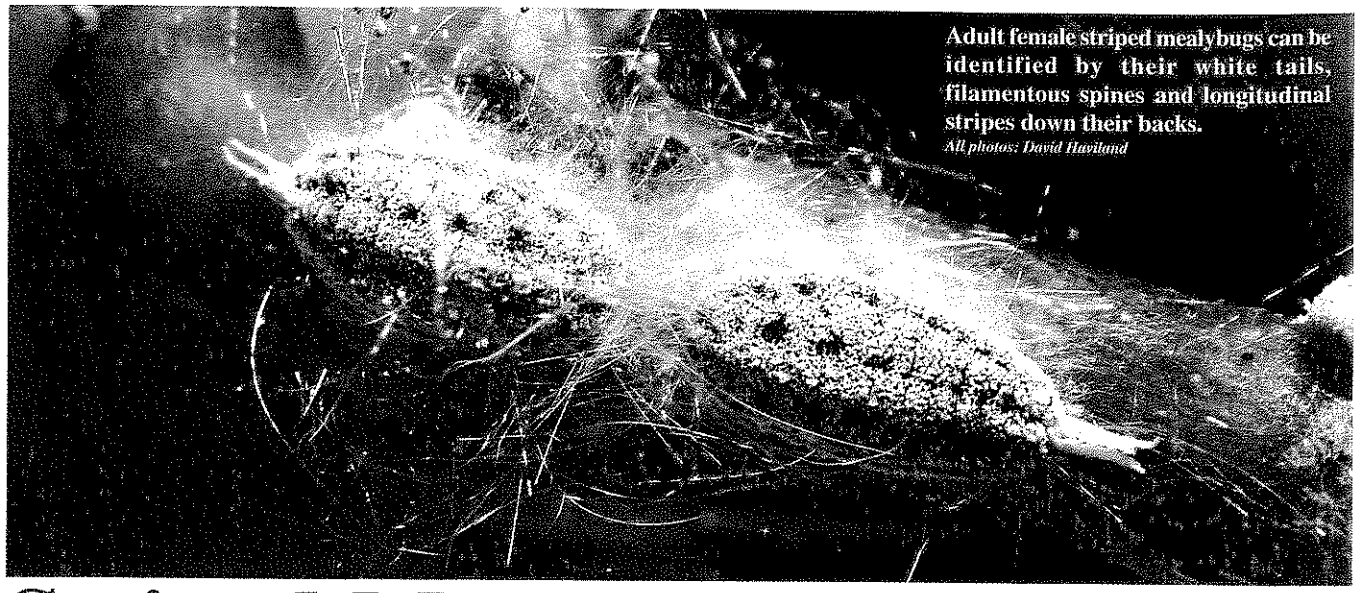


Adult female striped mealybugs can be identified by their white tails, filamentous spines and longitudinal stripes down their backs.
All photos: David Haviland

