Imported Parasites Established

natural enemies of the spotted alfalfa aphid brought from the Middle East in 1955–56 now established in California

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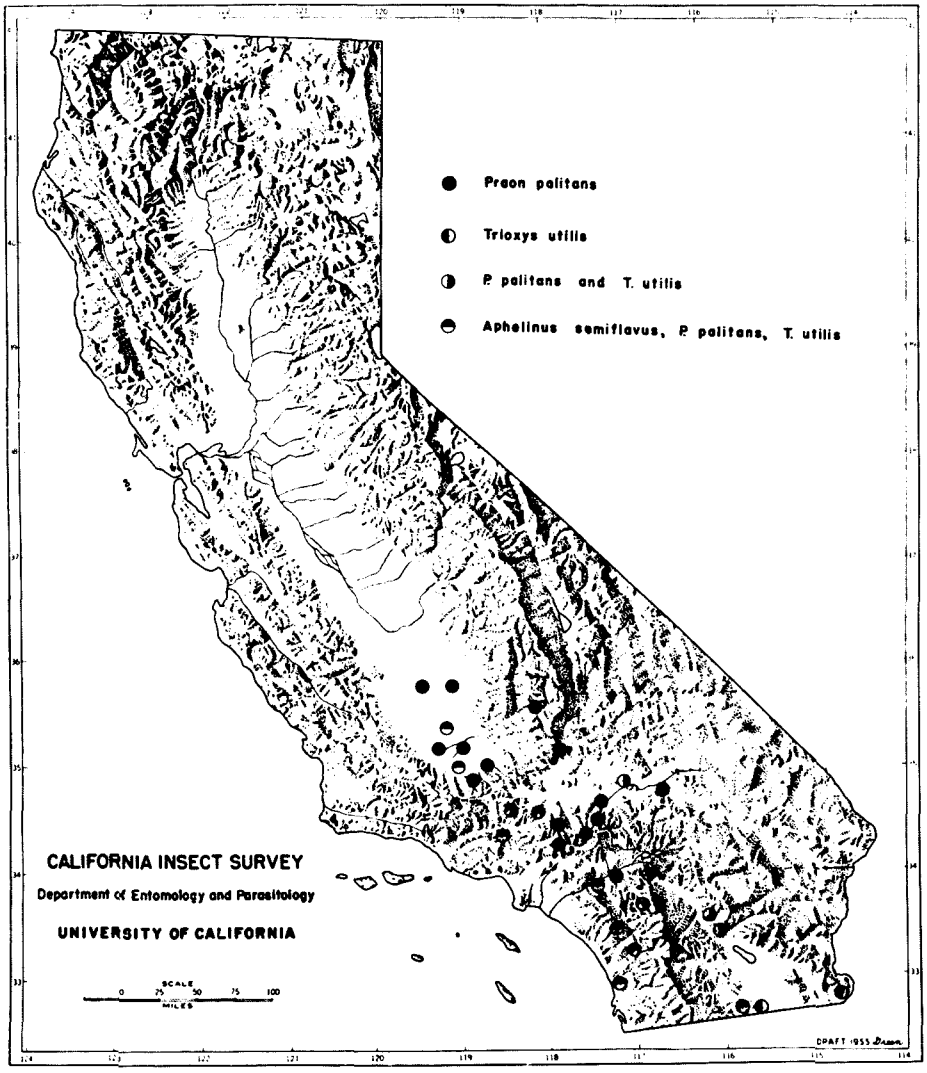
Three imported wasp species—parasites of the spotted alfalfa aphid—have survived their first winter in southern California alfalfa fields and have become abundant in several localities.

The parasites—*Praon palitans* Muesebeck, *Trioxys utilis* Muesebeck, and *Aphelinus semiflavus* Howard—became firmly established in the summer of 1956 in a release plot east of Lancaster in Los Angeles County and in another plot at Cawelo in Kern County. By late summer they reached tremendous abundance in the Lancaster plot, with parasite mummified aphids averaging 40 per alfalfa stem and adult parasites 65 per sweep of the insect net on one occasion.

