Cooperative Extension • Monterey County

Crop Notes

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In This Issue:

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STRAWBERRY FRUIT BRONZING CAUSED BY STRESS AND NOT THRIPS

Steven Koike, Frank Zalom, Kirk Larsen
University of California

"Bronzing" refers to the tan or bronzed discoloration that periodically occurs on green or mature strawberry fruit. Bronzed fruit have dried, rough surfaces that render the fruit unmarketable (Figure 1). The skin of such fruit can later crack. In coastal California, time of year when bronzing occurs and its severity vary from season to season. However, the problem occurs annually and can result in large economic losses. There are three types of bronzing. Type I bronzing occurs on distinct, localized parts of the fruit, often beneath the fruit calyx or around the strawberry seeds (achenes), and is caused by insect feeding, primarily thrips. Type II bronzing is caused by chemical sprays that cause a one-sided bronzing to the side of the fruit exposed to the application. In contrast, Type III bronzing covers virtually the entire surface of the fruit, occurs during certain periods of time, and can result in devastating crop loss. It is notable that Type III bronzing in coastal California tends to occur when the weather is sunny with high temperatures and low relative humidity. Despite these observations and associations with climatic conditions, Type III bronzing was thought by many to be caused by thrips feeding damage.

Supported by the California Strawberry Commission, our University of California research team conducted a series of field experiments to study and determine the cause of Type III bronzing. When we established both insecticide-treated and untreated strawberry field plots, we found that bronzing was equally severe in all plots, despite the reduced thrips populations in plots receiving insecticide applications (Figure 2). In contrast, when we applied stress-reducing treatments to other field plots, bronzing was reduced compared to plots subject to ambient temperature and solar radiation; all of these plots had comparable thrips populations. We successfully reduced plant stress and bronzing losses by applying overhead misting or sprinkling to the foliage and fruit in these field plots, demonstrating an environmental role in bronzing.

A final component of our Type III bronzing research was made possible by observant growers and pest control advisors who noticed that commercial fields that happened to receive insecticide or fungicide sprays prior to a high temperature, high-sunlight intensity bronzing period had in many cases significantly lower losses compared to adjacent untreated fields. Because pesticides contain additives that protect active ingredients from solar and ultraviolet radiation, we hypothesized that such materials could also protect the surfaces of strawberry fruit from damaging radiation. When we applied a series of commercial pesticide products to field plots, bronzing was significantly reduced compared to untreated controls (Figure 3). In addition, when we applied lignin products to other plots, bronzing was also reduced (Figure 3). Lignins are by-products of the paper industry and are often added to pesticide formulations because they shield the active ingredients from solar and ultraviolet radiation. These lignin sprays also protected the fruit and reduced damage from bronzing. It is notable that lignins have no insecticidal properties and did not suppress thrips in our trials.

Our study provided evidence that strawberry Type III bronzing is associated with fruit exposure to stressful environmental conditions rather than thrips feeding. Growers can better manage bronzing by knowing that this problem is triggered by extreme solar radiation, high temperatures, and low relative humidity. Strawberry plants can be predisposed to bronzing if plant vegetative development was limited by growing conditions during the previous winter or by farming practices that stress plants and prevent optimum growth. We thank the following for their assistance with this research: Riesa Bigelow, Brian Caster, David Delgado, Teo Gonzales, Esther Guedea, Diana Henderson, Dave Limburg, Gary Omori, Ed Show, Tom Sjulin, Richard Uyematsu, David Vasquez, Elia Vasquez, Frank Westerlund.

