Serpentine Leaf Miner Damage

spinach losses in 1956 recall cyclic attacks by pests and need of both insecticides and natural enemies for control

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A small leaf-mining agromyzid fly of omnivorous tastes—*Liriomyza langei* Frick—caused a 50% loss to fall spinach in the Salinas Valley in 1956. The unofficial allowable tolerance for larvae could not be met in many instances with as many as six weekly applications of combination phosphate and chlorinated hydrocarbon insecticides at a total cost of $60 an acre.

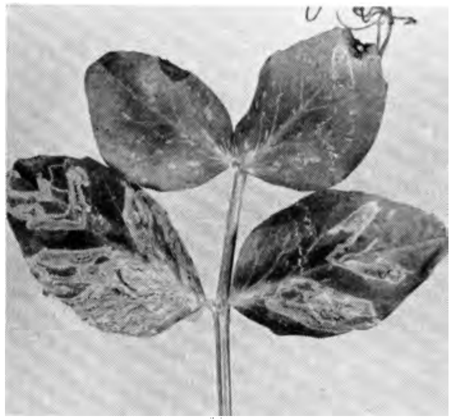
Widespread leaf miner attacks appear to be cyclic in nature, although localized attacks by certain species occur practically every year. Evidence indicates a flareup about 1938, one in 1948, and a more limited epidemic in 1956. In 1945 a 10-acre field of spinach at Salinas was lost because of a localized attack.

Leaf miners are subject to explosive population buildups—biological explosions—as there is often a delicate balance between climatic influences, parasites, available hosts, and the reproductive potential of the leaf miners.

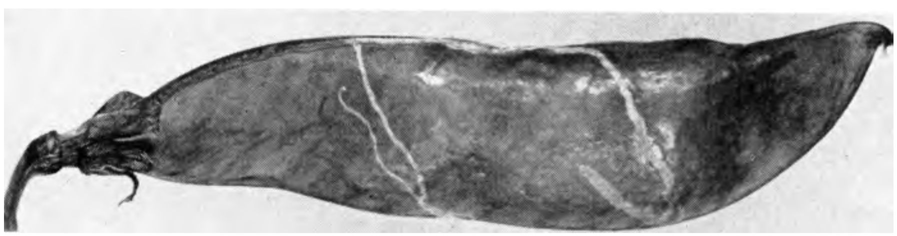
Climate exerts an important over-all effect in determining the abundance of leaf miners. Favorable conditions occurred in the Salinas Valley in 1956.

Winding mines inside the leaves, stems—or pods—of the plant attacked are characteristic of serpentine leaf miners and caused by boring larvae.

The adult serpentine leaf miners are small, black and yellow flies ranging from 1/10″ to 1/16″ long. The members of the genus *Liriomyza*—which contains most of the agriculturally important species—have a yellow mark on the posterior part of the thorax between the places of attachment of the wings. The adult females puncture holes in the leaves for feeding and for egg deposition. Many more feeding than egg punctures usually occur. The punctures turn light-colored and give the leaves a white, stippled appearance. Eggs are placed under the epidermis of the leaf through slits made on the upper or lower surfaces of the leaves. The slits are ovate in shape, range from 0.25 to 0.35 millimeter—mm—long, and are laid parallel to the leaves. The diameter of the mine increases as the larva grows.



Mines of the pea leaf miner on leaf—above—and on pod—below—of pea.



Below—Feeding punctures and mines of pea leaf miner on spinach.

On some host plants, and when several larvae work in the same leaf, blotch mines develop, and entire leaves turn white and wither. Mining may occur in the pods of peas, and stem mining may cause the complete collapse of small plants.

The mature larva, when 2 mm to 4 mm long, cuts an escape slit at the end of the mine and pupates on the leaf—in certain species as in *Liriomyza pictella*—or at the base of the plants, or in the soil, as in *L. langei.*

The period of development varies with species, host, and time of year. A typical life history consumes from 17 to 30 days in the summer and 50 to 65 days in the winter and spring. There are five to six generations a year in most species, and all stages may overwinter, but largely as pupae and adults. Adults may start feeding on new growth in January and February. Populations of flies usually increase as summer and fall progress and more available hosts are present.

The most important species of serpentine leaf miners attacking spinach in the coastal districts is the pea leaf miner—*Liriomyza langei* Frick—which has been called *L. flaveola* Fallen or *L. orbona* (Meig.).

Other species attacking spinach are the bean leaf miner—*L. pictella* (Thomson)—which has been called *L. subpusilla* Frost, a valley species; *Phytomyza atricornis* Meigen—which mines spinach, lettuce, and composites in the Salinas and other areas; and the spinach leaf miner—*Pegomyia hyoscyami* (Panz.)—which forms large blotch mines and has mature larvae 2/5″ long.

