LYGUS BUGS

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The western tarnished plant bug or lygus bug, *Lygus hesperus* (Knight), can be one of the most difficult pest problems in pistachio. The severity of this insect as a pest in orchards is dependent upon the development of the insect on host plants on which it lives and feeds. Unlike *Phytocoris*, *Lygus* does not develop on pistachio. Instead, *Lygus* moves into the orchard from surrounding crops or weeds and into the tree when understory vegetation becomes unsuitable. Environmental conditions such as rainfall and temperature, which favor the emergence and establishment of many broadleaf weeds, will favor *Lygus* population development in the general west side area of the San Joaquin Valley.

DESCRIPTION AND DEVELOPMENT

Lygus hesperus is predominantly brown with a gold straw-like mottling also present throughout the body. It is about 1/4 of an inch in length. Another species, *Lygus elisus* Van Duzee, is a light green color, the same size, but less common (Mueller et al., 2003). Both these species have yellowish triangular markings on the back between the wings. *Lygus* could be confused with *Calocoris* (Chapter 21) but *Calocoris* has two distinct spots on the pronotum just behind the head and usually has a green (compared to yellow for *Lygus*) triangular scutellum (Plate 22A). *Lygus* can be distinguished from *Neurocolpus* (Chapter 21) by their short first antennal segment and uniform leg coloration compared to a long first antennal segment and alternating white and brown bands on the legs and antennae of *Neurocolpus* (Plate 21A).

The immature or nymphal stages of *Lygus* are light green, hump-shaped and appear like aphids. As the nymphs mature, they develop wing pads. As the nymphs reach maturity, the presence of five black dots can be seen on the back of the insect. Two dots are located on the prothorax, two on the mesothorax, and one on the abdomen. *Neurocolpus* nymphs also have black dots and mottling, but also have black and white stripes on the legs and antennae (Plate 21B). *Calocoris* nymphs do not have black dots (Plate 22A). This stage is seldom found on pistachios because little egg-laying occurs on the crop. It is important to recognize the nymphs as they reach maturity, as this indicates when migration from host weeds to pistachios may occur. Just prior to migration small wing pads will be noted on the back of the nymphs (Plate 22A). While older nymphs can cause substantial damage in many crops, it is the adults that are key in population movements. Adults can fly away from unsuitable conditions, nymphs cannot.

Lygus overwinter as adults and move from ground cover protection to a variety of host plants in spring. In alfalfa, five to seven generations per year will occur but only three can develop in cotton (Leigh et al,, 1996). The number of generations occurring in spring on non-crop hosts is determined by the amount of heat available for development. Developmental thresholds for *L. hesperus* range from 46.4° (Champlain and Butler, 1967) to 53.6° F. As day length decreases to less than 9 hours, immature *L. hesperus* adults enter into an arrested development or sexual diapause (Beards and Strong, 1966).

DAMAGE

Like *Neurocolpus*, *Calocoris* and *Phytocoris*, *Lygus* damage is caused by feeding and occurs prior to hardening of the shell. These insects only cause epicarp lesion because they are incapable of piercing a hardened pistachio shell and do not cause internal nut (kernel) necrosis as do the larger stinkbugs and leaffooted bugs. Research conducted with *Calocoris* indicated

that shell hardening was sufficient to prevent damage when 1,197 $dd_{>50^\circ F}$ had occurred after 75% bloom (Purcell and Welter, 1991).

HOST PLANTS AND MOVEMENT

To understand *Lygus* management it is important to understand its biology in the agro-ecosystem in which pistachios are found. *Lygus* is a native insect in the San Joaquin Valley that feeds on developing reproductive or growth tissues. *L. hesperus* has a reported host range of 110 plant species, with two plant families (Asteraceae and Fabaceae) constituting 39% of its recorded hosts (Scott, 1977). Lygus bugs are pests on cotton, seed alfalfa, strawberries, dry beans, apples, pears, celery, broccoli, cauliflower, and vegetable seed crops. Lygus bugs generally do not use grasses as reproductive hosts.

Lygus intensity in any given year depends on 1) the abundance of hosts (determined by rainfall patterns), 2) warm temperatures in the early season that allow *Lygus* to complete multiple generations and 3) early summer hosts (Plate 22B).

