UNIVERSITY OF FLORIDA

IFAS EXTENSION

Vegetable Leafminer, *Liriomyza sativae* Blanchard (Insecta: Diptera: Agromyzidae)[1]

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Distribution

The vegetable leafminer, *Liriomyza sativae* Blanchard, is found commonly in the southern United States from Florida to California and Hawaii, and in most of Central and South America. Occasionally it is reported in more northern areas because it is transported with plant material. It cannot survive cold areas except in greenhouses.

Life Cycle and Description

The developmental thresholds for eggs, larvae, and pupae are estimated at 9 to 12 degrees C. The combined development time required by the egg and larval stages is about seven to nine days at warm temperatures (25 to 30 degrees C). Another seven to nine days is required for pupal development at these temperatures. Both egg-larval and pupal development times lengthen to about 25 days at 15 degrees C. At optimal temperatures (30 degrees C), the vegetable leaf miner completes development from the egg to adult stage in about 15 days.

Egg

The white, elliptical eggs measure about 0.23 mm in length and 0.13 mm in width. Eggs are inserted into plant tissue just beneath the leaf surface and hatch in about three days. Flies feed on the plant secretions caused by oviposition, and also on natural exudates. Females often make feeding punctures, particularly along the margins or tips of leaves, without depositing eggs. Females can produce 600 to 700 eggs over their life span, although some estimates of egg production suggest that 200 to 300 is more typical. Initially, females may deposit eggs at a rate of 30 to 40 per day, but egg deposition decreases as flies grow older.

Larva

There are three active instars, and larvae attain a length of about 2.25 mm. Initially the larvae are nearly colorless, becoming greenish and then yellowish as they mature. Black mouthparts are apparent in all instars, and can be used to differentiate the larvae. The average length and range of the mouthparts (cephalopharyngeal skeleton) in the three larval feeding instars is 0.09 (0.6-0.11), 0.15

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(0.12-0.17), and 0.23 (0.19-0.25) mm, respectively. The mature larva cuts a semicircular slit in the mined leaf just prior to formation of the puparium. Almost invariably, the slit is cut in the upper surface of the leaf. The larva usually emerges from the mine, drops from the leaf, and burrows into the soil to a depth of only a few cm to form a puparium. A fourth larval instar occurs between puparium formation and pupation, but this is generally ignored by authors (Parrella 1987).

Pupa

The reddish brown puparium measures about 1.5 mm in length and 0.75 mm in width. After about nine days the adult emerges from the puparium, principally in the early morning hours, and both sexes emerge simultaneously. Mating initially occurs the day following adult emergence, but multiple matings by both sexes have been observed, and up to a month post-emergence.

Adult

The adults are principally yellow and black in color. The shiny black mesonotum of L. sativae is used to distinguish this fly from the closely related American serpentine leafminer, *Liriomyza trifolii* which has a grayish black mesonotum. Also, the black hind margin of the eyes serves to distinguish this insect from *L. trifolii*, which has eyes with yellow hind margins. Females are larger and more robust than males, and have an elongated abdomen. The wing length of this species is 1.25 to 1.7 mm, with the males averaging about 1.3 mm and the females about 1.5 mm. The small size of these flies serves to distinguish them from pea leafminer, *Liriomyza huidobrensis* (Blanchard), which has a wing length of 1.7 to 2.25 mm. The yellow femora of vegetable leafminer also help to distinguish these species, as the femora of pea leafminer are dark. Flies normally live only about a month. Flies are uncommon during the cool months of the year, but often attain high, damaging levels by mid-summer. In warm climates they may breed continuously, with many overlapping generations per year.

The biology of *L. sativae* is not well documented because until fairly recently it was confused with other similar flies, but important elements have been studied by Parkman et al. (1989), Petitt and Wietlisbach (1994), and Palumbo (1995). The work by Oatman and Michelbacher (1958) probably refers to *L. sativae*. Keys for the identification of agromyzid leafminers can be found in Spencer and Steyskal (1986).

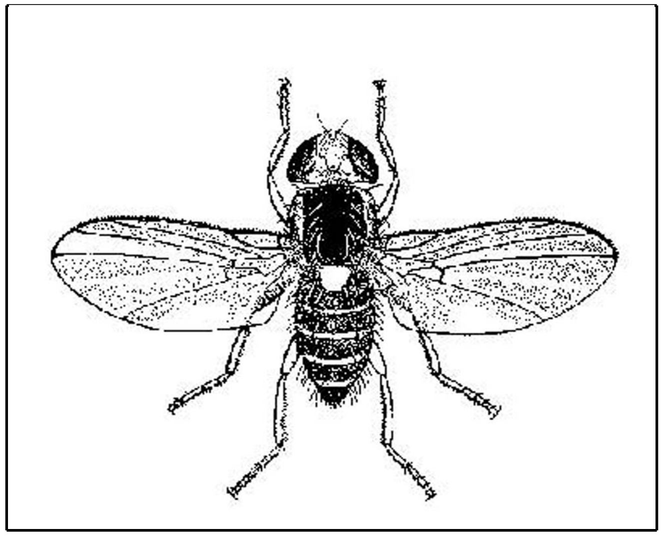

Figure 1. Adult vegetable leafminer. Credits: John L. Capinera, University of Florida

