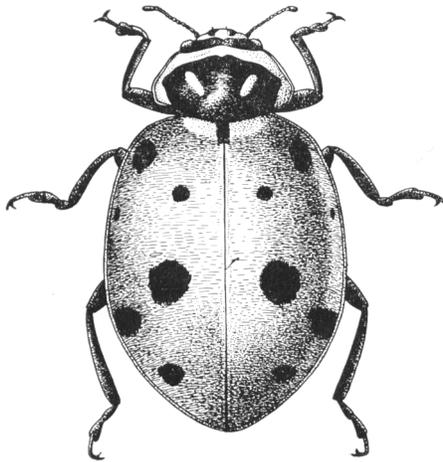
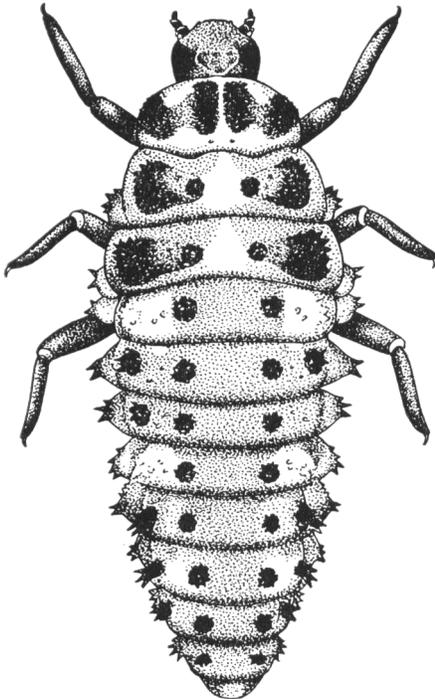


Adult convergent lady beetle feeding on spotted alfalfa aphids.



Above—Convergent lady beetle adult. 8x.
Below—Convergent lady beetle larva. 10x.



Enemies of Spotted Alfalfa

lady beetles, hover flies, lacewings are three native predators of aphids and other economic

Natural enemies—native insect predators and fungus diseases—helped to hold the spotted alfalfa aphid in check during the 1955 season. In some fields an epizootic—corresponding to an epidemic among humans—of a fungus disease prevented damage by the aphid.

None of the common aphid parasites attack the spotted alfalfa aphid in the field and the predators seem to be most important during the spring and fall and in stubble fields following cutting.

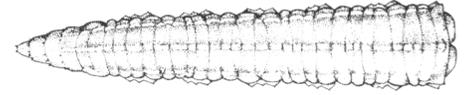
Among the many kinds of predators in alfalfa fields the lady beetles—or lady bugs—the hover flies, lacewings, damsel bugs and big-eyed bugs play significant roles in the natural control of the spotted alfalfa aphid.

Although predators do not always prevent economic outbreaks of the spotted alfalfa aphid, they are important in holding down light infestations and preventing reinfestation after a chemical control treatment has been applied.

The importance of the predators varies from field to field, area to area, and season to season. For example, under one set of conditions the lady beetles may be the most important, and under other conditions hover flies may be the most important. More often, it is the entire complex of predators working together that is significant in holding the aphids in check. This complex of predators appears to be larger and more important in areas with the mildest climates—like the central California coast—than in areas with severe climates—like the southern California deserts. The number of aphids destroyed by a particular predator depends on the kind of predator, its method of feeding, its size and stage of development, the abundance of aphids, and weather conditions.

The natural enemies of the spotted alfalfa aphid are also important in reducing other alfalfa pests and pests of other crops. Many potentially harmful alfalfa insects are kept below economic numbers by these parasites and predators; and other pests—such as the beet armyworm and leafminers—are reduced to minor problems.

Because it is the overwintering site—and the place of spring and early summer increase of many predators—alfalfa is an important reservoir of natural enemies for other crop pests. It is the main



Large hover fly larva. 5x.

source of predators of the bollworms and spider mites in cotton. Often the predators delay the development of economic infestations of these pests in fields of cotton.

Chemical control measures directed against any alfalfa pest should take into consideration their effect on natural control factors. Parathion as used for the control of the spotted alfalfa aphid is destructive to all of the important predators; however, the lower dosages are less harmful. Usually after three or four days the parathion has lost its effectiveness and predators start reappearing either through migration into the field or by the hatching of eggs which survived the treatment. Malathion is also very toxic to the predators but is less harmful to some than is parathion. Where big-eyed bugs and damsel bugs are very abundant, sufficient numbers may survive malathion treatments to delay the return of economic aphid populations. Systox reduces lady beetle populations, but most of the other predators survive treatments with this material. In alfalfa seed fields where DDT and toxaphane are used independently, they are moderately toxic to predators; aramite is essentially non-toxic.