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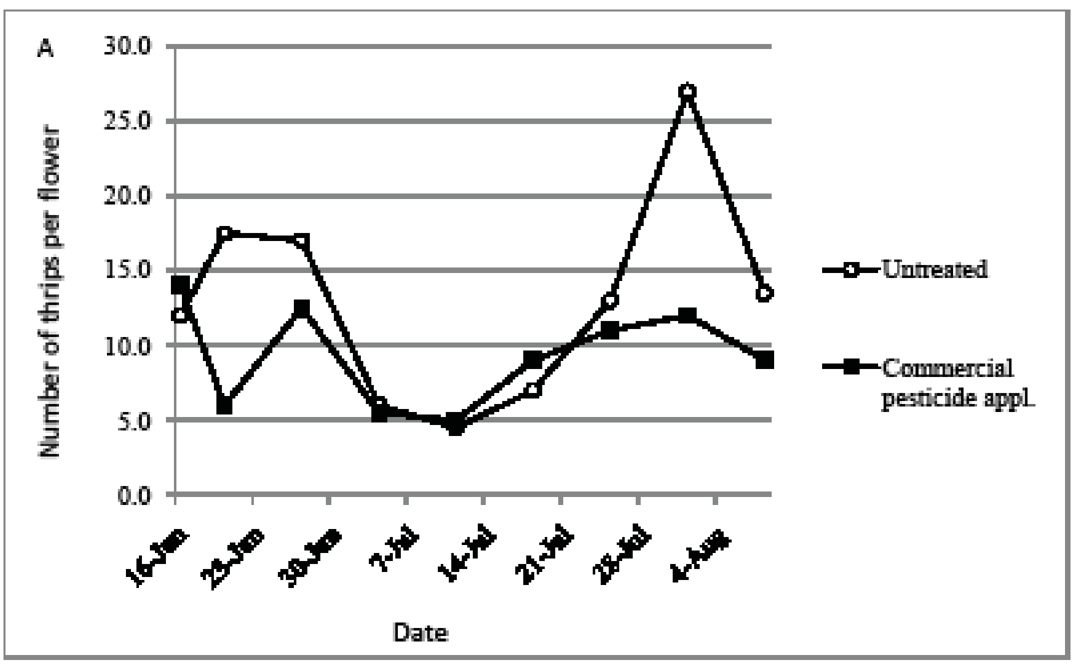
Figure 1: Strawberry fruit on the right is affected by Type III bronzing. Unaffected fruit is on the left.

Bronzing causes the skin of strawberry fruit to become dry, rough, and off-color, making such fruit unmarketable.

Figure 2: In field experiments, insecticide-treated plots had significantly fewer thrips than untreated control plots(A). However, percentages of bronzed fruit were comparable for treated and untreated plots (B).