Striped Mealybug in Pistachios

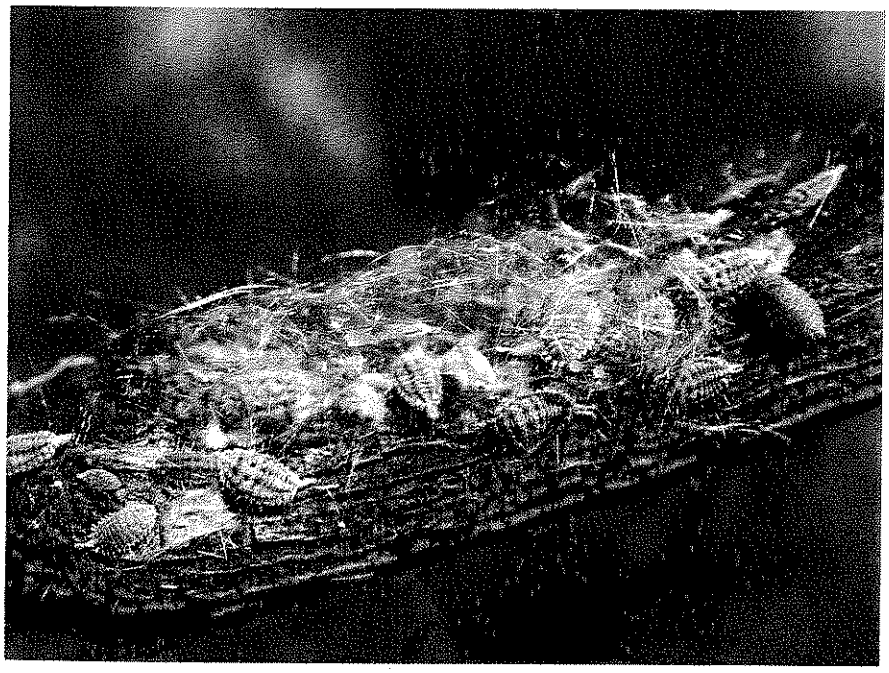
An Overview of this New Pest in California

By David Haviland

October's PNP article on striped mealybug in pistachio alerted growers to the increasing problem it poses to the industry. This month, information is provided about its biology and other hosts, which presently includes almonds, grapes, and several ornamentals.

Research and education programs are now underway to begin to better understand this pest, the damage it causes, and how to control it.

The striped mealybug, *Ferrisia gilli*, has become a significant pest of pistachios wherever it is found in the lower San Joaquin Valley. The current infestation near the town of Tulare has expanded greatly during the past few years, and this pest has now been reported to affect additional commodities such as almonds and grapes. Infestations in pistachios during 2004 appeared to have significantly lowered the quality, and possibly yields, of nuts in unsprayed orchards as well as in some that received insecticides.



Identification and Life Cycle

Adult female striped mealybugs are between 2 and 5 mm in length, and are covered in a white wax. They derive their name from two darker areas, or stripes, that run the length of the top of the insect. Adult male mealybugs are about one half the length of the females, have wings, and look like tiny wasps with two long tails. Seeing them usually requires a hand lens.

After mating, adult females produce mobile first-instar nymphs, called crawlers, which hide underneath the female to feed. As they grow in size, nymphs leave the protection of the mother to seek out a suitable feeding site. This is usually not too far away and results in clumping of this pest. Nymphs and adult female mealybugs can also be identified by the long, rod-like filaments of varying lengths that cover their bodies. These white, glassy rods can reach lengths up to a centimeter long, and cause aggregated clumps of these insects in the winter to give trees a white bearded appearance. During their life cycle, nymphs molt three times before reaching adulthood.

This mealybug is thought to have

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three generations per year in the San Joaquin Valley. They supposedly spend the winter under bark in the nymphal stages and then emerge to feed on new leaves in the spring. Mealybugs spend most of the year feeding within the tree canopy and have a great affinity for the clusters around the time of kernel fill. Research is currently underway to more fully understand the seasonal biology of this pest as it relates to pest management and the pistachio crop.

Distribution and Hosts

Mealybugs in the genus *Ferrisia* can be found on a wide range of host plants throughout the world. *F. gilli*, the species currently found in California, thrives on pistachios; it also does well on an ever-expanding list of stone fruits, almonds, grapes, deciduous shrubs and ornamentals. They will even feed on barnyard grass, areca palms and poison ivy. *F. virgata*, a close relative of the species found in California is said to feed on nearly any plant that produces a flower, and has been reported as a pest on crops as diverse as cotton and citrus.

The cross-commodity nature of this pest has resulted in striped mealybug infestations becoming more than just a pistachio issue. In August 2004, an infestation showed up in an El Dorado County vineyard, resulting in the need for compliance agreements to be written prior to the shipment of fruit to the winery. This pest has also been found in almond blocks in Tulare and Stanislaus counties. Additional concerns rest with commodities such as peaches, nectarines, cherries and table grapes which must produce fruit that is blemish- and pest-free for the fresh market. Pistachios and almonds are fortunate in that the hull provides season-long protection of the end product.