Lady beetles are important natural enemies of the spotted alfalfa aphid. There are over 20 different kinds that can be found in alfalfa fields in California and additional kinds are being introduced to assist in the control of aphids. All of the important lady beetles feeding on aphids are reddish brown and usually have variously shaped black markings. Seven kinds are found commonly in the Central Valley. The convergent lady beetle—*Hippodamia convergens* Guérin—is the most abundant. It has two oblique white marks on the prothorax and usually has 13 spots on the wing covers. The thirteen-spotted lady beetle—*H. tredecimpunctata tibialis* Say—which is very abundant in the Sacramento Valley also has 13 spots but lacks the white marks on the prothorax.

Alfalfa Aphid

The important economic pests of alfalfa

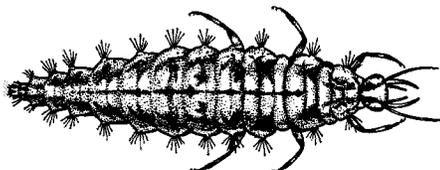
Ray F. Smith and Kenneth S. Hagen

The interrupted lady beetle—*H. quinquesignata ambigua* LeConte—is similar to spotless forms of the convergent lady beetle but has the white margin of the prothorax irregular in outline or broken. The spotless lady beetle—*H. quinquesignata punctulata* LeConte—is a common spotless species which lacks the oblique marks on the prothorax. The parenthesis lady beetle—*H. parenthesis* (Say)—usually has a parenthesis shaped mark on each wing cover behind the middle and has a square white spot at the base of the prothorax. The sinuate lady beetle—*H. sinuata* Mulsant—has wavy stripes running the length of the wing covers. The white-faced lady beetle—*Coccinella novemnotata franciscana* Casey—is spotless and can be separated from all the *Hippodamia* by its convex shape in lateral view and round outline. In the coastal areas, most of these same lady beetles occur and in addition two or three others are common.

Both the adults and the alligatorlike larvae of lady beetles feed on spotted alfalfa aphids. During its life a lady beetle may eat over 1000 aphids. The mature larvae or the adults eat about 40 to 50 aphids per day in good weather and under cool wet conditions only one or two. The adults are long-lived, living generally for about one year. They lay bright yellow eggs in groups of 10 to 50 and a single adult may lay over 1000 eggs. The larvae hatch in about five days in warm weather and start feeding immediately. The larvae, which are gray to black with variable scattered light spots, complete their development in two to four weeks depending on conditions and the availability of food. The pupal stage lasts about four to eight days and thus



Above—Lacewing adult. 3x.
Below—Lacewing larva. 7x.



the entire life from egg to adult takes about four to six weeks.

The lady beetles persist through the winter and other unfavorable periods as adults. The convergent lady beetle migrates many miles from its valley feeding areas to find suitable resting conditions in the mountain valleys. Apparently the migration is started by unfavorable conditions—such as scarcity of food—occurring in the valleys. In the mountain canyons, they form huge masses near the streams and remain more or less quiet. These lady beetles may enter the mountains as early as May and they do not leave again until the next year. In late February or March the aggregations break up and the lady beetles fly back to the valleys.

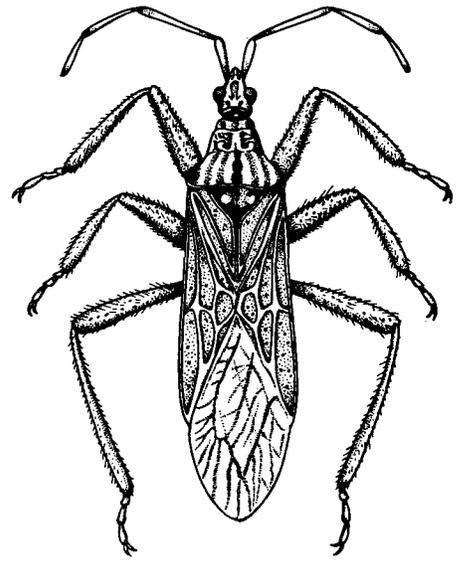
The other important lady beetles do not make such migrations in California, but remain in the areas near where they have been feeding. They can be found in small aggregations in ditch bank weeds, under logs, under bark, or any place that offers shelter. Most species will remain in alfalfa fields throughout the year if aphids are present.

It has been a practice over the past 50 years to collect large numbers of the convergent lady beetle as it overwintered in the mountain canyons and to release these beetles later in various crops in the valleys. Numerous careful tests over a period of years have not been able to demonstrate any benefits in aphid control from such spring releases, because the majority of the beetles disperse so rapidly they do not provide aphid control in the areas of release. Additional investigations are underway to determine methods of preventing this dispersal.