An estimated 50 million parasites were distributed from the Lancaster field into new plots in Kern, Los Angeles, Riverside, San Diego, San Bernardino, and Imperial counties in the fall of 1956. Where these massive colonizations were made, the parasites almost invariably became established and increased very rapidly. Later movement of parasites from the newer establishments hastened their spread—by natural and artificial means—over the aphid-affected areas.

During the winter of 1956–57 biological investigations were carried out on all three of the wasp parasites of the spotted alfalfa aphid.

Distribution of the imported parasites of the spotted alfalfa aphid in California on April 15, 1957.



The wasp—*Praon palitans* Muesebeck—attacks aphid nymphs of varying size range, but prefers those of somewhat larger size—second or third instar—than do *Trioxys* and *Aphelinus*. Because of this habit *Praon* generally kills its host at a later growth stage than do the other two species. Under optimum laboratory conditions the *Praon* life cycle requires about 12 days from egg to adult.

Field and laboratory investigations have revealed that *Praon* passes the winter in facultative diapause—a hibernating condition—as a mature larva within its cocoon. The diapause cocoons which are found in the litter in the alfalfa fields are brown in color and much tougher than those of the whitish, non-diapause type. Last fall *Praon* apparently went into diapause over about a two-month period with practically all the adults having disappeared from the field by December 1. Spring emergence was first noticed in early February and by April 15 substantial emergence had taken place in all areas. In early April, *Praon* adults were extremely abundant over—at least—a 100-square mile area in the eastern Antelope Valley. Also, they have been recovered in varying abundance in the Mojave River Valley, southern San Joaquin Valley, western Riverside County, coastal San Diego County, and the Coachella and Imperial valleys. In all those areas, aphids parasitized by the first or second spring parasite generation have been observed.

Because it kills aphids at a later growth stage *Praon* is carried in flight by parasitized winged aphids to a much greater extent than either *Trioxys* or *Aphelinus* and consequently has spread over greater distances.

In the fall of 1956, *Praon* spread from the original establishment area near Lancaster to Victorville, about 40 miles to the east. Areawise, it is now established over at least 700 square miles in the Mojave Desert.

Praon has also spread very rapidly in the southern San Joaquin Valley. A recent survey revealed this parasite to be distributed over about a 700-square mile area in Kern County bounded by Shafter

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Navel Orangeworm

summer infestations of codling moth on walnuts favorable to navel orangeworm

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Summer walnuts infested with the codling moth furnish breeding locations for the navel orangeworm and—as a result—a population of moths is present in the orchard when the husks begin to crack as the harvest period approaches. The caterpillars of the navel orangeworm are unable to penetrate the green husks of sound walnuts so they are not subject to infestation until maturity is reached and the husks split. After this stage of nut development is reached, the crop is open to attack until it is harvested. As a result the amount of infestation tends to increase as harvest is delayed.

Because the codling moth infestation was higher in 1956 than in any recent year, an increase in the navel orangeworm infestation was expected. Evidence that an increase did occur was found in the experimental orchard at Modesto. The number of nuts attacked by the navel orangeworm was greater than in 1955. Further, the degree of infestation was correlated with the control obtained of the codling moth. The highest infestation of the navel orangeworm occurred in the check plot and the lowest in the plot where the best control of the codling moth was obtained.

Walnuts Infested with the Codling Moth and the Navel Orangeworm in the Experimental Orchard at Modesto

Treatment and amount applied/acre in pounds	Infestation in harvested crop	
	Codling moth %	Navel orangeworm %
Check (no treatment) ..	6.6	6.16
DDT, 50% W.P., 8	4.0	3.30
DDT, 50% W.P., 12	2.5	2.10

Other than controlling the codling moth, no effective spray program has been developed for the control of the navel orangeworm. Cultural practices—sanitation within the orchard, about hullers and buildings—must be relied upon to check the pest in the field. Prompt harvest of the crop and—because the navel orangeworm can breed in storage—immediate fumigation of the harvested crop are precautionary measures when an infestation is suspected.

