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Data Sheets on Quarantine Pests

Liriomyza trifolii

IDENTITY

Name: *Liriomyza trifolii* (Burgess)
Synonyms: *Liriomyza alliovora* Frick
Taxonomic position: Insecta: Diptera: Agromyzidae
Common names: American serpentine leaf miner, chrysanthemum leaf miner (English)
Mineuse du gerbera (French)
Floridaminierfliege (German)
Bayer computer code: LIRITR
EPPO A2 list: No.131
EU Annex designation: I/A2

HOSTS

L. trifolii has been recorded from 25 families with preference shown for the Asteraceae, including the following important crops: *Aster* spp., beetroots, *Bidens* spp., *Brassica chinensis*, *Capsicum annuum*, celery, Chinese cabbages, chrysanthemums, cotton, cucumbers, *Dahlia* spp., *Dianthus* spp., garlic, *Gerbera* spp., *Gypsophila* spp., *Lathyrus* spp., leeks, lettuces, lucerne, marrows, melons, onions, peas, *Phaseolus coccineus*, *P. lunatus*, *P. vulgaris*, potatoes, spinach, tomatoes, *Tropaeolum* spp., *Vigna* spp., watermelons, *Zinnia* spp. For more information, see Stegmaier (1968).

GEOGRAPHICAL DISTRIBUTION

L. trifolii originates in 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).
EPPO region: First detected in 1976. Now present in Austria, Belgium, Bulgaria, Cyprus, Egypt, France, Greece, Ireland, Israel, Italy, Lebanon, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain (including Canary Islands), Switzerland, Turkey, Yugoslavia. Eradicated in the Czech Republic, Denmark, Finland, Germany, Hungary, Norway, Sweden, UK.
Asia: Cyprus, India (Andhra Pradesh), Israel, Japan (Honshu), Korea Republic, Lebanon, Philippines, Taiwan, Turkey.
Africa: Egypt, Ethiopia, Kenya, Mauritius, Nigeria, Réunion, Senegal, South Africa, Tanzania, Tunisia.
North America: Canada (Alberta, Nova Scotia, Ontario, Quebec), Mexico (unconfirmed), USA (outside in New Mexico, California, most eastern states from Florida northward to New Jersey, Wisconsin and Iowa; under glass in other southern states).
Central America and Caribbean: Bahamas, Barbados, Costa Rica, Cuba, Dominican Republic, Guadeloupe, Guatemala, Martinique, Trinidad and Tobago.
South America: Brazil, Colombia, French Guiana, Guyana, Peru, Venezuela.
Oceania: American Samoa, Guam, Micronesia, Northern Mariana Islands, Samoa, Tonga.

EU: Present.
Distribution map: See CIE (1984, No. 450).

BIOLOGY

Peak emergence of adults occurs before midday (McGregor, 1914). Males usually emerge before females. Mating takes place from 24 h after emergence and a single mating is sufficient to fertilize all eggs laid. Female flies puncture the leaves of the host plants causing wounds which serve as sites for feeding or oviposition. Feeding punctures cause the destruction of a larger number of cells and are more clearly visible to the naked eye. About 15% of punctures made by L. trifolii contain viable eggs (Parrella et *al*., 1981). Males are unable to puncture leaves but have been observed feeding at punctures produced by females. Both males and females feed on dilute honey (in the laboratory) and take nectar from flowers.

Eggs are inserted just below the leaf surface. The number of eggs laid varies according to temperature and host plant. *L. trifolii* females each laid 25 eggs in celery at 15°C and 400 eggs at temperatures around 30°C. One female of *L. trifolii* laid 493 eggs in peas (Poe, 1981) and another laid 639 eggs in chrysanthemums (cv. Fandango).

Eggs hatch in 2-5 days according to temperature. The duration of larval development also varies with temperature and host plant but is generally 4-7 days at mean temperatures above 24°C (Harris & Tate, 1933). In *Phaseolus*, at a constant 30°C *L. trifolii* larvae complete development in 4 days and at 20°C within 7 days (Poe, 1981). At temperatures above 30°C the mortality rate for immature stages rises sharply.

L. trifolii pupariates externally, either on the foliage or in the soil just beneath the surface. It has also been observed to pupariate in the leaf of, for example, onion (Harris & Tate, 1933) and lucerne (Webster & Parks, 1913). Pupariation is adversely affected by high humidity and drought.

Adult emergence of *Liriomyza* species occurs 7-14 days after pupariation, at temperatures between 20 and 30°C (Leibee, 1982). At low temperatures emergence is delayed. In the laboratory *L. trifolii* survived cold storage at 4.5°C for 8 weeks (Miller, 1978).

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). On celery *L. trifolii* completes its life-cycle (oviposition to adult emergence) in 12 days at 35°C, 26 days at 20°C, and 54 days at 15°C (Leibee, 1982). On chrysanthemums the life-cycle is completed in 24 days at 20°C but on *Vigna sinensis* and *Phaseolus lunatus* it takes only 20 days at this temperature (Poe, 1981). Adults of *L. trifolii* live between 15 and 30 days. On average, females live longer than males.

DETECTION AND IDENTIFICATION

Symptoms

Feeding punctures appear as white speckles between 0.13 and 0.15 mm in diameter. Oviposition punctures are smaller (0.05 mm) and are more uniformly round.

Mines are usually white with dampened black and dried brown areas. They are typically serpentine, tightly coiled and of irregular shape, increasing in width as larvae mature; there should be no confusion with the mines of the European chrysanthemum leaf miner *Chromatomyia syngenesiae* which are less contorted and uniformly white.

Morphology

Eggs

Size 0.2-0.3 mm x 0.10-0.15 mm, off-white and slightly translucent.

