DUSKY-VEINED WALNUT APHID STUDIES

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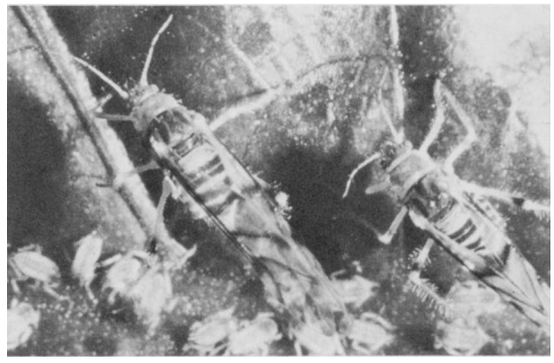


Summer form of **P. juglandis**. Pictured are two winged female aphids and several larvae along the midrib on the upper leaf surface of a walnut leaflet.

IN 1928, THE EUROPEAN DUSKY-VEINED walnut aphid, *Panaphis juglandis* (Goeze), made its first appearance in the Western hemisphere in Oregon's Willamette Valley. The aphid first appeared on walnut trees in California near San Jose in 1952. By the following year it had spread over much of the walnut-producing area of the San Francisco Bay region. Recently the aphid has been found in Contra Costa, San Mateo, Butte, El Dorado, San Joaquin, Glenn, Sutter, Colusa, Tehama, Stanislaus, and Nevada counties.

This aphid is much larger than the common walnut aphid, *Chromaphis juglandicula* (Kalt), from which it differs in that it works entirely on the upper surface of the leaves. Both aphids obtain their nutrition from the phloem tissue. In laboratory life table studies, using seedling walnuts in temperature controlled growth chambers, competition with *C. juglandicula* proved to be an important factor limiting the population growth rate of *P. juglandis*, which survived an average of 12 days when competing for nutrients.

The preference of *P. juglandis* for the upper leaf surface subjects it to a constant rain of honeydew and debris from colonies of *C. juglandicula* on the lower leaf surface of higher leaflets. Contamination of the upper leaf surface with *C. juglandicula* honeydew also helps limit the population of *P. juglandis*, which survived an average of eight days when exposed to *C. juglandicula* honeydew. *P. juglandis* not exposed to honeydew or nutrient competition survived an average of 20 days.

In recent years *C. juglandicula* has been brought under control by the introduction of a parasite, *Trioxys pallidus*, which rapidly became established after its release in northern and central California. Control of *C. juglandicula* by this *parasite* has not only reduced competition between the two aphid species, but has led to the virtual elimination of pesticide applications directed against *C. juglandicula*. The resulting lack of competition with, and the lack of chemical control against *C. juglandicula* has allowed *P. juglandis* to increase.

Life cycle

In the fall wingless females migrate to the trunks of walnut trees where they deposit orange-colored eggs in cracks in the bark. If the females have been fertilized, the eggs turn black in 2 to 5 days, depending on the temperature. After the fertilized eggs hatch in the spring, the young larvae migrate to the upper surface of young tender leaflets, where they settle down to feed on the midrib and develop into winged females. These females produce live young which themselves develop into winged females, settle on other leaflets, and produce live young. This summer form develops very characteristic colonies with individuals lining up in a uniform manner on either side of the midrib on the upper leaf surface (cover photo). Winged males and wingless females appear again in the fall, typically in September.

Injury

A field experiment was begun in June 1971, on Payne walnut trees at the San Jose Deciduous Fruit Station. The study indicated that the aphids had a detrimental effect on walnut leaflets, and on nut quality.

Sleeve cages were placed at random over terminal sections of branches, each enclosing an average of 67 leaflets and four nuts. Two treatments were compared: one set of cages was kept completely free of aphids; and in the other set, a single winged female was introduced. These two conditions were replicated four times each on a different walnut tree. Within these field cage conditions the aphids were allowed to increase in number. Measurements were taken on the population growth of the aphids, on the effects these aphids had on the leaflets, and on nut quality.

The aphids within each cage were counted at approximately weekly intervals. After 39 days the aphids had increased to peaks averaging 56 aphids per leaflet. The aphid populations declined to zero after 65 days from the start of the trial.