In California's Mediterranean climate, few non-cultivated hosts survive beyond June and most *Lygus* movement from wild areas occurs between April and May. Winter rainfall patterns set the stage for the abundance, diversity, and longevity of hosts that are suitable for the colonization. Early winter rains tend to produce grass years in the surrounding hills while late winter rains favor broad leaf hosts suitable for *Lygus* such as London rocket, filaree and clovers (George et al., 1988). Abundant rainfall in spring provides deep moisture for Russian thistle and tarweed. In years when moisture is adequate to extend these host plants into June or July, additional generations can build and create severe *Lygus* migrations. Many crops such as sugar beets, seed alfalfa, tomatoes, and weeds within orchards, vineyards, and row crops provide areas of refuge during the winter and spring, regardless of weather conditions (Stern, 1969).

Summer hosts consist almost entirely of cultivated plants or their associated weed complexes, which in the San Joaquin Valley includes over 200 crops. As these crops are readied for harvest, *Lygus* will be forced to migrate in neighboring fields. Alfalfa hay represents a substantial portion of cropland that *Lygus* inhabit and is preferred over many other plants.

Thus, it is the proximity of a pistachio orchard to these sources that determines the intensity of the migration. Since the majority of the production occurs on the western edge of the San Joaquin Valley, the native plant growth in the west side hills would be more important as a source of *Lygus* then cultivated crops bordering the orchard. For example, in years when late winter or early spring rainfall (February through April) plants such as *Hemizonia* (tarweed) or Russian thistle can cover hundreds or even thousands of acres. The population density can build to high levels if the plant can draw sufficient moisture to remain a suitable host to *Lygus* for multiple generations.

Once the insects move into the orchard, the understory vegetation can become an important source of *Lygus* that can move into the tree when the vegetation becomes unsuitable. Cover crops that serve as good *Lygus* hosts include vetch, bur medic, crimson, rose, and berseem clover and these should be avoided. For seeded cover crops the use of subterranean clover has been suggested (Thomas et al., 1998) as a non-*Lygus* host.

The timing of *Lygus* movement into a pistachio orchard determines the severity of the problem. *Lygus* can penetrate the shell only before it hardens so migration into an orchard between bloom and shell hardening is critical. For example, both birdsfoot trefoil and bur clover naturally decline prior to the growth of nut clusters in pistachio. However, other weed hosts that overlap with developing nut clusters include lupine, London rocket, various mustards, stinging nettle, and tarweed and the development of *Lygus* on these weeds is important. During dry years these weed species usually become unattractive at the same time when pistachio nut clusters are susceptible to *Lygus*.

Plants that can act as hosts should be sampled to detect of *Lygus* and estimate the threat of movement. A standard 38" sweep net is useful in striking the tops or sides of plants and counting the insects caught in the net. As

an aid in predicting possible *Lygus* movements, it is valuable to identify the host, note its condition (i.e. vigorously growing, flowering, drying), and the age structure of *Lygus* collected from the host (nymphs or adults, instar of nymphs). Grasses are not a host for *Lygus* and sampling for *Lygus* in grasses will result in a misleading estimation of population abundance.

Following *Lygus* populations in these hosts over several years will help in describing their relationship to movement into pistachio orchards. The cotton industry has supported regional *Lygus* surveys in the San Joaquin Valley for many years. The annual reports are published in local papers, newsletters, and other media during late May or early June.

MONITORING AND CONTROL

Monitoring of *Lygus* should be done with a sweep net on host weeds at the appropriate time. Numerous sweeps should be made to detect the presence of *Lygus* and the stage of their development. As the wing pads become visible on the captured insects there is potential for migration if the weeds dry. If weeds can be sprayed within pistachio, the insects are easily killed. The material proven most effective is permethrin (Pounce® or Ambush®).

Within the pistachio tree, *Lygus* is difficult to detect. The most common method of sampling is the use of a beating tray whereby the catch tray is held under a nut cluster and the limb holding the cluster is struck with a club to dislodge bugs. This technique is not very efficient and even two or three insects found is an indication of a damaging population. If epicarp lesion is increasing within the orchard and adult *Lygus* can be found, it may be necessary to spray the crop. The amount of lesion present is also a determinant in deciding upon the need for treatment. There are no current thresholds for treating *Lygus* in pistachio. If the decision to spray is made, timing should be based on the development of adults in the weed hosts nearby. It is important not to disturb weeds within the orchard during the period from bloom through shell hardening. If weeds are disturbed, *Lygus* may be driven into the trees where bug feeding results in epicarp lesion.

Due to the migratory nature of this pest, future work should address regional management of *Lygus.* Research has already documented that alfalfa is a preferred host of *Lygus*, and practices such as strip cropping can help keep *Lygus* in the alfalfa (Goodell et al., 2000). Future research could potentially develop better ways to utilize host weeds or plants as trap crops which would keep the insect from migrating to the less preferred pistachios.

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