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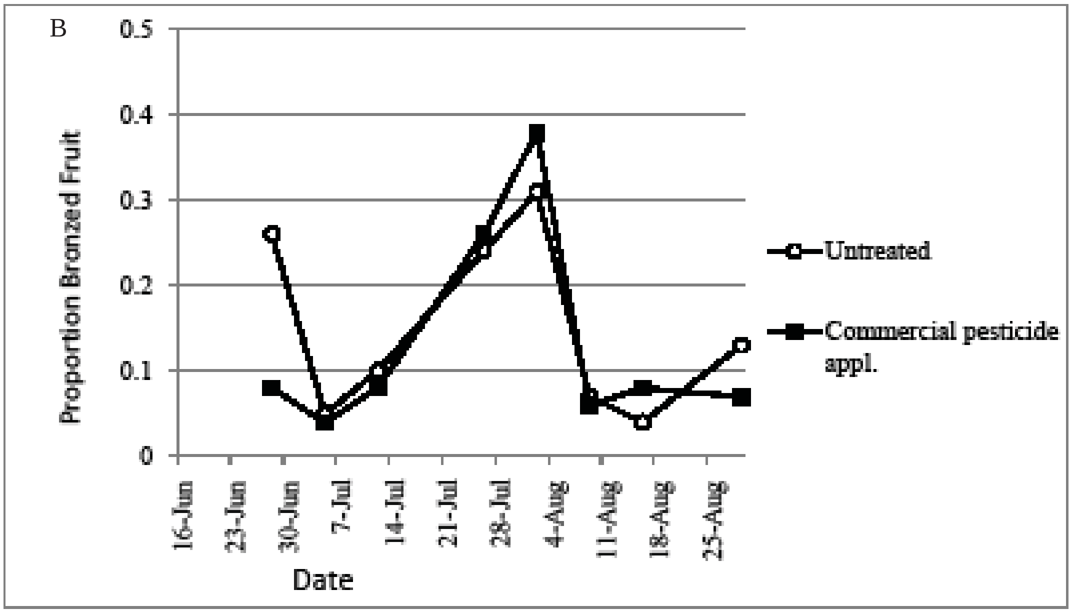
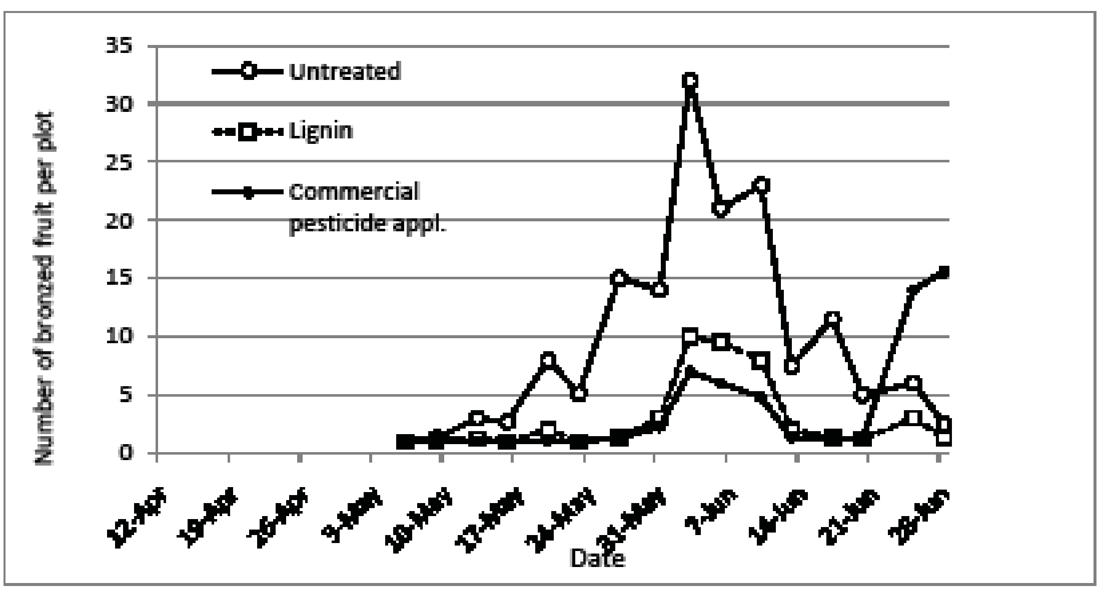


Researchers found that Type III bronzing was not caused by thrips but was due to stressful environmental conditions.

Figure 3: Lignin and pesticide sprays, containing chemicals that protect against solar and UV radiation, resulted in fewer bronzed fruit. Untreated plants had higher numbers of bronzed, damaged fruit.



POOR POLLINATION IN RASPBERRIES

By Mark Bolda, UCCE Santa Cruz County

There are many causes of poor formation and misshaping of raspberry fruit, including bad weather, genetics or viruses. However, the most common cause is a lack of pollinators, such as domestic and wild bees, during the flowering period. Although raspberry flowers are self pollinating, bee activity is still responsible for 90-95% of pollination. Generally, two strong hives are recommended per acre of raspberries.

To understand how poor pollination can result in misshapen fruit, it is important to view the nature of the raspberry flower. The flower is composed of 100-125 pistils, to which the pollen must be transferred to create a mature seed and the druplet surrounding the seed.

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Around 75-85 druplets compose a raspberry fruit and each individual druplet has the same structure as a plum, cherry or peach. If each and every one of these druplets is not pollinated, the overall integrity of the fruit is compromised. This is because the immature druplet stays small, does not contribute to the structure and strength of the whole, and the resulting fruit is misshapen and crumbly (i.e. falls apart easily).