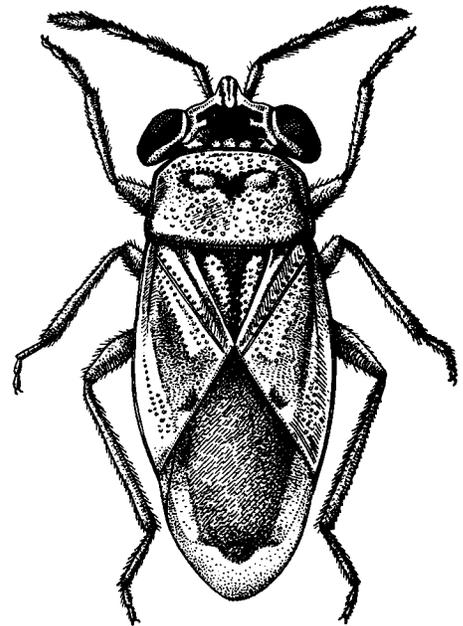
Syrphid flies or hover flies have in some instances reduced heavy populations of spotted alfalfa aphids. The bee-like adult flies are brown or black with conspicuous white or yellow markings. They are commonly seen hovering about the plants or near flowers and they may have some value as pollinators. The adults do not eat aphids but feed on pollen, nectar and honeydew. The young are greenish or grayish legless maggots, pointed at the anterior end, and frequently with a light stripe down the back. These maggots feed on any stage of the aphid they encounter as they blindly grope their way through the aphid colonies. They grasp the aphid with their pointed mouth hooks, suck the body dry, and then cast it aside. The larger species such as *Scaeva pyrastris* may destroy over 500 aphids in reaching maturity, while smaller ones consume about 200 to 300.

There are over a dozen kinds of aphid-feeding hover flies in alfalfa fields in the Central Valley but only eight are important. The large hover fly—*Scaeva py-*

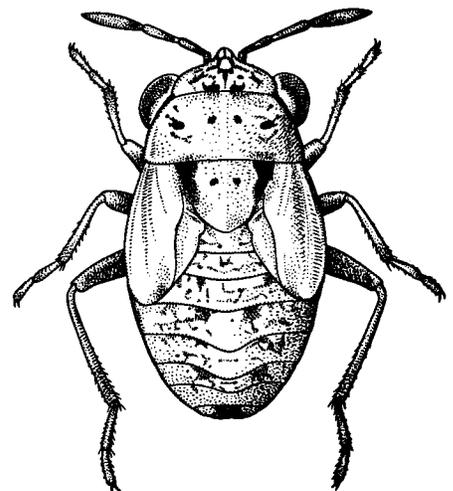
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Damsel bug adult. 7x.



Above—Big-eyed bug adult. 18x.
Below—Big-eyed bug nymph. 15x.



ALFALFA APHID

Continued from preceding page

rastris (Linnaeus)—is the largest—about a half an inch in length—and the most abundant. The dark colored abdomen has six light colored curved spots. The spineless larvae are light green with a white longitudinal stripe. The western hover fly—*Syrphus opinator* Osten Sacken—has a yellow face, is slightly smaller and has two spots and two bands extending across the abdomen. The spiny larvae are yellow or brown. *Metasyrphus meadii* (Jones) is similar to the western hover fly but has black markings on the face and a shiny thorax. The bird hover fly—*Eupeodes volucris* Osten Sacken—looks like the large hover fly but is only one third of an inch in length. The larvae have several longitudinal whitish stripes. The chevroned hover fly—*Allograpta obliqua* (Say)—is about one third of an inch long and has two oblique yellow marks near the tip of the abdomen in addition to the usual yellow bands. The smooth green larvae have a broad whitish median stripe and very prominent breathing tubes. *Sphaerophoria cylindrica* (Say) is about the same length but has a narrow cylindrical abdomen. *Mesogramma marginata* (Say) has gray stripes on the top of the black thorax and is only one quarter of an inch long. The larvae are greenish-yellow and more or less transparent. *Platycheirus* are slender, small—one third of an inch or less—and have dark faces. The pinkish larvae feed at night.

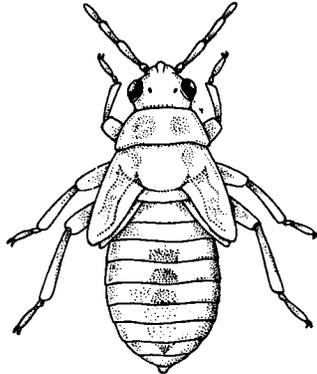
The eggs of aphid-feeding hover flies are elongate, oval and chalky white. The adult fly lays the eggs on the leaves while it hovers over the aphid colony. In from three to 11 days, the eggs hatch and the larvae begin feeding immediately. In the absence of aphids, the larvae will feed on each other. In 11 to 33 days the mature larvae are ready to pupate. They excrete a large mass of black sludgelike material and usually form the greenish or brownish puparia in the surface soil but occasionally on the plants.

