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Ecology and Behavior of Western Tarnished Plant Bug

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Western tarnished plant bug

The Western tarnished plant bug (*Lygus hesperus*) is a key pest of a diversity of crops throughout California. Feeding by plant bugs destroys flower buds, deforms developing fruit, and can terminate shoot development. Previous reports indicated that the level of damage caused by plant bugs is often much lower, or higher, than expected based on their numbers. This inconsistency increases the difficulty of making management decisions, and of interpreting results of studies to investigate plant bug damage.

A potential explanation for these inconsistencies is variation in feeding behavior among plant bugs of different life stages or genders. Previous studies which compared damage caused by different life stages produced conflicting results. Some studies suggested that adults caused more damage than nymphs while other studies suggested the opposite. Adult plant bugs undergo a pre-reproductive period of 3-7 days to complete reproductive maturity. Adults do not mate or reproduce during this pre-reproductive period, but it is not known how feeding behaviors differ among pre-reproductive and reproductive adults.

Using high-definition video, we recently compared the behaviors of adult plant bugs of different genders and reproductive states (pre-reproductive, reproductive and mated, and reproductive and unmated). Our studies indicated that pre-reproductive adults tend to feed more and spend more time on plants compared to reproductive adults. The behaviors of reproductive adults differed be-

tween genders, and were further influenced by mating history. Reproductive unmated males tended to feed less and spend less time on plants compared to pre-reproductive males. However, after mating, behaviors of reproductive males were similar to those of pre-reproductive males. Presumably, mated males feed more than unmated males in order to replenish the reproductive organs in preparation for additional mating. Behaviors of reproductive unmated females did not differ substantially from those of pre-reproductive females. Mated females left the plant more frequently and inserted their stylets (mouthparts) into plants twice as many times as pre-reproductive or unmated females. The stylet-probes by mated females tended to be short in duration (<10 seconds) and may be associated with searching behaviors for appropriate locations to lay eggs. Before each egg laying event, female plant bugs inserted their stylets at the location on plants at which eggs were inserted. We are currently using video-based assays to compare



Laboratory technician Stephen Wingard collects data from video based behavior assays.



Greenhouse assays are used to assess plant damage.

behaviors of the nymph stages to those of pre-reproductive adults.

Although we identified distinct differences in behaviors among adult plant bugs of different

gender and reproductive state, it is currently not known whether these behavioral differences reflect differences in feeding damage to crops. Using greenhouse assays, we are currently assessing how differences in feeding behaviors among adult plant bugs affect feeding damage to crops. While feeding, plant bugs inject toxic saliva into plants. Therefore, plant bugs which feed the most (pre-reproductive males and females, mated reproductive males, and unmated reproductive females) may cause more damage than other adult plant bugs. Alternatively, if mated females inject saliva into crops while searching for locations to lay eggs, then they could cause more damage to crops than other adult plant bugs.

Our results document previously unrecognized sources of variation in adult plant bug feeding behavior and indicate that comparisons of damage caused by adults and nymphs are incomplete without information on the relative age of adults. Our studies will enable researchers to standardize experiments (and therefore decrease variability) to investigate plant bug damage and to screen crop germplasm for potential sources of resistance or tolerance to plant bug damage.

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Development of an Area-wide Lygus Bug Monitoring Program for the Central Coast and Santa Maria Valley

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Lygus bugs (*Lygus* species) damage strawberry fruit by puncturing individual seeds. This, in turn, stops development of the berry in the area surrounding the feeding site causing fruit distortion called “cat-facing”. Even at moderate densities, Lygus bugs cause economic loss to strawberry growers. Lygus bugs feed on many host plant species. In the Central Coast and the Santa Maria Valley, they feed on strawberries and many flowering weed species and alternate crop hosts such as wild mustards, pepper weed, wild radish, vetch, alfalfa, and fava beans. Adult bugs usually overwinter in these alternate hosts and on second-year berries when present. They start to migrate to fall plantings in the spring, but only the adults can fly from one host to another. Therefore, an understanding of Lygus bug ecology and developmental biology on strawberries and the alternative hosts will help develop effective management strategies.

Chemical control remains as the primary tool for the suppression of lygus populations. Due to the emergence of pesticide resistance, it is essential to better time the few pesticides registered to control this pest.

The sprays must be timed to kill the youngest immatures because the registered pesticides are less effective against the adults. This will become even more critical as IGRs and other newer products become registered that have activity against more specific life stages of lygus.

Monitoring to detect lygus bugs on strawberries and alternative hosts is the first step towards successful management of this pest. The rate of Lygus bug development is directly related to the amount of heat the bugs are exposed to. So measuring the amount of heat accumulation over time can be used to tell when different developmental stages in the lygus bug life cycle will occur. Degree-day is the unit of measurement for physio-

logical time for insect maturity. Degree-day is the unit of measurement for physiological time for insect maturity. A degree-day model was developed to measure the amount of heat accumulation over the season and is an effective tool to predict the lygus bug development, but this method has not been widely adopted by strawberry growers.