Shortly after the aphids began building up on the leaflets, darkening of the midrib occurred. This discoloration remains distinct even after the aphid colonies have gone. The significance of this discoloration was investigated by examining thin cross sections of midrib with the aid of a compound microscope. This examination revealed that the discoloration extended into the conductive tissues of the leaflet, leaving little doubt that the aphids were injurious to leaflets.

Under the test conditions where aphids were present, leaf necrosis first appeared on the 39th day of the trial. All leaflets were necrotic by the 53rd day of the trial. No necrotic leaflets appeared where the cages were kept completely free of aphids. In addition to feeding, copious amounts of honeydew on the leaflets was most likely also a factor in leaf necrosis since *C. juglandicula* honeydew is known to be phytotoxic to green tissue on Payne walnut leaves.

At the end of this trial the walnuts on the branches in each cage were collected, cracked open, and the kernels examined for quality. The color of the kernel was used for quality comparisons—the lighter the color, the higher the quality. The results showed that high aphid populations from mid-June to mid-August reduced kernel quality considerably. Of the nuts collected from infested branches, 29% were light-to-amber in color, and 71% were off-grade. Of the nuts collected from aphid-free branches, all were light-

to-amber in color, and none were off-grade. Even though many leaflets had fallen off and husks were stained from coming in contact with honeydew, the reduction in kernel quality was attributed primarily to aphid feeding and not sunburn, because temperatures were relatively mild and the white sleeve cages provided shading to the walnuts.

First year data (1973) on a trial designed to determine the effect of natural spring aphid populations on walnut quality and yield indicated that the percentage of large-size nuts was the only factor affected by high aphid populations.

Butte Co.

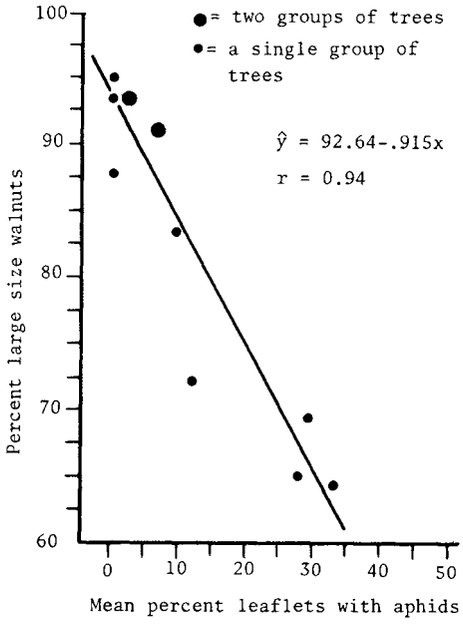
A trial was conducted in Butte County on Ashley trees consisted of monitoring aphid populations on 12 groups of four trees within an orchard. By examining 25 leaflets per tree per week the average percentage of leaflets colonized by aphids on each group of trees was determined. Three groups of trees showed no aphid infestation, and two groups had 1% and 6% of their leaflets infested. The remaining groups had 10, 12, 28, 29, and 33% of their leaflets infested. A portion of the orchard was sprayed with an insecticide to insure that some groups of trees would have low aphid populations. Normal cultural practices were carried out for the entire orchard. Thus differences in walnut yield in this test were attributed to *P. juglandis* populations alone.

The aphid infestations began in early May, reached a peak on May 10, and completely died out in early June. This period coincides with the period of most rapid increase in walnut size.

Harvest samples of 500 gms were taken from each group of trees and hulled, dried, and fumigated. Each sample was sent to Diamond Walnut Growers and evaluated for yield and quality. This trial showed a significant negative correlation —the higher the aphid population the lower the per cent large-size nuts (see graph).

In the trees where an average of 33% of the leaflets were infected during May, 64% of the nuts were graded "large." In trees where no aphids were present, 93% of the nuts were graded "large" size. Based on the weight of a pound consisting of 64% large nuts, and a pound consisting of 93% large, it was calculated that approximately 10,000 more nuts at 64% large were needed to make a ton than at 93% large. These additional 10,000 nuts represent a loss of about 256 lbs for every ton, or about $77 per ton.