Larva

A headless maggot up to 3 mm in length when fully grown. First instar larvae are colourless on hatching, turning pale yellow-orange. Later instars are yellow-orange. Larvae (and puparia) have a pair of posterior spiracles shaped like a triple cone. Each posterior spiracle opens by three pores, one pore located toward the apex of each cone.

Puparium

Oval, slightly flattened ventrally, 1.3-2.3 x 0.5-0.75 mm, with variable colour, pale yellow-orange often darkening to golden brown (in contrast, the puparia of *C. syngenesiae* are greyish off-white).

Adult

Small, greyish-black, compact-bodied, 1.3-2.3 mm in body length, 1.3-2.3 mm in wing length. Female adults are slightly larger than males.

To distinguish adults of *L. trifolii* from other leaf miners of quarantine concern, the following simplified key can be used for initial identification (accurate identification requires dissection of male terminalia and all identifications made with this key should be confirmed by a specialist):

1. Scutellum bright-yellow 2
   Scutellum black ..... *Amauromyza maculosa*

2. Inner setae usually standing on yellow ground; prescutum and scutum black with grey bloom ..... *Liriomyza trifolii*
   Outer vertical setae standing on black; prescutum and scutum shining black 3

3. Inner vertical setae usually standing on dark ground (yellow mixed with black) ..... *Liriomyza huidobrensis*
   Inner vertical setae usually standing on yellow ground ..... *Liriomyza sativae*

Other morphological differences are described in Spencer (1973) and Knodel-Montz & Poe (1982).

Menken & Ulenberg (1986) have described a method to distinguish between four species of *Liriomyza* (*L. bryoniae* and the three species in the above key), using starch gel electrophoresis and enzyme staining (see also OEPP/EPPO, 1992). This method can be used on single individuals.

MEANS OF MOVEMENT AND DISPERSAL

Adults flies are capable of limited flight. Dispersal over long distances is on planting material of host species. Cut flowers can also present a danger as a means of dispersal; it should be noted, for example, that the vase life of chrysanthemums is sufficient to allow completion of the life-cycle of the pest.

PEST SIGNIFICANCE

Economic impact

This species is now the major pest of chrysanthemums in North America (D'Aguilar & Martinez, 1979). Vegetable losses in the USA are also considerable, for example losses for celery were estimated at US$ 9 million in 1980 (Spencer, 1982). It was noted, however, that damage to celery during the first 2 months of the 3-month growing season was insignificant and largely cosmetic, whereas considerable yield loss resulted from pest presence during the final month (Foster & Sanchez, 1988). 1.5 million larval mines per ha were recorded from onion in Iowa (Harris & Tate, 1933). *L. trifolii* is also known to be a vector of plant viruses (Zitter *et al.*, 1980).

L. trifolii is already a serious pest of chrysanthemums in those countries in the EPPO region where it is established. It is apparently not capable of overwintering outdoors in northern Europe.

Damage is caused by larvae mining into leaves and petioles. The photosynthetic ability of the plants is often greatly reduced as the chlorophyll-containing cells are destroyed. Severely infested leaves may fall, exposing plant stems to wind action, and flower buds and developing fruit to scald (Musgrave *et al.*, 1975). The presence of unsightly larval mines and adult punctures in the leaf palisade of ornamental plants can further reduce crop value (Smith *et al.*, 1962; Musgrave *et al.*, 1975). In young plants and seedlings, mining may cause considerable delay in plant development leading to plant loss.

Control

Some insecticides, particularly pyrethroids, are effective, but leaf miner resistance can sometimes make control difficult (Parrella *et al.*, 1984). Natural enemies periodically suppress leaf miner populations (Spencer, 1973), and foliar applications of the entomophagous nematode *Steinernema carpocapsae* significantly reduced adult development of *L. trifolii* (Harris *et al.*, 1990).

Phytosanitary risk

L. trifolii is listed as an A2 quarantine pest by EPPO (OEPP/EPPO, 1984). It is one of the most important recent introductions to the EPPO region. *L. trifolii* is a major pest of a wide variety of ornamental or vegetable crops grown under glass or as protected crops in the EPPO region. It could also cause damage to these crops grown in the open in the warmer parts of the region. Although it is quite widely distributed in the region, there are still several countries where it has not established and others where successful eradication programmes have been conducted.

PHYTOSANITARY MEASURES

In chrysanthemum cuttings, *L. trifolii* survives cold storage at 1.7°C for at least 10 days. Newly laid eggs of *L. trifolii* in chrysanthemums survived for up to 3 weeks in cold storage at 0°C (Webb & Smith, 1970). Eggs incubated for 36-48 h were killed after 1 week under the same conditions (Webb & Smith, 1970). All stages of larvae were killed after 1-2 weeks at 0°C (Webb & Smith, 1970). These authors, therefore, proposed that chrysanthemum cuttings should be maintained under normal glasshouse conditions for 3-4 days after lifting to allow eggs to hatch. Subsequent storage of the plants at 0°C for 1-2 weeks should then kill off the larvae.

Gamma irradiation of eggs and first larval stages at doses of 40-50 Gy provided effective control (Yathom *et al.*, 1991), but lower doses were ineffective.

EPPO (OEPP/EPPO, 1990) recommends that planting material (except seeds) of celery, *Cucumis*, lettuces and tomatoes, and material (except seeds and pot plants) of *Capsicum*,

carnations, chrysanthemums, *Gerbera*, *Gypsophila* and *Senecio hybridus* from countries where the pest occurs must either have been inspected at least every month during the previous 3 months and found free from the pests, or have been treated by a recommended method. It is left optional as to whether countries make the same requirements for pot plants of the second group of plants mentioned above. A phytosanitary certificate may be required for cut flowers and for vegetables with leaves.

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