The pictures below demonstrate what improper pollination will look like in raspberry. In this case, many of the druplets at the tip of the fruit have not apparently been pollinated, and are staying immature and small. Beyond that, one can see clearly in the second picture that there is excess nectar accumulating on the flower, simply because it has not been collected by bees. Later, this nectar is certain to cause problems with sooty mold and other fungi, which flourish in this nutrient rich medium.

There are several things raspberry growers must know of when managing bees:

1. Hives must be strong. There should be many frames of brood in the spring and lots of bees in the boxes. Anything less will be an indication of a weak beehive. Flight activity should be heavy, and the raspberry field should be full of bees, not just a bee here or there.
2. Raspberry flowers are supposed to be quite attractive to honeybees. However, the possibility remains that they are being attracted to other flowers in the vicinity, either because they are more attractive, or because the raspberry crop is overwatered, meaning the nectar might be thin and not attractive. If a grower's bees are not going to his or her field, they should be followed out to see where they are going.
3. Some pesticides, if not directly toxic to bees, may yet serve to repel them. Growers should take note of any changes in bee behavior or hive strength following pesticide application.

The pictures below demonstrate what improper pollination will look like in raspberry. In this case, many of the druplets at the tip of the fruit have not apparently been pollinated, and are staying immature and small.

I thank Dr. Eric Mussen from UC Davis for his valuable insight and contributions on this issue.

Poorly pollinated raspberry fruit

Nectar dripping from poorly pollinated raspberry fruit

POPULATION DYNAMICS AND DEVELOPMENTAL BIOLOGY OF LYGUS BUGS IN STRAWBERRIES AND THE TRAP CROP ALFALFA

Jian Bi[1], Mark Bolda[1], Surendra Dara[1] and Frank Zalom[2]

[1]Farm Advisors, UC Cooperative Extension
[2]Professor and Extension Specialist, UC Davis

Lygus bugs (*Lygus* species) are serious pest of strawberries in California. They damage strawberry fruit by causing fruit distortion called "cat-facing". Even at moderate densities, they cause economic loss to strawberry growers.

Lygus bugs feed on many host plant species. In the Central Coast and Santa Maria Valley, they feed on strawberries and many flowering weed species and alternate crop hosts such as mustards, wild radish, vetch, alfalfa, asylum and fava beans. Some organic strawberry growers culture trap hosts such as alfalfa and asylum to attract Lygus bugs. Near the Old Stage Road in Salinas, an alfalfa strip was cultured on the edge of a first-year strawberry field for organic production in 2009 (Figure 1). We monitored the population dynamics and developmental biology of Lygus bugs in this strawberry field and the alfalfa. We also investigated the effect of this alfalfa strip on numbers of Lygus bugs in strawberries in various distances.

Population dynamics and developmental biology of Lygus bugs in strawberries and alfalfa were monitored by intensive sampling. Number and age structure (adults, small nymphs – 1st – 3rd instars, and large nymphs 4th – 5th instars) of the Lygus population on each host were determined. The sampling was on a weekly basis, starting from early May. Sampling in strawberries was done using a beating tray. The sampling unit was 10 plants that were "beaten" to dislodge any Lygus present onto the tray on each sampling date. Five areas in each field were sampled in this manner. The alfalfa was sampled by a sweep net, using 10 sweeps through the foliage or flowers as a sample unit to determine number and age structure of Lygus present. Five sample units in alfalfa were sampled. The grower frequently vacuumed the strawberry plants for Lygus management while left the alfalfa largely untreated. To determine the effect of this alfalfa strip on numbers of Lygus bugs in the strawberry field at various distances from the strip, we sampled strawberries in July by "beating" 40 plants in each bed for every 10 beds across the field. The strawberry field was plowed in early December and the alfalfa was terminated in late November.