EFFECT OF SPRING INFESTATIONS OF **P. JUGLANDIS** ON THE PERCENTAGE OF LARGE SIZE WALNUTS, 1973



From these data it appears that an early, heavy, but short-lived, infestation of aphids will reduce nut size but have little effect on kernel quality. Later prolonged infestations appear to have a more direct influence on kernel quality.

P. juglandis is preyed upon by a number of natural enemies, especially ladybird larvae and adults, lacewing larvae, and syrphid fly larvae. Other predators observed feeding on the eggs of the aphid include certain species of pirate bugs. The only species which has been observed parasitizing the aphid is *T. pallidus*, the effective parasite introduced for control of *C. juglandicula*.

In a laboratory study, three individually caged walnut seedlings were infested with 200 aphids (200 *C. juglandicula*, or 200 *P. juglandis* or 100 *C. juglandicula* and 100 *P. juglandis* aphids, respectively). To each cage 10 female *T. pallidus* parasites reared from *C. juglandicula* were added and held for three days. After three days the parasites were removed and the aphids were examined for parasitism. Of the 200 *C. juglandicula* aphids, 43% were infested with the parasites; of the 200 *P. juglandis* aphids, 10% were infested; and of the mixed group, 15% of the *C. juglandicula*, and none of the *P. juglandis* were infested. These results indicated that in the absence of its preferred host, *C. juglandicula*, the parasite would parasitize *P. juglandis*, and be successful in completing its development to the adult stage.

The impact of this parasite on *P. juglandis* has not been fully observed. However, preliminary laboratory and field observations indicate that the parasite does have an influence on the population growth of this aphid.

Several insecticides were evaluated for control against this aphid in a severely infested orchard in Sutter County during 1973. The insecticides were applied on May 5 with a conventional pressure sprayer using hand guns and spraying to run-off. Four single tree replicates were evaluated for each insecticide tested.

All the treatments reduced the aphid population well below the check (see table). However, Galecron and Volck Supreme Oil did not reduce the aphid population as dramatically as did the other insecticides tested. Supracide, used in this test, is not currently registered for use on walnuts.

Field observations indicate that this aphid is fairly easy to control and several other materials besides those tested in this trial should do an adequate job of controlling this pest.

High temperatures have also contributed to *P. juglandis* control. Life table studies conducted in temperature controlled growth chambers in 1972 showed that the aphid could not survive constant temperatures of 86°F. This study also showed that, of the constant temperatures evaluated, 68°F best promoted long life of adult aphids. Field observations indicate that daytime temperatures of around 100°F for 3 to 5 consecutive days are quite detrimental to the aphid. High summer temperatures have undoubtedly restricted the distribution and abundance of this aphid over the walnut-growing areas of California. Natural selection for more heat-tolerant strains may already have occurred and further selection of this nature could result in this aphid becoming a major pest of walnuts throughout the state.

W. H. Olson is a Farm Advisor, Butte County. *Assistance was provided by Agriculture Advisors Inc. in the insecticide screening trial conducted in Sutter County.*

TREATMENTS AND CONTROL OBTAINED AGAINST **P. juglandis**, 1973

Material	Dosage per 100 gal. water	Mean no. colonies per 25 leaflets	
		Pretreatment 5/5/73	Posttreatment 5/12/73*
Thiodan 50% WP	¾ lb.	8.5	0.0 a
Thiodan 50% WP	¼ lb.	12.8	0.5 a
Zolone E.C.	12 oz.	11.0	0.2 a
Zolone E.C.	4 oz.	13.2	0.8 a
Diazinon 50% WP	1 lb.	9.0	0.0 a
Supracide 2E†	1 pt.	12.5	0.5 a
Volck Supreme Oil	1 gal	13.2	3.8 b
Galecron SP 95%	½ lb	10.8	4.2 b
Untreated check		10.0	14.5 c

* Means not followed by a common letter are statistically different at the 0.05 level according to Duncan's Multiple Range Test.
† Supracide not presently registered for use on walnuts.