Strawberry Leaf Miner Damage

effectiveness of natural enemies usually holds pest damage below levels of economic importance in commercial plantings

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The larvae of a small, leaf-mining moth —*Tischeria* sp. Family Tischeriidae— apparently a new species close to *T. aenea* Frey and Boll, burrow serpentine mines in the leaves of strawberry plants.

Since a severe outbreak in a field of Twentieth Century strawberries at Sacramento in 1951, mines—or tunnels—of the larvae have been seen in many interior and coastal localities, but the damage is usually not severe enough to require chemical control measures.

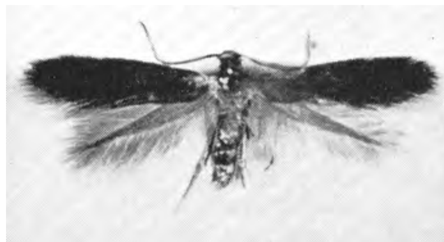
The serpentine mines of the larvae appear white and radiate outward from the midveins on the upper surface of the leaflets. The mines may be ½″–1″ long. Larvae eat only the palisade parenchyma, and do not feed on the spongy parenchyma nor on the veinlets. The tunnels are webbed from the start which keeps the spongy parenchyma from drying out. The epidermis of the leaf is usually puckered along the mid-line of the burrow and especially so over the pupal chamber. The lower surface of the leaf is drawn into a U-shaped groove and the edges of the leaves may roll inwardly due to desiccation of the tissues.

The mature larvae—which overwinter in the mined leaves—are 3⁄16″ long, green, with amber head, cervical shield, and anal plate. The characteristic shape tapers evenly from the anterior to the posterior end. The head is flattened dorsoventrally. True legs are absent on the thorax and the crochets lie flush with the body due to a reduction of the prolegs.

The active larvae extrude large amounts of black excrement pellets—outside the mine—which form conspicuous black deposits on the leaves. For pupation the larva bends the leaf into a fold.

The pupa is ⅛″–3⁄16″ long and varies in color from a uniform pale green, to amber, to greenish with amber markings. The pupa is covered with small spicules and has long abdominal hairs and two characteristic posterior projections. Pupae are active when disturbed and vibrate the tip of the abdomen rapidly back and forth.

Eggs are laid only on the lower surface of the leaflets and usually near the base of the blade or close to the main veins. The larvae enter directly into the leaf through a crescent-shaped hole cut in one end of the egg. Excrement is pushed out through a hole cut in the egg-shell.



Adult of strawberry leaf miner, *Tischeria* sp.

The egg is a flattened disc, smooth, shiny, pale amber in color, and is about 0.27 millimeter wide by 0.45 millimeter long—25 millimeters equal 1″.

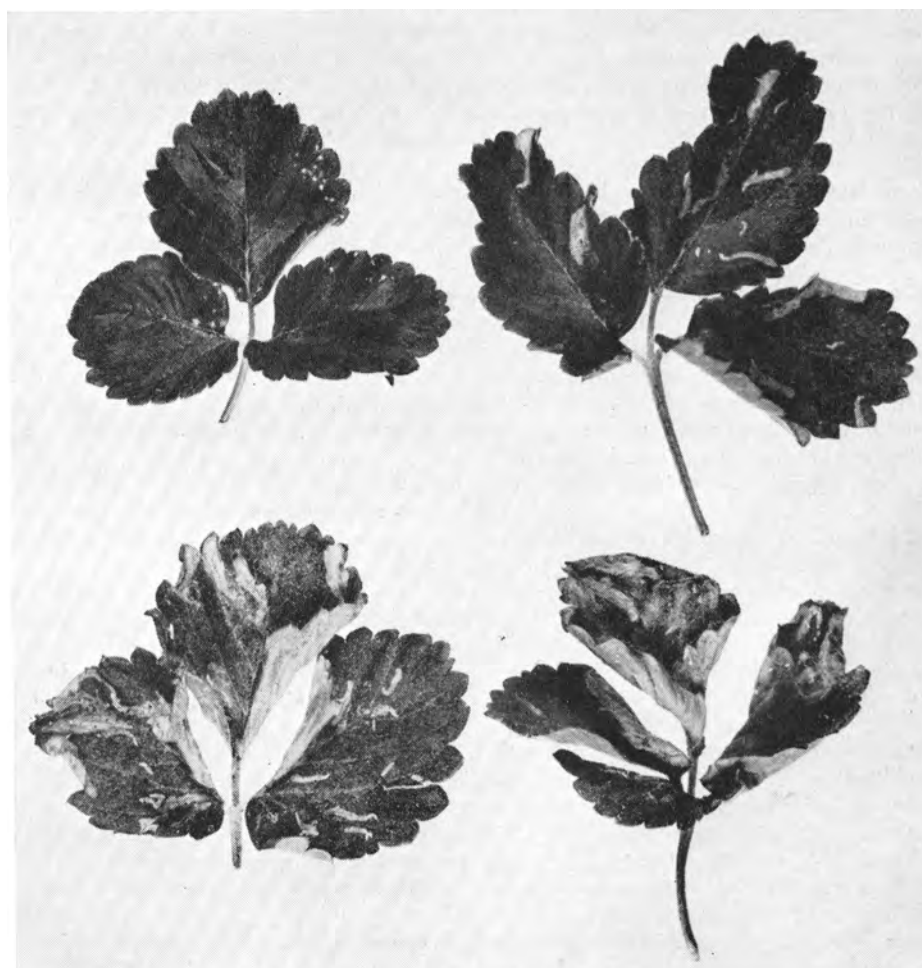
The adult moth has a wingspread of about ¼″ and the wings are lanceolate—pointed at the tips. The forewings are dark gray with a metallic, coppery iridescence. The gray hind wings are edged with long cilia or hairs.

