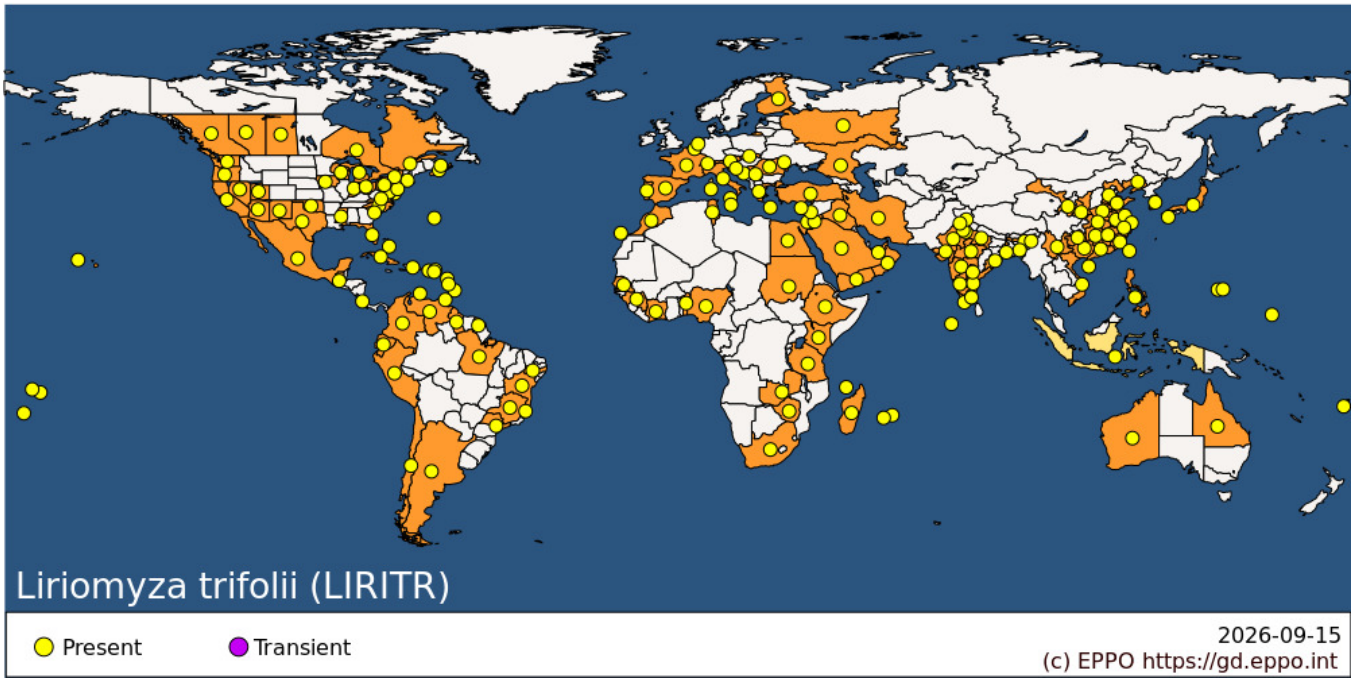
Agromyzidae are usually restricted to a limited number of host plants but a few species are highly polyphagous and have become important pests. *Liriomyza trifolii* is one of these species and causes severe damage to vegetable crops such as celery (Spencer, 1982) and ornamentals such as chrysanthemums (Spencer, 1973).

*L. trifolii* has been recorded from 29 families.

**Host list:** *Abelmoschus esculentus, Allium cepa, Allium fistulosum, Allium porrum, Allium sativum, Allium schoenoprasum, Apium graveolens, Arachis hypogaea, Argyranthemum frutescens, Artemisia vulgaris, Asteraceae, Baccharis halimifolia, Beta vulgaris, Bidens alba, Bidens pilosa, Borrichia frutescens, Brassica juncea, Brassica oleracea var. viridis, Brassica rapa subsp. chinensis, Brassica, Callistephus chinensis, Capsicum annuum, Capsicum chinense, Chenopodium album, Chrysanthemum indicum, Chrysanthemum x morifolium, Chrysanthemum, Cirsium arvense, Citrullus lanatus, Coffea arabica, Coffea canephora, Crotalaria incana, Cucumis melo, Cucumis sativus, Cucumis, Cucurbita pepo, Dahlia hybrids, Daucus carota, Dianthus caryophyllus, Emilia sonchifolia, Erechtites hieraciifolius, Eupatorium caelestinum, Eupatorium serotinum, Flaveria trinervia, Gaillardia aristata, Galinsoga quadriradiata, Gerbera jamesonii, Gossypium barbadense, Gossypium hirsutum, Gypsophila paniculata, Helianthus annuus, Heliotropium europaeum, Helminthotheca echioides, Hymenopappus scabiosaeus, Kallstroemia maxima, Lactuca canadensis, Lactuca sativa, Lactuca serriola, Lagenaria siceraria, Lathyrus, Leucanthemum vulgare, Leucanthemum x superbum, Luffa aegyptiaca, Medicago lupulina, Medicago sativa, Melanthera nivea, Melilotus albus, Melilotus indicus, Ocimum basilicum, Packera glabella, Pericallis x hybrida, Phaseolus coccineus, Phaseolus lunatus, Phaseolus vulgaris, Picris hieracioides, Pisum sativum, Solanum americanum, Solanum lycopersicum, Solanum melongena, Solanum nigrum, Solanum tuberosum, Sonchus asper, Sonchus oleraceus, Spinacia oleracea, Symphyotrichum novi-belgii, Synedrella nodiflora, Tagetes erecta, Tagetes patula, Tanacetum parthenium, Tanacetum vulgare, Tribulus terrestris, Tridax procumbens, Trifolium repens, Trifolium, Tropaeolum majus, Vicia villosa, Vigna radiata, Vigna unguiculata, Vigna, Zinnia, herbaceous ornamental plants, vegetable plants*

## GEOGRAPHICAL DISTRIBUTION

*L. trifolii* originates from North America and spread to other parts of the world in the 1960-1980s. A detailed review of its spread is given in Minkenberg (1988). Today, it is present in South America, Europe, Africa, Asia and Oceania.




