

Lettuce Root Aphid

value of a preplanting soil treatment with parathion proven by tests in 1956

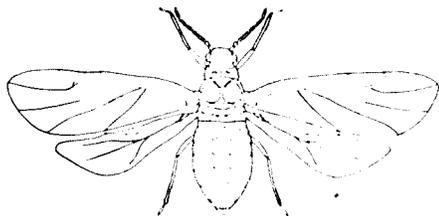
— W. H. Lange, L. C. Benson, D. C. Force, A. A. Grigarick, N. F. McCalley

For the first time, a practical and economical means of controlling the European lettuce root aphid—*Pemphigus bursarius* (L.)—seems to be available for commercial use.

Several hundred acres of lettuce in coastal areas have been stunted or killed each year by the lettuce root aphid. In addition, the aphid has damaged seed lettuce in several interior valley localities.

The first noticeable damage to lettuce is the wilting of the plants, particularly during the middle of the day. The heads remain soft—fail to develop properly—and yields fall off. In heavy infestations the plants may collapse completely and die. Masses of white, woolly material—and the aphids themselves—are indications of their presence.

Populations of 500 to 5,000 aphids per plant are not uncommon. The first aphids are usually found on the smaller rootlets. As the infestation progresses aphids may completely cover all the roots including the main tap root. The feeding of the aphids turns the rootlets brown and often they die. The lack of root area—with toxins probably inserted into the roots—creates an inadequate root system. Application of excessive amounts of water—or fertilizer—to the plants during a heavy infestation often causes complete collapse of the plants, similar to nematode injury.



Winged lettuce root aphid from poplar galls.

The life cycle of the aphid is complicated, and proper timing is important in insecticidal control.

The aphid overwinters in the egg stage in crevices of the bark of the Lombardy poplar—*Populus italica* var. *nigra*—an introduced tree commonly grown as an ornamental. In March, small, wingless stem mothers crawl forth and seek out new growth—stems or leaf petioles—and feed. In less than a week a gall starts forming around the aphid, and reaches



Galls of the lettuce root aphid—*Pemphigus bursarius* (L.)—on Lombardy poplar.

White, moldy appearance of roots of lettuce from root aphid attack. Note wilting of lettuce.



full size in about 25–30 days. The mature gall is pear-shaped or globular, with a small, apical opening—usually directed downwards—that is the emergence hole for the aphids after they attain wings. The gall may be as large as $\frac{3}{4}$ " long by $\frac{1}{2}$ " wide.

The aphid stem mother gives birth to parthenogenetic females inside the gall. In about 50–55 days some of the females start forming wings, crawl out of the gall and fly to lettuce seedlings. Migration of the winged aphids from galls to lettuce roots is usually over by September 1, but a few winged forms have been observed in galls in October and November. On lettuce roots the aphids go through several generations on successive crops of lettuce—completing a single cycle in about 50 days. The winged migrants from lettuce roots seek out other lettuce plants and spread the infestation. Young lettuce plants seem to be preferred over more mature plants.

In October and through December, winged migrants from lettuce—the sexuales—fly back to Lombardy poplar and select the thick bark at the bases of the trees as sites to give birth to the sexual males and females. The winged forms can crawl into cracks or under bark as high as 30' or more from the ground to give birth to sexuals. Winged forms often concentrate in one spot and their bodies can be observed protruding from these favored sites. The sexual forms are small, and being beakless, do not feed. After mating, the females deposit a single egg each—often the egg almost fills the abdominal cavity. The females cover the eggs with a coating of white, wax-like material and then die. The eggs overwinter again to complete the cycle.

In addition to the occurrence of a sexual cycle—lettuce to poplar—the European lettuce root aphid can overwinter in the soil on favored host plants, or occasionally in soil devoid of living plants. Aphids overwinter only occasionally in lettuce fields, but it is possible under certain cultural procedures. Root aphids seem to carry over more successfully in dry winters because excessive moisture seems to increase a fungus that attacks the aphids and creates conditions unfavorable for rapid reproduction.