During warm periods the adults emerge from these puparia in about 11 to 16 days while during the winter they may not emerge for as long as three months. In favorable periods the entire life cycle from egg to adult may take only a month. Hover flies are most abundant in spring and fall, but they are active throughout the year.

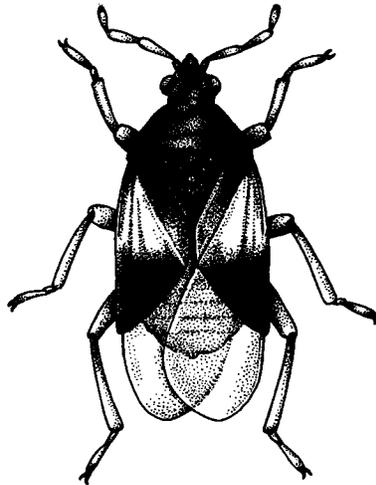
The delicate, green lacewing—*Chrysopa plorabunda californica* Coquillett—is another important enemy of the spotted alfalfa aphid as well as other soft bodied insects. The adults do not feed directly upon the aphids but obtain their nutrients from honeydew excreted by the aphids. This habit helps to explain the large increase in numbers of green lace-

wings in alfalfa since the introduction of the spotted alfalfa aphid. Other species of *Chrysopa* may occasionally occur in alfalfa fields as well as brown lacewings of the genus *Hemerobius*.

An adult green lacewing lays up to 800 eggs scattered in groups in the adult feeding area. Each egg is green, oval and supported on a long slender stalk. The larvae hatch from the eggs in six to 12 days and climb down the stalk. These light-gray spindle-shaped larvae move about rapidly in search of aphids. They have been reported as traveling 223 feet per hour and searching 107 square inches per hour. The aphids are grasped in the



Above—*Orius* nymph. Below—*Orius* adult.



long sickle-shaped jaws and sucked dry. During the larval development of 11 to 27 days, a green lacewing will eat 300 to 400 aphids. When mature they spin globular whitish silken cocoons on the leaves or in protected places. In about 16 days the pupa cuts a circular lid from the top of the cocoon and crawls out. The adult then emerges.

Damsel bugs—*Nabis ferus* (Linnaeus)—are slender grayish bugs about one third of an inch in length when full grown. The smaller nymphs feed on spider mites, aphids and leafhoppers and the larger ones attack aphids, lygus bugs and even caterpillars. They grasp their victims with their forelegs and insert the

beak. The prey soon becomes paralyzed and dies within a day even if no feeding by the damsel bug occurs. One adult consumed 176 fourth instar pea aphids in 45 days or an average of 3.9 per day. Aphids are often overlooked by the damsel bugs if they remain motionless.

Big-eyed bugs—*Geocoris pallens* Stål, *G. punctipes* (Say), and *G. atricolor* Montandon—are small bugs—about one-eighth inch in length—with large conspicuous eyes in both the adult and nymphal stages. They feed on aphids, thrips, spider mites and other small soft-bodied insects. They drop quickly from the plant and are commonly seen running on the ground. They consume about 1,600 spider mites during their life cycle and an adult can account for about 80 spider mites per day. They eat about three or four aphids per day when mature. Sometimes big-eyed bugs may be seen running over the leaves destroying aphids without eating them. They also feed on honeydew.

Other predators may occasionally feed on aphids but in general the ones mentioned above are most important. Spiders are often very abundant in alfalfa fields; they will feed on aphids but seem to prefer larger insects. The adults of *Collops necopinus* Fall and *C. versatilis* Fall will feed on aphids and are occasionally abundant. Minute pirate bugs—*Orius tristicolor* (White)—are often very abundant but they feed largely on spider mites and thrips and rarely take aphids. Leather-winged beetles—such as *Podabrus pruinus* LeConte—feed on aphids and are common in alfalfa fields in coastal areas in the spring. Stilt bugs—*Neides muticus* (Say)—feed on leafhoppers and other small insects but are never abundant enough in alfalfa fields to be significant control factors. Soldier bugs and assassin bugs—like *Sinea diadema* (Fabricius)—although sometimes abundant usually feed on larger insects like lygus bugs and small caterpillars.

These natural enemies are important aids in controlling the spotted alfalfa aphid. Even though they do not always control the aphid, their presence and effectiveness should always be considered before applying chemical treatments. On the other hand, the grower should not blindly depend upon natural enemies to control the aphid.

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