**EPPO Region:** Austria, Belgium, Bosnia and Herzegovina, Croatia, Cyprus, Finland, France (mainland), Greece (mainland, Kriti), Israel, Italy (mainland, Sardegna, Sicilia), Jordan, Malta, Moldova, Republic of, Morocco, Netherlands, Portugal (mainland), Romania, Russian Federation (Central Russia, Southern Russia), Serbia, Slovakia, Spain (mainland, Islas Canárias), Switzerland, Tunisia, Türkiye
**Africa:** Benin, Cote d'Ivoire, Egypt, Ethiopia, Guinea, Kenya, Madagascar, Mauritius, Mayotte, Morocco, Nigeria, Reunion, Senegal, South Africa, Sudan, Tanzania, United Republic of, Tunisia, Zambia, Zimbabwe
**Asia:** China (Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Liaoning, Shaanxi, Shandong, Shanghai, Yunnan, Zhejiang), India (Andhra Pradesh, Assam, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Nagaland, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, West Bengal), Indonesia, Iran, Islamic Republic of, Iraq, Israel, Japan (Honshu, Kyushu), Jordan, Korea, Republic of, Lebanon, Maldives, Oman, Philippines, Saudi Arabia, Taiwan, United Arab Emirates, Vietnam, Yemen
**North America:** Canada (Alberta, British Columbia, Nova Scotia, Ontario, Prince Edward Island, Québec, Saskatchewan), Mexico, United States of America (Arizona, California, Delaware, District of Columbia, Florida, Hawaii, Indiana, Iowa, Maryland, Massachusetts, Michigan, Mississippi, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, Texas, Utah, Virginia, Washington, Wisconsin)
**Central America and Caribbean:** Bahamas, Barbados, Bermuda, Costa Rica, Cuba, Dominican Republic, Guadeloupe, Guatemala, Martinique, Netherlands Antilles, Puerto Rico, Saint Kitts and Nevis, Trinidad and Tobago, Virgin Islands (British), Virgin Islands (US)
**South America:** Argentina, Brazil (Bahia, Espirito Santo, Minas Gerais, Para, Pernambuco, Sao Paulo), Chile, Colombia, Ecuador, French Guiana, Guyana, Peru, Venezuela
**Oceania:** American Samoa, Australia (Queensland, Western Australia), Fiji, Guam, Micronesia, Federated States of, Northern Mariana Islands, Samoa, Tonga

## 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 trifolii* are summarized from Harris & Tate (1933), Lanzoni *et al*. 2002,

Leibee (1982), Minkeberg (1988), Parrella *et al.* (1981), Parrella (1987), Spencer (1973), Tokumaru & Abe (2003, 2005).

Copulation takes place on the day when females emerge. Non-fertilized females are not able to oviposit. 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. Feeding punctures can be used for egg laying with approximately 15% of punctures containing eggs.

Eggs are inserted just below the leaf surface. *L. trifolii* females lay on average 11.5 eggs per day. The number of eggs laid depends on the host plant. The duration of the egg stage varies from 1 to 7 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 at mean temperatures above 24°C. 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 burrow just below the surface of the soil or in crop debris before pupating. The pupal stage lasts from 7 to 33 days depending on temperature.

In the Southern USA, the life-cycle is probably continuous throughout the year. There is a noticeable first generation which reaches a peak in April (Spencer, 1973). In Southern Florida, *L. trifolii* has two or three complete generations followed by a number of incomplete, overlapping generations (Spencer, 1973).

## 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, 1973). 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 (Reitz *et al*., 2013; Minkeberg & van Lenteren, 1986). 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. trifolii* is given in Spencer (1973). 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. trifolii* larvae are translucent and turn yellow-orange in the later stages.

*Puparium*

Oval cylinder in shape of about 2.0 mm, yellowish brown. 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 predominantly 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. trifolii* males can thus be separated from the very similar *L. bryoniae*, *L. huidobrensis*, *L. sativae* and *L. strigata* by the structure of their distiphallus (terminal part of the intromittent organ) which has one distal bulb with a marked constriction between its apical and basal parts. The basal section of the bulb is strongly curved (IPPC, 2017; EPPO, 2022a).

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. trifolii* 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 (EPPO, 2022a; IPPC, 2017). 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. trifolii* 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, 2012; Parrela, 1987, Reitz *et al.*, 2013). *L. trifolii* is regularly intercepted in trade, in particular on leafy vegetables and cut flowers (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. trifolii* originates from North America but is now present worldwide (CABI, 2021).

This species is a major pest of chrysanthemums (Spencer, 1973) and celery (Spencer, 1982) in the USA and near total production loss of chrysanthemums has been reported in California (Newman & Parrella, 1981).

### 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 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 trifolii* is a highly polyphagous species present in Europe essentially in the Mediterranean region. The main dispersal mechanisms is through the trade related movement of plant material hosting the immature stages of *L. trifolii* (EFSA, 2012). 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. trifolii* is present are inspected over three months at regular intervals before export can take place, to verify the absence 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, specific measures are taken to protect areas that are still free from *L. trifolii* (Protected Zones), which means that plant material should respect a list of established rules (Commission implementing regulation (EU) 2021/2285) before being cleared for import into the Protected Zones.

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### How to cite this datasheet?

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### Datasheet history

This datasheet was first published in the EPPO Bulletin in 1984 and revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 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.

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