The initial infestations on lettuce found in the Salinas Valley—on June 14, 1956—seemed to correlate almost perfectly with the first emergence of winged aphids from galls on adjacent Lombardy poplar trees. That correlation indicates that—in 1956, at least—Lombardy poplar was a more important primary source of aphids on lettuce than other hosts.

On June 1, 1956, small, replicated chemical control plots were initiated adjacent to a row of Lombardy poplars in Alameda County near Alvarado.

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Parathion, guthion, OMPA, and thimet were applied at the rate of five pounds of the actual chemical per acre, as pre-planting treatments, and rototilled immediately after application into the upper 5"-6" of soil. In addition, OMPA and thimet at the same rates were applied as granules, side-dressed into the beds.

Plants dug and examined on July 27 gave a range of from 70%-100% over-all infestation for all of the treatments. If rated on the basis of severity of infestation, however, parathion had only 22.5% medium to severely infested plants in contrast to a range of from 78%-98% for the other treatments. No control was obtained where the materials were side-dressed into the beds after the plants were partly grown.

Salinas Valley Tests

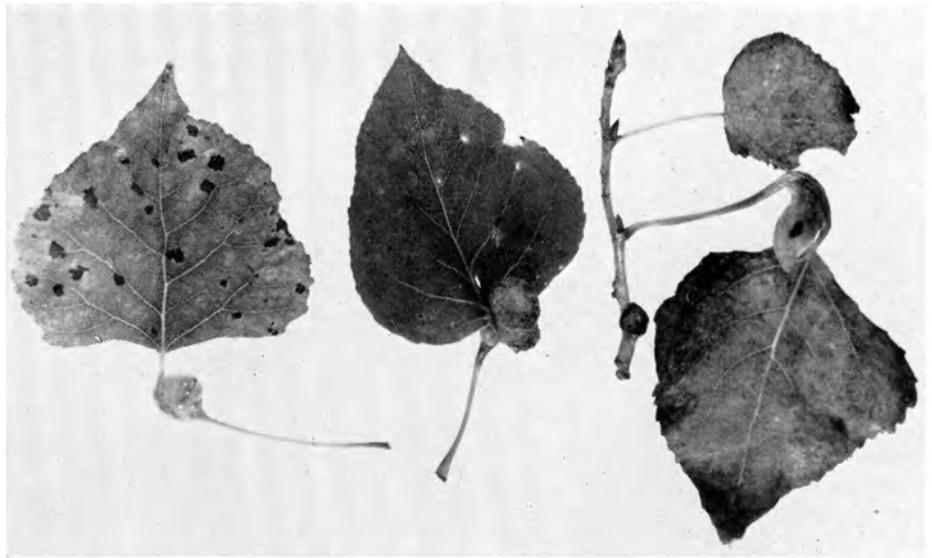
In other test plots—in 14 different fields in the Salinas Valley—parathion was applied as a preplanting treatment at the rate of five pounds of actual chemical per acre, during April, June, July and August, 1956. A commercial sprayer applied the parathion in 100 gallons of spray per acre. The plot areas varied from single treated blocks eight beds wide through a field, to single blocks of five acres. In all cases adjacent untreated lettuce was available. The sprayer was followed almost immediately with a rototiller or disk and the chemical was mixed with the upper 5"-6" of soil.

In one trial parathion was sprayed on the flat soil, followed by listing into beds with a bed shaper, then the beds rototilled. In eight trials parathion was applied to the flat soil, then disked, and listed into beds, but not rototilled. In the remaining trials the chemical was sprayed directly on the beds and rototilled into the soil.

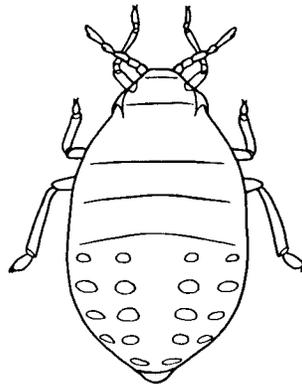
An examination of plants at the time of harvest in the untreated soil gave a range of from 0.0% to 81.6% infested, for an average of 42.3% infested for all 14 fields. Plants examined from the treated fields varied from 0.0% to 13.3% infested, for an average of 3.9% for all 14 fields. This corresponds to an over-all reduction of about 90% in the treated fields as compared to the untreated.