Other economic species include the cabbage leaf miner—*Liriomyza brassicae* (Riley); the tomato leaf miner—*L. munda* Frick (mss.); a grass leaf miner—*L. flaveola* (Fall.); and a miner of alfalfa and other legumes—*L. congesta* (Becker). A miner of cabbage in northern California is *Scaptomyza terminalis* (Lowe). Two miners of weeds are often confused with *Liriomyza: Haplomyza minuta* (Frost), a miner of

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LEAF MINER

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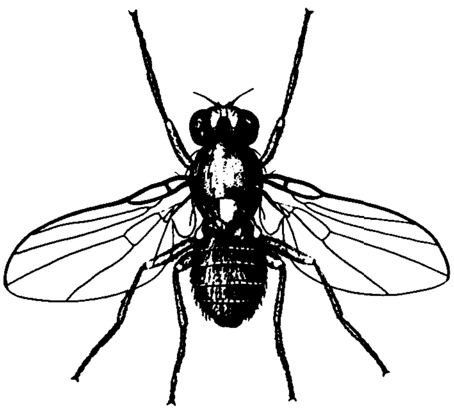
Chenopodium spp.; and *H. togata* (Melander), a common miner of *Amaranthus* spp.

The pea leaf miner has a history of damage to spinach, peas, peppers, lettuce, carrots, onions, cruciferous crops, asters, sugar beets, celery, and beans. Cage tests have verified the following additional hosts: cineraria, zinnia, stock, guayule, cabbage, Brussels sprouts, kohlrabi, cauliflower, turnip, broccoli, okra, parsnip, radish, dandelion, endive, chicory, rutabagas, and tomato. Larkspur is not attacked. The pea variety Green Admiral is tolerant of attack because of its growth habit, whereas the usual hamper types of peas are severely damaged. Weeds such as *Chenopodium* and *Amaranthus* are commonly selected.

Adult male of *Liriomyza langei*.



The bean leaf miner on the other hand selects beans, melons, castor beans, cowpeas, and alfalfa, but it can occur on spinach in certain valley areas.

In 1948 leaf miner trouble in California was widespread on spinach, melons, tomatoes, alfalfa, lettuce, sugar beets, cultivated flowers, potato, beans, weeds, black-eyed peas, and mustard. An attack of *Liriomyza langei* occurred on sugar beets in the Salinas Valley in 1948, supposedly correlated with the widespread use of DDT for leafhopper control. Spinach, lettuce, and onions were attacked in 1956.

Mines of the tomato leaf miner in leaves of tomato plant.

Often, localized outbreaks can be correlated with parasite relationships, the use of excessive amounts of insecticides destructive to the natural enemies, and the availability of suitable host plants.

Puparium, above, and mature larva, below, of pea leaf miner.

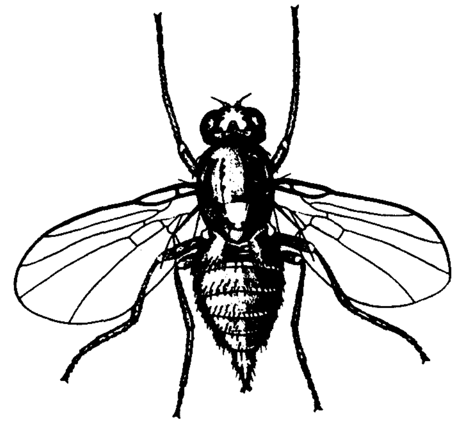
In one instance in the Salinas Valley, the reduction of *Liriomyza langei* was the result of a maximum diurnal temperature of 105° F, an unusual temperature for coastal conditions.

Parasites often control leaf miner infestations, but they can not be depended upon—as seems to be the case for currently used insecticides—to control miners to a degree sufficient to meet existing maggot tolerances. Under extremely high population levels the flies are continually moving into the fields from outside, adding to those escaping destruction.

The best solution to the leaf miner control problem seems to lie in the judicious use of insecticides in such a way as to more fully utilize the natural enemies.

The most effective wasp parasites of the pea leaf miner are *Solenotus intermedius* (Girault), *S. begini* (Ashmead), larval parasites in the family Eulophidae, and *Halticoptera aenea* (Walker), a larval parasite that emerges through the pupae. Other parasites include *Mesora* sp., and *Opius* sp., and *Chrysocharis ainsliei* Crawford, and *C. parksi* Crawford. A combined parasitism of 50% to 90% is not unusual.

Adult female of *Liriomyza langei*.