In mid-May, adult, large and small nymphal Lygus bugs were all detected in both strawberries and alfalfa (Fig. 2A-D). In strawberries, number of small nymph peaked from mid-June to late July (numbers ranged from 4 to 12 per 20 plants) and again from early September to late October (numbers ranged from 8 to 32 per 20 plants), while large nymphs and adults were generally below 5 per 20 plants. From May to late September, small nymph represented 50% to 80% of the population while after mid-October adults became predominant. In alfalfa, the population dynamics followed a similar pattern to that observed in strawberries. Age structure was also similar to that in strawberries, with an exception being that number of adults was greatest from late June to mid-August. This difference may be the result of removal of larger bugs by frequent vacuuming of strawberries while the alfalfa remained untreated except for a single cut-back in early August. Number of adult Lygus in the strawberries was sharply higher on the August 5 sampling date, likely as a result of migration following the cut-back.

Next to the alfalfa strip, there were 180 strawberry beds across the field (Fig. 3). Within a distance of 115 beds, sampling indicated the closer to the alfalfa strip, the greater number of small nymphs. Numbers of adults and large nymphs were similar across the whole field, likely due to the removal of larger bugs by frequent vacuuming. The effect of this trend on numbers of deformed strawberry fruit warrants further investigation.

Lygus bugs (*Lygus* species) are serious pest of strawberries in California.

Some organic strawberry growers culture trap hosts such as alfalfa and asylum to attract Lygus bugs.

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Fig. 1. An alfalfa strip cultured on the edge of a strawberry field