Figure 2. Adult vegetable leafminer *Liriomyza sativae* Blanchard. Credits: Lyle J. Buss, University of Florida

Host Plants

Vegetable leafminer attacks a large number of plants, but seems to favor those in the plant families Cucurbitaceae, Leguminosae, and Solanaceae. Stegmaier (1966a) reported nearly 40 hosts from 10 plant families in Florida. Among the numerous weeds infested, the nightshade, *Solanum americanum*; and

Spanishneedles, *Bidens alba*; are especially suitable hosts in Florida (Schuster et al. 1991). Vegetable crops known as hosts in Florida include bean, eggplant, pepper, potato, squash, tomato, and watermelon. In California, Oatman (1959) reported a similar host range, but also noted suitability of cucumber, beet, pea, lettuce and many other composites. Celery is also reported to be attacked, but to a lesser extent by this leafminer species than by American leafminer, *Liriomyza trifolii* (Burgess). In Hawaii, damage to onion foliage is a problem for the marketing of scallions (green onions) (Kawate and Coughlin 1995). Vegetable leafminer was formerly considered to be the most important agromyzid pest in North America (Spencer 1981), but this distinction is now held by *L. trifolii*

Damage

Foliage punctures caused by females during the acts of oviposition or feeding may cause a stippled appearance on foliage, but this damage is slight compared to the leaf mining activity of larvae. The irregular mine increases in width from about 0.25 mm to about 1.5 mm as the larva matures, and is virtually identical in appearance and impact with the mines of *L. trifolii*. Larvae are often easily visible within the mine where they remove the mesophyll between the surfaces of the leaf. Their fecal deposits are also evident in the mines. The potential impact of the mining activity is evident from the work of Sharma et al. (1980), who studied the value of treating squash with insecticides in California. These authors reported 30 to 60% yield increases when effective insecticides were applied, but as is often the case with leafminers, many insecticides were not effective.

Natural Enemies

Vegetable leafminer is attacked by a number of parasitoids, with the relative importance of species varying geographically and temporally. In Hawaii, *Chrysonotomyia punctiventris* (Crawford) (Hymenoptera: Eulophidae), *Halicoptera circulis* (Walker) (Hymenoptera: Pteromalidae), and *Ganaspidium hunteri* (Crawford) (Hymenoptera: Eucoilidae) were considered important in watermelon (Johnson 1987). In California and Florida, the same genera or species were found

Figure 3. Mines in squash leaf caused by *Liriomyza* leafminers. Credits: J.L. Castner, University of Florida

attacking vegetable leafminer on tomato or bean, but *Opius dimidiatus* (Ashmead) (Hymenoptera: Braconidae) also occurred commonly in Florida (Stegmaier 1966a, Lema and Poe 1979, Johnson et al. 1980a). Levels of parasitism are often reported to be proportional to leafminer density, but parasitoid effectiveness can be disrupted when insecticides are applied. Steinernematid nematodes can infect *L. trifolii* larvae when the nematodes are applied in aqueous suspension and the plants are held under high humidity conditions (Broadbent and Olthof 1995).

Management

Sampling

Several methods for population assessment have been studied, and collecting puparia in trays placed beneath plants was recommended by Johnson et al. (1980b) as a labor-saving technique. Zehnder and Trumble (1984) used yellow sticky traps to monitor adults, and reported that *L. sativae* flies were more active at the middle plant height of tomatoes, while *L. trifolii* was more active at low plant height. They also confirmed the value of pupal counts for prediction of adult numbers two weeks later. Yellow sticky traps, however, have the advantage of being able to quickly detect invasion of a field by adults from surrounding areas. Sequential sampling plans were developed by Zehnder and Trumble (1985).

Insecticides

Foliar application of insecticides is often frequent in susceptible crops Insecticide susceptibility varies greatly both spatially and temporally. Many organophosphate and carbamate insecticides are no longer effective. Insecticides are disruptive to naturally occurring biological control agents, and leafminer outbreaks are sometimes reported to follow chemical insecticide treatment for other insects.

For more insecticidal information see:

Insect Management Guide for Vegetables (http://edis.ifas.ufl.edu/TOPIC_GUIDE_IG_Vegetables)

Cultural Practices

Some crops vary in susceptibility to leaf mining. This has been noted, for example, in cultivars of tomato, cucumber, cantaloupe, and beans (Hanna et al. 1987). However, the differences tend to be moderate, and not adequate for reliable protection. Nitrogen level and reflective mulches are sometimes said to influence leafminer populations, but responses have not been consistent (Chalfant et al. 1977, Hanna et al. 1987). Placement of row covers over cantaloupe has been reported to prevent damage by leafminer (Orozco-Santos et al. 1995). The same study evaluated the benefits of transparent polyethylene mulch, and found no reduction in leafminer populations. Sometimes crops are invaded when adjacent crops are especially suitable, as was reported by Sharma et al. (1980) in California, where cotton was an important source of invaders. Weeds are a source of flies (Parkman et al. 1989), but also a source of parasitoids.

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