One field had no aphids in the untreated area at the time of harvest. However, in the treated fields, six had no infestation. In addition, the plants infested with aphids from the treated areas had approximately half the number of aphids on the roots as those from the untreated.

Analyses of lettuce and soil for the presence of parathion were made in connection with five fields in the Salinas



Different types of galls produced by *Pemphigus* species: left to right—*P. populi transversus* (Riley); *P. monophagus* Maxson; and *P. bursarius* (L.).



Wingless aphid from roots of lettuce.

Valley. At the time of harvest—varying from 83-92 days after treatment—less than 0.1 ppm—part per million—of parathion was found in the lettuce from all five fields, and in the soil from two fields. Soil from two fields contained 0.20 ppm and 0.21 ppm of parathion, but contamination was indicated because the controls gave 0.10 ppm and 0.15 ppm of parathion.

In one field in the Salinas Valley, yields of lettuce were taken by means of commercial methods in 12 beds through a treated area of 32 beds, in comparison with an adjacent untreated area of 12 beds. An increased yield of 28% was obtained in the treated area when compared with the untreated.

The use of top applications of parathion to lettuce as a means of controlling migrating aphids was not successful. As many as seven weekly applications only reduced the root aphid infestation from 88% to 53%.

The European lettuce root aphid is the only *Pemphigus* sp. associated with Lombardy poplar. However, there are several related species on native cotton-

woods and poplars, but most of these make galls of different shapes.

Root forms from numerous plants in California have not all been properly associated with their galls. Aphids similar to—or almost identical with the form occurring on lettuce—have been found on sugar beets, chard, lambsquarters, pigweed, spinach, sow thistle, several perennial composites, dandelion, and others. Work to date has indicated that these aphids can not be readily moved from one host to another, suggesting the presence of physiological strains, the presence of more than one species, or the occurrence of sibling species.

Investigations are being made to determine host relationships. Until the host relationships are known, the European lettuce root aphid is being associated with lettuce and other composites only. The status of *Pemphigus betae* Doane, in California, still remains to be determined.

Natural enemies are very important in the control of the lettuce root aphid. The larvae of several species of chloropid flies—*Thaumatomyia* (*Chloropisca*)—effectively control root aphids, as they are active predators. The larvae of a large syrphid—*Metasyrphus* sp.—seek out aphids at all levels in the soil and feed on them. A fungus disease—*Empusa* sp.—is often important in reducing populations in the fall and winter. Aphids in the galls are commonly attacked by a pirate bug—*Anthocoris* sp.—that often completely eliminates the aphids.

Cultural methods often play a part in determining root aphid damage. Rototilling an infested crop of lettuce and replanting with lettuce usually lead to trouble. The soil should be worked

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mined by local economic conditions reflecting the relationship between price of hogs and price of feeds including garbage. The results in all trials indicate the palatability and suitability of cooked residential garbage as a swine feed.

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Rancher C. J. Lyons of Saugus cooperated in the swine feeding trials

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deeply and allowed to dry thoroughly before being replanted to lettuce. Often lettuce can produce a satisfactory crop—even with a heavy infestation of aphids—if it can be made to grow rapidly. Even, adequate irrigation and the elimination of cracks through which winged aphids can enter the soil often assist in averting damage.

Some varietal differences in susceptibility to the lettuce root aphid have been observed. Imperial strain E-4—currently not an acceptable commercial variety—is the most resistant variety found to date, and attempts are being made to incorporate that resistance in the commercial variety Great Lakes.

Based on the results of the investigations in 1956, it is possible to control the European lettuce root aphid by a preplanting soil treatment with parathion at five pounds of actual chemical per acre. However, parathion is a highly toxic organic phosphate insecticide and all precautions and rules on the label should be followed and permits from the County Agricultural Commissioner are required before it can be purchased or used. Parathion should only be used for summer and fall harvested acreages and ordinarily only where there is a history of aphid attacks. Protection will probably last for only a single crop.