The specific objectives in this project are: (1) to monitor the population dynamics and developmental biology of lygus bugs in the Central Coast and the Santa Maria Valley, (2) to identify the migration pattern of lygus bugs to/from strawberries in the Central Coast and the Santa Maria Valley, (3) to establish biofix dates for the lygus bug degree-day model at multiple sites, and calculate degree-days throughout the sampling season, and (4) to disseminate timely information to the strawberry growers and PCAs to help with their management decisions.

Methods: Seasonal lygus bug life cycles are determined by systematically sampling strawberry fields and nearby flowering weed species starting early February, 2010 to determine age structure (number of adults, small nymphs – 1st – 3rd instars, and large nymphs 4th – 5th instars) of the lygus population on each host. We are cur-



Lygus fifth instar nymph

rently sampling four sites in the Central Coast and two sites in the Santa Maria Valley. These sites cover a variety of climatic conditions. Sampling in the strawberries is done using a beating tray. The sampling unit is 10 plants that have been “beaten” to dislodge any lygus bug present onto the tray on each sampling date. A suction sampling machine could be substituted in practice. Five areas in each field are sampled in this manner. Weeds are sampled by a sweep net, using 10 sweeps through the foliage or flowers as a sample unit and at least 5 units are sampled to determine number and age structure of lygus bugs present. Weeds that are flowering or have seeds are preferred for sampling.



Cut back strawberry for second year production



Wild mustard, an alternate host of lygus

Ambient temperatures at sampling sites are recorded at hourly intervals during the sampling season using micro data loggers (HOBO temperature recorders, Onset Computer Corporation, Bourne, MA). The recorded temperature data are collected weekly for the degree-day calculation. Biofix for the degree-days is the first adult captured in strawberry plantings, and first nymph on weeds or other alternative hosts. These data are used to validate and demonstrate the lygus bug degree-day model.

The resulting data is entered at the UC IPM Pest Monitoring web site and the web site is updated frequently. The web site address is <http://www.ipm.ucdavis.edu/PM/>.

Information can be accessed with LDDmem as the username and Membugs as the password.

Monitoring Location information:

1. Boronda Road, Salinas
2. Blackie Road, Castroville
3. Old Stage road, Salinas
4. San Juan Road, Pajara
5. Mahoney Road, Santa Maria
6. Foxen Canyon Road, Santa Maria

Meeting Announcement

Vegetable Pest Management and Postharvest Issues

Wednesday, 9 June 2010

9:00 a.m. – 11:30 a.m.

Shepard Hall, Santa Maria Public Library
421 S McClelland St, Santa Maria, CA 93454

*2 hours each of DPR and CCA Continuing Education
Credits have been approved*

Presentations: Weed control update for lettuce, peppers and specialty vegetables, Update on Verticillium wilt of lettuce, Pest management in vegetables with cultural practices, and Postharvest handling update for cool season vegetables.

Speakers:

Richard Smith, Vegetable Crops and Weed Science Advisor-UCCE Salinas, Krishna Subbarao, CE Plant Pathology Specialist, Salinas, Surendra Dara, Strawberry and Vegetable Crops Advisor, UCCE Santa Maria, and Marita Cantwell, Postharvest Specialist, University of California Davis

Groundwater Information Resources

Mark Gaskell

The Regional Water Quality Control Board is hosting workshops for Irrigated Agriculture along the central coast to explain their new draft set of rules designed to reduce the amount of polluted farm water released into streams and groundwater aquifers. The rules would require farmers to closely monitor the amount of pollutants they are releasing and to reduce those pollutants through programs that curb fertilizer and pesticide use and establish buffer zones between farms and creeks. The rules are especially focused on the Salinas and Santa Maria Valleys. The next meeting will be July 8, 2010 in Watsonville.

The issues related to groundwater management are complex and in heated discussions it is often difficult to separate facts from smoke. One of the most complete resources available that directly applies to our California situation is a website produced by Thomas Harter, Groundwater Hydrology Specialist in the Department of Land, Air, and Water Resources at <http://groundwater.ucdavis.edu/>. Harter offers a variety of educational resources, meeting announcements, and links on the website. One of the most useful general resources is a UC-ANR publication from 2008, titled “Watersheds, Groundwater, and Drinking Water – A Practical Guide” authored by Harter. Harter also maintains a blog with timely and continuing commentary about continuing issues. Check the Random Groundwater blog at <http://grundwasser.blogspot.com/>.