A complete cycle from egg to adult at a mean temperature of 73.2°F required about 30 days in laboratory rearings. The egg stage lasted 5–6 days, larval period 18–20 days, and pupal stage 5–6 days, suggesting that numerous generations can be completed during the course of a year.

Parasites—natural enemies—play an important role in keeping the strawberry leaf miner under control.

A tiny wasp—*Zagrammosoma mirum* Girault—in the family Eulophidae, is the most effective larval parasite. The black pupae of the wasp are commonly found

Damage of strawberry leaf miner to leaves showing light to severe injury.



Citrus Mite Control

effective new acaricide of low toxicity to insects registered for use on citrus

L. R. Jeppson

Relatively safe to handle during spray operations and less toxic to mammals than DDT, Kelthane—4,4′-dichloro-α-(trichloromethyl) benzhydrol—has utility for control of mites injurious to citrus in California.

A residue tolerance of 10 ppm—parts per million—of Kelthane on and in citrus fruit has been established by the Food and Drug Administration. When used at dosages found to be effective in experimental studies and field experience—and not less than seven days before harvest—the resulting residues on harvested fruit should not exceed the tolerance level.

On citrus trees of average size Kelthane—applied at about 16 pounds of the 18.5% wettable powder formulation, or 16 pints of the 18.5% emulsifiable concentrate formulation per acre—has resulted in effective control of both phosphate and Ovotran resistant strains of the citrus red mite—*Panonychus citri* (McG.)—the six-spotted mite—*Eotetranychus sexmaculatus* (Riley); the Yuma mite—*E. yumensis* (McG.); and the Lewis mite—*E. lewisi* (McG.).

When applied by boom equipment with oscillating guns or by conventional sprayers using manually operated guns, 1–1½ pounds of the wettable powder or 1–1½ pints of the emulsifiable formulations per 100 gallons of spray have been effective. Applications of less than 1,000 gallons of total spray per acre—with sufficient concentration of material or volume of spray to obtain 15–16 pounds or 15–16 pints of the formulated material per acre—have proved inadequate. On young trees, 1½ pounds or 1½ pints of the respective formulations per 100 gallons of spray were effective. When sprayblower equipment is used in the citrus red mite control program, Kelthane should be applied at the rate of 16 pounds or 16 pints of the formulated material per acre. The spray volume required for adequate control depends on the degree of atomization and distribution supplied by the spray equipment.

The citrus flat mite—*Brevipalpus lewisi* McG.—appears to be effectively controlled with eight pounds of the wettable powder formulation or eight pints of the emulsifiable concentrate formulation per acre.

Kelthane appears to be compatible with most of the spray materials currently used on citrus. However, it should not be used with the more basic materials such as lime or soda ash. It has been used in combination with petroleum oil sprays, but its value as an oil spray additive for mite control has not been fully investigated.

Kelthane has a low order of toxicity to insects and therefore it has little effect on beneficial insects, including bees.

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in the larval burrows and parasitism of 30% is not unusual.

Another wasp of the family Eulophidae—*Derostenus punctiventris* Crawford—was reared in large numbers from the strawberry leaf miner. It is believed to be a primary parasite of the strawberry leaf miner because as many as eight parasites often develop from a single host larva. In the past the wasp has been considered a parasite of dipterous leaf miners.

Several specimens of still another wasp—*Pnignalio* sp. also in the family Eulophidae—were reared from larvae of the miner.

In the Santa Clara area another eulophid parasite — *Sympiesis stigmata* Girault—was commonly swept from strawberry plants and may be another parasite of this leaf miner.

In addition to parasites there is often a high—20%–30%—natural mortality of leaf miner larvae in the mines. The larvae appear sensitive to desiccating conditions such as might occur from hot, dry winds. In addition, female parasites often sting larvae in the mines resulting in added mortality.

Chemical control has not been necessary. In the 1951 outbreak nicotine sulfate sprayed on the plants at the rate of two pints per 100 gallons of spray per acre killed about 50% of the nonparasitized larvae in the mines and had no apparent effect on parasites or on pupae of the moth.

Because it is possible to upset the natural balance between parasite and host, phosphates or other chemicals for the control of strawberry leaf miner should be applied only on advice of the proper agricultural authorities.

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DISBUDDER

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It is necessary for the disbudder to remove the main bud and the two secondary buds. Removal of only one or two of these buds may result later in the growth of a sucker from the third bud, and the sucker will continue to develop shoots profusely unless it is carefully removed at its point of origin on the rooting.

To determine the cause of suckers that frequently grow from disbudded cuttings, an experiment was conducted with 200 cuttings each of St. George and 1613 rootstocks disbudded by shears and equal numbers disbudded by machine, using either saw blades or a wirewheel. After six weeks in callusing boxes at room temperature, the cuttings were examined to determine the effectiveness of each type of disbudding. All lateral buds that pushed in this time represented potential suckers.

Disbudding by wirewheel was the most thorough of the three methods, because the wirewheel tends to make a rather large scar at the node. The scar may be rough and sometimes very long.

For practical purposes, 1613 was free of potential suckers: less than 1% of the cuttings had buds capable of growing, where the disbudder had failed to remove all the buds of the eye. Disbudding of 1613 is easy because its nodes are distinct and the buds project clearly from the node.

St. George rootstock produces many suckers, and failure to remove the entire bud was the greatest trouble. Other frequent difficulties were mistaking the tendril scar for a bud and failure to recognize the nodal region of the cutting, particularly on basal cuttings, where nodes are indistinct and buds are small and inconspicuous.

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