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Data Sheets on Quarantine Pests

Liriomyza sativae

IDENTITY

Name: *Liriomyza sativae* Blanchard
Synonyms: *Liriomyza pullata* Frick
Liriomyza canomarginis Frick
Liriomyza minutiseta Frick
Liriomyza munda Frick
Liriomyza guytona Freeman
Liriomyza propepusilla Frost
Taxonomic position: Insecta: Diptera: Agromyzidae
Common names: Vegetable leaf miner, serpentine vegetable leaf miner, cabbage leaf miner, tomato leaf miner (English)
Bayer computer code: LIRISA
EPPO A1 list: No. 152
EU Annex designation: I/A1

HOSTS

This species prefers hosts within the Solanaceae and Fabaceae, but has also been recorded on seven other families. It has been recorded on lucerne, *Amaranthus* spp., *Aster* spp., aubergines, *Capsicum annuum*, celery, cucumbers, *Cucurbita pepo*, *Dahlia* spp., faba beans, *Lathyrus* spp., melons, peas, *Phaseolus lunatus*, *P. vulgaris*, potatoes, tomatoes, *Tropaeolum* spp. and *igna* spp.

GEOGRAPHICAL DISTRIBUTION

EPPO region: Absent.
Asia: India (Uttar Pradesh), Oman, Thailand, Yemen.
Africa: Cameroon, Sudan, Zimbabwe.
North America: Canada (under glass in Ontario), Mexico, USA (Hawaii; outside in southern and western states; in glasshouses in Ohio, Maryland and Pennsylvania).
Central America and Caribbean: Antigua and Barbuda, Bahamas, Barbados, Costa Rica, Cuba, Dominica, Dominican Republic, Guadeloupe, Jamaica, Martinique, Montserrat, Nicaragua, Panama, Puerto Rico, St. Kitts and Nevis, St. Lucia, St. Vincent and Grenadines, Trinidad and Tobago.
South America: Argentina, Brazil, Chile, Colombia, French Guiana, Peru, Venezuela.
Oceania: American Samoa, Cook Islands, French Polynesia, Guam, Micronesia, New Caledonia, Northern Mariana Islands, Samoa, Vanuatu.
EU: Absent.
Distribution map: See CIE (1986, No. 477).

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. sativae* 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. 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). At temperatures above 30°C the mortality rate for immature stages rises sharply.

L. sativae usually pupariates externally, either on the foliage or in the soil just beneath the surface. Pupariation is adversely affected by high humidity and drought.

Adult emergence occurs 7-14 days after pupariation, at temperatures between 20 and 30°C (Leibee, 1982). At low temperatures emergence is delayed.

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). *L. sativae* completes its life-cycle in 24-28 days during the winter in California (December-January) when heaviest crop attacks occur (Wolfenbarger, 1947). Adults of *L. sativae* 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. Petitt (1990) describes characters that can be used to distinguish the larval instars of *L. sativae*.

Puparium

The puparium is 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. Females are slightly larger than males.

To distinguish adults of *L. sativae* 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

Adult flies are capable of limited flight. Dispersal over long distance 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

L. sativae is reported as economically damaging on a wide range of vegetables in the USA including tomatoes, potatoes and *Cucurbita*. The damage threshold of *L. sativae* in tomatoes is one active leaf miner per three terminal leaflets or 25 miners per 18 leaflets (Pohronezny *et al.*, 1978). Tomatoes can tolerate a 30% infestation of pre-bloom leaves and 60% post-bloom (Spencer, 1982). *L. sativae* has been recorded as causing 30% defoliation in an 80-ha field of tomatoes in the USA (Spencer, 1982). Cucurbit crops severely attacked in the seedling stage by *L. sativae* can be totally destroyed. This species transmits a number of plant viruses, including celery mosaic potyvirus (Zitter *et al.*, 1980).

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).

Phytosanitary risk

L. sativa has the potential to become a major pest of a wide variety of ornamental or vegetable crops grown under glass or as protected crops in the EPPO region. These crops grown in the open in the warmer parts of the region could also be damaged. *L. sativae* is, therefore, listed as an A1 quarantine pest by EPPO (OEPP/EPPO, 1984).

PHYTOSANITARY MEASURES

All stages are killed within a few weeks by cold storage at 0°C. Newly laid eggs are, however, the most resistant stage and it is recommended that cuttings of infested ornamental plants 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 of leaf miner species (Webb & Smith, 1970).