A second, complementary source of valuable information is the Nutrient Management for Vegetable Fruit and Nut Crops website – also from UC-Davis - at <http://groups.ucanr.org/nutrientmanagement/index.cfm>. This website is produced and maintained by Tim Hartz, Cooperative Extension Vegetable Specialist in the Plant Sciences Department at UC Davis. This website addresses key aspects of plant nutrients and their efficient management in production systems that dominate these coastal valleys.

Finally, a more comprehensive guide to groundwater management in California is

a book titled “Groundwater Management” (2nd edition) published in 2005 and available from the Groundwater Resources Association of California (GRA) at <http://www.grac.org>. This book is authored by a diverse group of hydrologists, geologists, attorneys, and water resources policy makers with extensive experience managing water resources in California.

The Groundwater Resources Association of California website at [grac.org](http://www.grac.org) is an additional valuable water resource management website. The Groundwater Resources Association of California (GRA) was formed in 1992 and is a statewide, non-profit organization of scientists, engineers, planners, educators, attorneys, students, hydrogeologists and other professionals that focuses on all aspects of California’s groundwater resources including assessment, development, recharge, quality, protection, education and management.

These are a diverse group of water management information sources so there is plenty of opportunity to obtain valuable background information to better understand the continuing dialogue over ground and surface water management in California’s coastal valleys.

California Organic Program Questioned in Audit of National Organic Program and is Implementing Changes in Program Management

Mark Gaskell

The USDA Inspector General’s Office released a report in March 2010 that was critical of different aspects of management of the USDA National Organic Program (NOP). The report contained several conclusions, some of which single out California organic program management. The audit stated that California, with more than 2,000 certified organic operations and organic sales of more than \$1.8 billion, had oversight problems that resulted in “reduced assurance that the state’s certified organic operation and their products meet regulatory requirements.” If corrective actions

aren't taken by June, the USDA will initiate "appropriate enforcement actions." Auditors said the USDA failed to conduct spot testing of organically grown foods for pesticides or take action against companies that were improperly marketing products as certified organic. USDA officials said they planned to add organic program staff and make more unannounced inspections.

The following is excerpted from "California agrees to tighter organic oversight" By Bruce Blythe The Packer. 06/01/2010.

After a government audit outlined serious gaps in California's oversight of organic products, the state department in charge of the program plans to be fully compliant with U.S. organic food rules by this fall. Federal regulators, who gave the state until June 1 to address violations detailed in the audit, approved proposed corrective measures in May.

Enforcement of California's organic standards "will be significantly enhanced" with the corrective measures in place, said Rick Jensen, chief of the inspection and compliance branch for the California Department of Food and Agriculture, on May 25. "It's a welcomed improvement in uniformity and application of organic laws."

Among the eight corrective measures approved by the USDA, California now requires producers, shippers and processors to register and pay fees before selling organic products in the state.

The USDA also gave the state the authority to conduct spot inspections of organic operations, according to a May 11 letter from Miles McEvoy, deputy administrator of the USDA's National Organic Program, to A.G. Kawamura, California's agriculture secretary. While California had been approved to regulate organic food, it "did not have the required compliance and enforcement procedures in place," according to a report on the audit results released in March.

But enforcement deficiencies "resulted in reduced assurance that the state's certified organic operations and their products meet regulatory requirements," according to the audit by the USDA's Office of Inspector General. State regulators were

"not equipped to properly enforce" National Organic Program requirements, auditors said.

The government's organic regulatory capabilities have been the target of heightened criticism as demand for organically grown fruits, vegetables and other foods grew rapidly in recent years. Some questioned whether products labeled organic actually met federal standards, which include requirements the foods be grown and handled without synthetic chemicals.

California organic growers such as Dick Peixoto, owner of Watsonville-based Lakeside Organic Gardens, acknowledged there have been credibility problems for the organic industry but said oversight has improved. "Those doors are being closed" Peixoto said, referring to holes in organic oversight. "In the last year, our certifier has been watching a lot more closely. They've definitely tightened up on it."

Larry Jacobs, president of Jacobs Farm/Del Cabo, a Pescadero, Calif.-based organic fruit and vegetable grower, said California's recent steps are an "enormous positive" for the industry. "Anything that strengthens implementation of the laws and makes it work better, with more transparency, is good for the industry and good for the public," Jacobs said.

Rick Jensen, of California's Dept. of Food and Agriculture, said the state also developed a "quality systems manual" for the organic industry, detailing procedures for spot inspections and random samplings. The formal regulations are expected to be filed with the state's office of administrative law by the first week of June, followed by two public comment periods over the summer, Jensen said. Formal rule making is expected to be completed by the end of summer.

Ultimately, California will place additional requirements for organic businesses beyond what the national program does, Jensen said. The overarching goal is "a very strong and very transparent organic enforcement" in the state, Jensen said. "The industry will gain confidence and the consumer will gain confidence as well."