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The analyses for the presence of parathion were made by Professor W. M. Hoskins and the Insect Toxicology Laboratory, University of California, Berkeley.

CUTTINGS

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alcohol can be used satisfactorily. This solution will keep indefinitely without losing its effectiveness, but should be tightly sealed and stored in the dark.

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California Agriculture, May 1956, page 7, published a description of mist equipment.

STRAWBERRY

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rooting habit of the strawberry, because most of its feeder roots are rather shallow. When the strawberry beds were formed the top soil—which had a good potassium content—was piled together. Therefore, most of the strawberry roots were in soil with an adequate potassium supplying potential. This contrasts with the apricot trees, which had no roots in the cultivated surface and were unable to obtain adequate supplies from the deeper layers of soil. The fact that the apricot requires large amounts of potassium as shown by leaf analyses may also be pertinent.

The reason for the failure of the strawberry plants to absorb potassium from the added fertilizer is not so clear. The large amount applied to the beds should have encouraged luxury consumption.

This trial does not provide any basis for considering the use of a complete fertilizer for strawberries under similar conditions. Further trials are in progress in other districts to determine what may be expected on other soil types and under different climatic conditions.

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WALNUT

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maturity. Thorough application is most essential, and special care must be exercised when trees are in full leaf.

Although OMPA is the most effective aphicide for the control of the walnut aphid, it can not be used commercially because it has not been nationally registered by the United States Department of Agriculture for use on walnuts, nor has a tolerance been established by the Food and Drug Administration as authorized by the Miller Amendment.

However, satisfactory control can be

expected where Systox is applied twice at a dosage of 0.25–0.37 pound—1–1½ pints of two pounds per gallon emulsion—per acre for each treatment if applications are made with an air carrier sprayer. The first application should be made in the spring and the second in July or August, when the aphid population begins to increase. To avoid injury from Systox it should not be applied until after the leaves are fully expanded. Further, applications should not exceed a total of 0.75 pound—three pints—in a single treatment or during a season, and no treatment should be made closer than three weeks before harvest.

An effective treatment is to use BHC or nicotine in the first treatment, followed by a 0.25–0.37 pound application of Systox when needed in June or July.

Walnut Aphid Control Treatments

Where air carrier sprayers are used, the aphicides listed below have given adequate aphid control when incorporated with the codling moth spray. If used alone, the aphicide should be applied in from 50–150 gallons of water per acre, depending on the air capacity of the sprayer.

Aphicide	Amount per acre
Parathion, 25% wettable powder	1.0–1.5 lbs.
or	
Malathion, 25% wettable powder	3–4 lbs.
or	
TEPP, 40%	¼–1 pt.
or	
Nicotine, 25% dry concentrate	5–6 lbs.
or	
BHC—12% gamma isomer	3.75–4.00 lbs.
or	
Systox	0.25–0.37 lb.

Where conventional sprayers were used, the aphicides gave good control when applied as full coverage sprays. The amounts used per 100 gallons of spray were:

Aphicide	Amounts per 100 gallons
Parathion, 25% wettable powder . . .	3 oz.
or	
Malathion, 25% wettable powder . . .	8 oz.
or	
Nicotine, 25% dry concentrate	10 oz.
or	
BHC—12% gamma isomer	8 oz.
or	
Systox—two pounds per gallon concentrate	¼ pt.

Because of the danger of BHC imparting an off-flavor to the harvested nuts, it should not be used more than once in a season, or later than May, and never at a concentration greater than that recommended by the manufacturer.

In areas where the walnut aphid is resistant to phosphate aphicides, other treatments than parathion, malathion or TEPP should be utilized.

Control of the walnut aphid can be obtained with dusts, where they are thoroughly applied. A 4% malathion dust or a 1% TEPP dust or a 2% nicotine dust applied at the rate of 40–60 pounds per acre have resulted in satisfactory control.

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