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and Cawelo to the north, Buttonwillow to the west, Arvin to the east, and Wheeler Ridge to the south. The original source of parasites for this dispersion was a field near Mettler Station that had been colonized in the fall of 1956 with field-collected parasite material obtained at Lancaster.

The wasp—*Trioxys utilis* Muesebeck—unlike *Praon*—continued to reproduce throughout the past winter and hence multiplied and spread while populations of *Praon* remained in diapause. *Trioxys* has a shorter life cycle than *Praon*, requiring about 10 days to pass from egg to adult under optimum laboratory conditions. It attacks aphid nymphs of smaller size—first and second instar—than does *Praon*, and mummifies the aphids at an earlier growth stage. This factor unquestionably accounts for the much slower spread of *Trioxys* as it is not carried to the same extent by parasitized winged aphids. However, principally by its own powers of dispersion, this parasite spread over about a 10-square-mile area in the Antelope Valley in the summer and fall of 1956. During the winter it spread throughout and beyond a 50-acre field at Hemet, a 300-acre field at Thermal, a 50-acre field in Pauma Valley—San Diego County—a distance of over 10 miles from an 80-acre field near Mettler Station, and over an area of about five square miles at Calexico. In several places, *Trioxys* has reached very great abundance, particularly at Calexico, Hemet, Indio, Lancaster, Mettler Station, Pauma Valley, Saugus, and Thermal. It appears to be established in all areas where *Praon* is found and in addition has been recovered from the Yuma Valley.

The performance of the wasp—*Aphelinus semiflavus* Howard—has been much less spectacular than that of *Praon* or *Trioxys*. However, in recent months it has been recovered with increasing frequency and shows considerably greater promise than was evident originally.

Aphelinus requires about 14 days to pass from egg to adult under optimum conditions. Like *Trioxys*, it prefers to attack the smaller aphid nymphs and generally kills the aphids before they reach maturity. All evidence indicates that this parasite continued to reproduce throughout the past winter. It is currently abundant in several places and appears to be definitely established at Del Mar—where it has spread over about 100 acres—and at Cawelo, Lancaster, Mettler Station, Pauma Valley, Riverside, and Temecula.

The performances of the three imported spotted alfalfa aphid parasites are extremely encouraging. There is evidence that they are already destroying great numbers of aphids in many localities. However, it is as yet difficult to evaluate their effectiveness, as the field situation is complicated by invading aphids flying into the study plots from areas where the parasites have not become established.

Because of the widespread establishment of the spotted alfalfa aphid parasites in southern California, colonization of insectary-reared material has been curtailed. However, an intensive effort is being made to disseminate field-collected parasites. This program has been expedited by the development of a mechanical parasite collector.

The mechanical collector is mounted on a pick-up truck, and consists of a 15′ scoop, two canvas wind tunnels containing insect collecting sacks, and a large rotary fan powered by a gasoline motor. Parasites are knocked onto the scoop—as the collector moves through an alfalfa field—and are drawn into the wind tunnels by an air stream generated by the rotary fan. Coarse mesh sacks within the wind tunnels screen off larger insects and debris while the parasites and parasitized aphids pass through to outer organdie sacks. The mechanical collector can be driven over 30–40 acres of alfalfa a day and—under favorable conditions—can collect almost unlimited numbers of parasites.

In the first six weeks of operation an estimated 150 million parasites were collected and distributed to 140 farms in southern California.

As the season and conditions permit, the mechanical collector will be used to collect parasites for release in other parts of the state. It is anticipated that every aphid-infested area in California will have been heavily colonized with parasites by the end of 1957.

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