Adult male striped mealybugs are rarely noticed in the field.

Striped mealybug feeding within pistachio clusters.

Striped mealybugs are thought to have been introduced into California some time between the 1960s and 1980s. Pest and Damage Records of the California Department of Food and Agriculture report that this pest has been intercepted over 100 times in nursery shipments over the past 40 years. Currently infestations have been reported around Redding, San Mateo, Sacramento, Placerville, Keyes, in Madera County and in much of Tulare County. It is also likely that many small infestations throughout the state have gone undetected.

The current infestation in Tulare County pistachios originated near the town of Tulare in the late 1990's. In 1998 there were about 20 acres infested. By 2002 the estimated number of acres rose to about 200, followed by about 2,000 in 2004. It is likely that the large increase in 2004 was a result of equipment movement during the 2003 harvest. If this is the case, another increase in spread will likely be observed next season. Birds may also be important contributors to the continued spread of this pest.

Effect on Yield and Quality

Mealybugs use their strawlike proboscis to feed from the phloem tissue of their host. They extract plant juices, digest portions of the fluids, and excrete the remainder as honeydew. Honeydew is primarily composed of sugars which can completely cover the surface of tree limbs, leaves and clusters. On limbs, the honeydew gives the top surface a wet appearance. On leaves and clusters the honeydew supports the growth of black sooty mold which renders the leaves photosynthetically inactive and can cause sunburn to fully exposed nut surfaces.

Striped mealybug likely has the greatest impact on yield and quality due to its affinity for feeding within the cluster during the period of kernel fill. During this period they intercept carbohydrates and other nutrients intended

for kernel development. It appears that this can reduce the size of kernels, resulting in increases in the percentage of closed shells and sticktights.

Heavy feeding can also completely kill the cluster, causing it to dry up prior to harvest. These effects are similar to damage caused by heavy flat mite populations. Experiments are being planned for 2005 to measure the actual effects of striped mealybug on nut size and quality, and to validate observations regarding the economic damage caused by this pest. Research is also planned for almonds, which appear to be severely affected by this pest. Observations this fall showed that infested almond trees became defoliated prior to harvested, and then pushed out a new flush of leaves in November.

Chemical control

Imidan and Sevin are currently the only two registered insecticides identified as effective against striped mealybug. Both products are nerve toxins that work on contact. Neither product has a long residual. Since both insecticides must come in direct contact with the mealybugs to work, coverage is extremely important. This is difficult with mealybugs since they can often be found feeding several layers thick on the tree, and immature stages are known to feed directly underneath the adult females.

There are currently efforts underway to identify and register reduced-risk insecticides that are effective against striped mealybug. These include the insect growth regulator buprofezin (Applaud) and the neonicotinoid imidacloprid (Provado, Admire). Buprofezin, which plays a key role in vine mealybug control in grapes, could be registered as soon as spring 2005, whereas registration for imidacloprid is on track for some time in 2006.

Biological control

Literature sources identify multiple parasitic wasps that suppress populations of striped mealybug throughout the world. This means that there are many candidate species of wasps that could be evaluated for importation into California to control this pest. Additionally, two parasitoid species have already been found attacking striped mealybug in an