The best chemical control program depends upon the species, crop, and locality, but certain insecticides have shown

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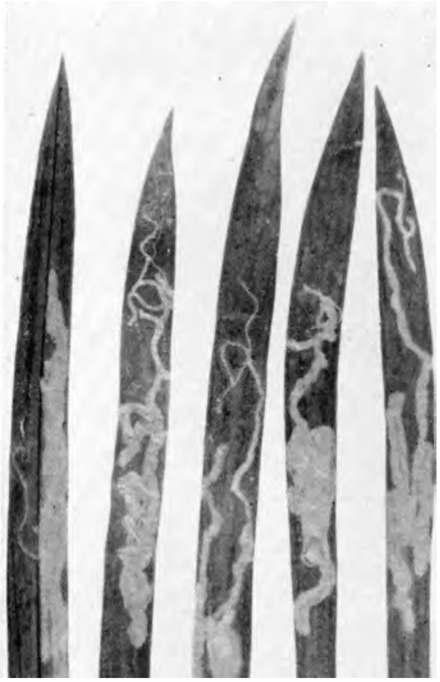
Damage of the pea leaf miner to leaves of sugar beets.

New Carnation Pests

bud mite and leaf miner found in California may cause serious problems

A. Earl Pritchard



Leaf injury caused by the maggots of the carnation leaf miner.

Carnation growers in California—constantly combating spider mites, thrips and aphids, and occasional infestations of carnation bud moth or mealybugs—have two new pests to fight.

The carnation bud mite—*Aceria paradianthi* Keifer—was first discovered in California in 1952. A subsequent collection from Maryland constitutes the only other known record of this pest in the western hemisphere. It is probable that the mite was introduced from Europe.

The original infestation was found in Santa Barbara County, and a state-wide survey by the State Department of Agriculture showed the pest to be present also in Los Angeles and Orange counties. During 1956, infested nurseries were found in the San Francisco Bay area, in Alameda, Santa Clara, and San Mateo counties.

Carnation bud mites are exceedingly tiny and they prefer to live within the new shoots, between the bases of the leaves and stem, and under the flower calyxes. Their presence in large numbers is detected by somewhat greasy, distorted, and stunted new growth.

Because of the secretive habits of the bud mite, it has been very difficult to control. Parathion, chlorobenzilate, and Kelthane have given good control of exposed mites, but repeated applications of these chemicals serve only to keep down mite populations.

In recent experimental plots at Redwood City, two new chemicals have shown greater promise for bud mite control. One of these is Diazinon and the other is Phostex, an experimental chemical.

Excellent kill was obtained with wettable powder of Diazinon applied at a rate of three pounds of a 25% material per 100 gallons of water and 25% emulsifiable Phostex used at a rate of one pint per 100 gallons of water. The addition of four ounces of a commercial spreader to the Diazinon spray caused a rather even distribution of the residue over the leaves and possibly enhanced the performance. Phostex, when used as a 25% wettable powder at a rate of three pounds per 100 gallons of water, was inferior to the other chemicals. No plant injury was incurred in these tests.

The other new carnation pest is the carnation leaf miner—*Liriomyza* n. sp.

Distorted terminal shoots injured by the carnation bud mite.

The native home of this pest is not known, but it was first found in several nurseries in San Mateo County in 1956. The maggots of this tiny, black and yellow fly tunnel within the leaves, making serpentine mines. As far as is known, at the present time, only carnations serve as a host.

A 2% parathion dust has given good control of the adult flies as they emerge. Applications are made at 10- to 14-day intervals.

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no beneficial effect and usually a deleterious effect on parasites in addition to rather poor control of miners. Such insecticides include DDT, DDD, methoxychlor, perthane, TEPP, rotenone, and toxaphene. DDT was found to affect the larval parasites, *Solenotus* spp., more than *Halticoptera*, due to differences in the biology of these species. Other materials—parathion, methyl parathion, EPN, aldrin, dieldrin, heptachlor, endrin, isodrin, chlordane, and lead arsenate—may or may not affect parasites, but are more effective in controlling the leaf miner.

More work is needed to determine the best use of insecticides and still preserve natural enemies. The use of seed treatments, systemic materials, baits, and other controls needs investigating. However, mild and warm fall and winter conditions tend to increase numbers of flies on all host plants. Sugar beets, weeds, and lettuce are sources of flies and parasites.

Insecticides should not be applied early in the growth of spinach, so as to allow parasites to get started on the first generation of leaf miners. Where flies are abundant—and insecticides are necessary—parathion applied as a 2% dust at 45 pounds per acre, or the equivalent as a spray, at about the rosette stage, is usually effective when followed by one or two additional applications at 7–10-day intervals, depending upon growth and possible chemical residue problems. DDT or related materials should not be used. If dieldrin, aldrin, or heptachlor is used early, it should be combined with a phosphate.

The use of more than two or three insecticide applications is not usually economically feasible, and—under high leaf miner population conditions—may not allow the spinach to meet unofficial allowable larval tolerances.

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