To avoid the introduction of *L. sativae* (and the other leaf miner species *L. huidobrensis* and *Amauromyza maculosa*), EPPO (OEPP/EPPO, 1990) recommends that propagating material (except seeds) of *Capsicum*, carnations, celery, chrysanthemums, *Cucumis*, *Gerbera*, *Gypsophila*, lettuces, *Senecio hybridus* and tomatoes from countries where the pests occur must have been inspected at least every month during the previous 3 months and found free from the pests. A phytosanitary certificate should be required for cut flowers and for vegetables with leaves.

BIBLIOGRAPHY

CIE (1986) *Distribution Maps of Pests, Series A* No. 477. CAB International, Wallingford, UK.

Harris, H.M.; Tate, H.D. (1933) A leafminer attacking the cultivated onion. *Journal of Economic Entomology* **26**, 515-516.

Knodel-Montz, J.J.; Poe, S.L. (1982) Ovipositor morphology of three economically important *Liriomyza* species (Diptera: Agromyzidae). *Proceedings of the Third Annual Industry Conference on Leaf Miners, San Diego, USA*, pp. 186-195.

Leibee, G.L. (1982) Development of *Liriomyza trifolii* on celery. In: *Proceedings of IFAS-Industry Conference on Biology and Control of* Liriomyza *leafminers, Lake Buéna Vista, Florida* (Ed. by Schuster, D.J.), pp. 35-41.

Menken, S.B.J.; Ulenberg, S.A. (1986) Allozymatic diagnosis of four economically important *Liriomyza* species (Diptera, Agromyzidae). *Annals of Applied Biology* **109**, 41-47.

McGregor, E.A. (1914) The serpentine leafminer on cotton. *Journal of Economic Entomology* **7**, 227-454.

Musgrave, C.A.; Poe, S.L.; Weems, H.V. (1975) The vegetable leafminer *Liriomyza sativae* Blanchard. *Entomology Circular, Florida Department of Agriculture and Consumer Services, Division of Plant Industry* No. 162, pp. 1-4.

OEPP/EPPO (1984) Data sheets on quarantine organisms No. 131, *Liriomyza trifolii*. *Bulletin OEPP/EPPO Bulletin* **14**, 29-37.

OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.

OEPP/EPPO (1992) Quarantine procedures No. 42. Identification of *Liriomyza* spp. *Bulletin OEPP/EPPO Bulletin* **22**, 235-238.

Parrella, M.P.; Allen, W.W.; Marishita, P. (1981) Leafminer species causes California chrysanthemum growers new problems. *California Agriculture* **35**, 28-30.

Parrella, M.P.; Keil, C.B.; Morse, J.G. (1984) Insecticide resistance in *Liriomyza trifolii*. *California Agriculture* **38**, 22-33.

Petitt, F.L. (1990) Distinguishing larval instars of the vegetable leafminer *Liriomyza sativae* (Diptera: Agromyzidae). *Florida Entomologist* **73**, 280-286.

Pohronezny, K.; Waddill, V.H.; Stall, W.M.; Dankers, W. (1978) Integrated control of the vegetable leaf miner (*Liriomyza sativae*) during the 1977-78 tomato season in Dade County, Florida. *Proceedings Florida State Horticulture Society* **91**, 264-267.

Smith, F.F.; Boswell, A.L.; Wave, H.E. (1962) New chrysanthemum leaf miner species. *Florists' Review* **130**, 29-30.

Spencer, K.A. (1973) *Agromyzidae (Diptera) of economic importance* (*Series Entomologica* No. 9), 418 pp. Junk, The Hague, Netherlands.

Spencer, K.A. (1982) US celery under threat. *Grower* **97**, 15-18.

Webb, R.E.; Smith, F.F. (1970) Survival of eggs of *Liriomyza munda* in chrysanthemums during cold storage. *Journal of Economic Entomology* **63**, 1359-1361.

Wolfenbarger, D.O. (1947) The serpentine leaf miner and its control. *Florida Agriculture Experiment Station Press Bulletin* No. 639, pp. 1-6.

Zitter, T.A.; Tsai, J.H.; Harris, K.F. (1980) Flies. In: *Vectors of plant pathogens* (Ed. by Harris, K.F.; Maramorosch, K.), pp. 165-176. Academic Press, New York, USA.