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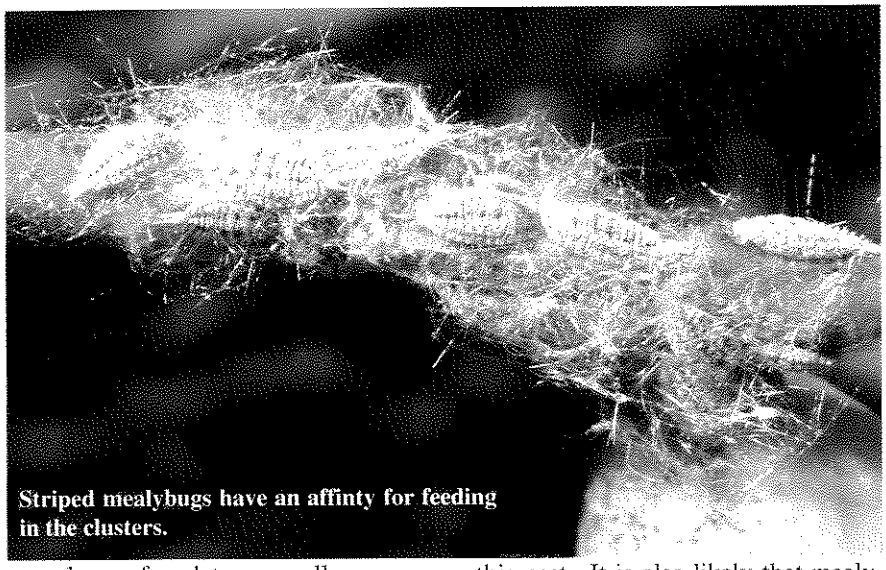
unsprayed almond block in Tulare County. It is likely that these parasitoids are coming from various mealybug species on other hosts such as grapes, and samples of the parasitoids have been sent to taxonomists for identification. Thus far, no parasitoids have been found in any blocks of pistachios, likely due to insecticide control programs being used for striped mealybug.

Several predatory insects have also been found attacking striped mealybug. These include lacewings, syrphid fly larvae, and the mealybug destroyer, *Cryptolaemus montrouzieri*. The mealybug destroyer is a coccinellid (ladybird) beetle whose larval stage is camouflaged to resemble a mealybug. Each of these predators, and likely others, promise to be present in blocks of trees with soft pesticide programs, but all are sensitive to organophosphate and carbamate insecticides. It is highly unlikely, though, that predators alone will suppress striped mealybug below economically damaging levels. Ultimately, success of biocontrol will depend on complexes of predators as well as parasites, their compatibility with our climate and cropping systems, and the availability of reduced risk insecticides as an alternative to organophosphates and carbamates.



Striped mealybugs have an affinty for feeding in the clusters.

Cultural Controls to Prevent Further Spread

Since reproducing female mealybugs do not fly, the primary means of spread is through human movement. Mealybugs commonly hitchhike on equipment such as tractors, mowers, sprayers, harvest bins and shakers. Shakers are the biggest concern as they undoubtedly get infested during the shaking process and spread this pest when they blow off leaf trash or move to new locations. Crews that come in contact with the trees can also spread this pest. It is also likely that mealybugs can hitchhike on birds, or on nuts carried by birds.

Long-distance spread of mealybugs could also occur with nursery stock. This pest thrives on the young succulent growth of nursery plants, and can hide underneath bark and possibly inside bud scales during plant dormancy. Nurserymen should be vigilant to spot any striped mealybug infestations on nursery plants and ensure that budwood originates from clean orchards. Nurseries that propagate multiple types of deciduous and ornamental plants should have a heightened level of awareness due to the ability of this pest to infest nearly any type of nursery plant.

During the winter, aggregations of mealybugs give the tree a bearded appearance.

Research and Extension

Efforts are currently underway to develop information that will provide growers with an understanding of this pest, its affect on the pistachio crop, and how to control it. These efforts are being spearheaded by UC Researchers David Haviland, Bob Beede, and Walt Bentley in conjunction with growers, PCAs and the Pistachio Commission. We anticipate that articles such as this one will be periodically distributed through UCCE newsletters and trade journals to provide growers with up-to-date information on current research. A presentation on striped mealybug will also be included at Pistachio Day on January 19th in Visalia.

David Haviland is an Entomology Farm Advisor with UCCE, Kern County. *He thanks Gary Weinberger, Bob Beede, Bob Klein, Chuck Nichols, and Kris Godfrey for contributing information used in the production of this article.*