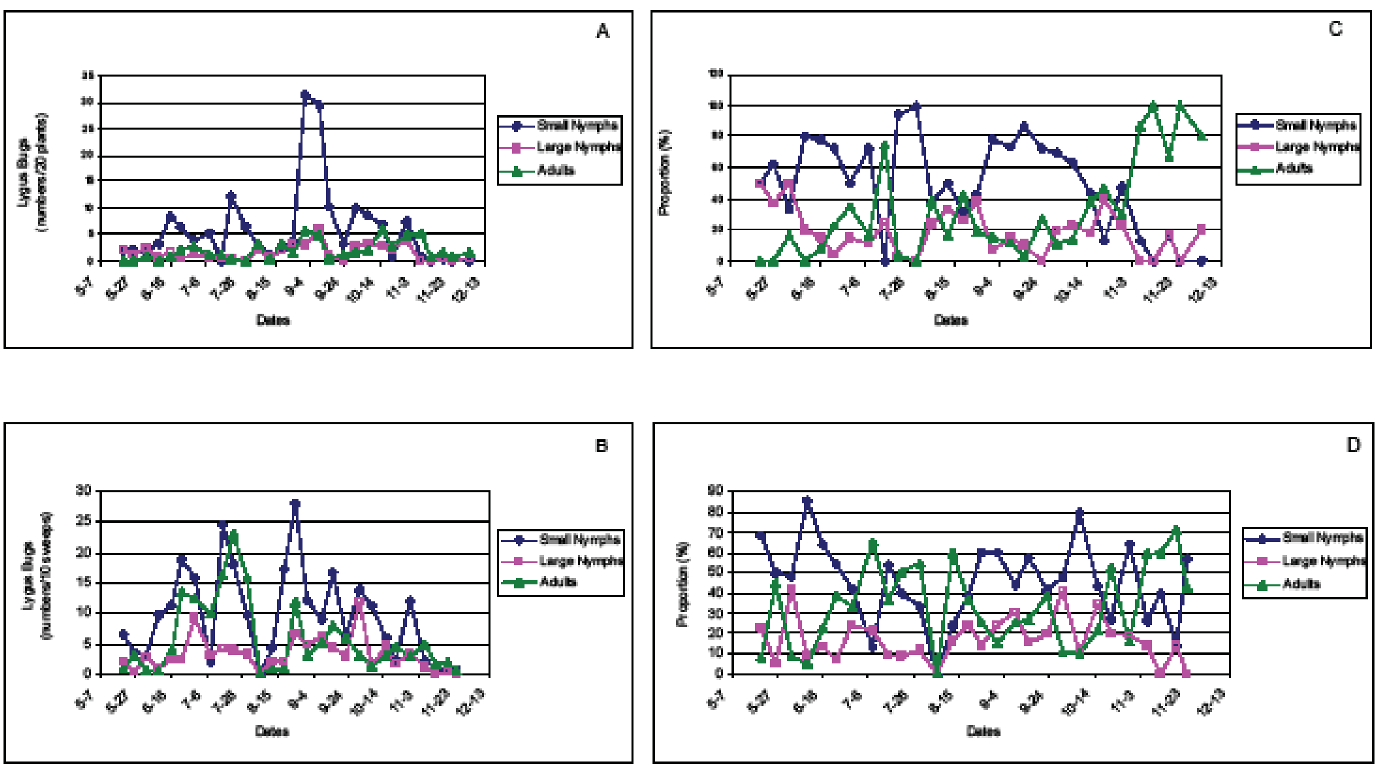

Fig. 2. Population dynamics and age structure of Lygus bugs in strawberries and alfalfa, 2009-2010. A: population dynamics in first year strawberries; B: population dynamics in alfalfa; C: age structure in first year strawberries; D: age structure in alfalfa

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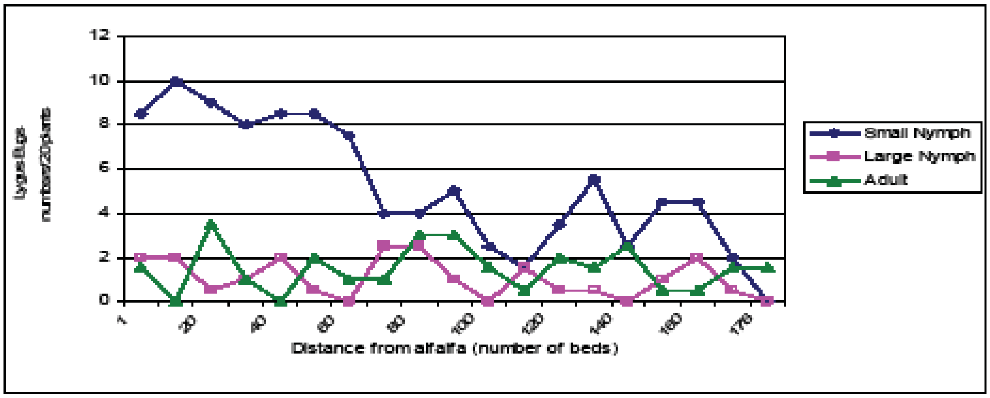

Fig. 3. Numbers of Lygus bugs in strawberries in relation to a distance to Alfalfa strip cultured on the edge of strawberry field, July 10, 2009.

Within a distance of 115 beds, sampling indicated the closer to the alfalfa strip, the greater number of small nymphs.

PHYTOPHTHORA FRUIT ROT OF STRAWBERRY ON THE CALIFORNIA CENTRAL COAST IN 2010.

Mark Bolda and Steven Koike, UC Cooperative Extension

The wet, rainy spring weather in 2010 created ideal conditions for fruit rot of strawberry caused by *Phytophthora*. Significant fruit loss occurred in some fields in both Watsonville and Salinas production areas. Fruit samples submitted to UC Cooperative Extension all tested positive for the *Phytophthora* pathogen but negative for other pathogens such as *Colletotrichum* and *Botrytis*.

Phytophthora rot of fruit, known as leather rot, can affect immature green or pink fruit (photo 1) as well as fully ripened red fruit (photos 2 and 3). Symptoms consist of off-white, gray, or yellow-brown lesions. Lesions often begin as localized, circular to oval shaped infection areas that later enlarge into irregularly shaped patches that can affect much of the fruit. The infected area is very soft to the touch. Fruiting bodies or other fungal structures are not seen externally on these lesions. Upon examining internal fruit tissues with a microscope, the diagnostic appearance of the mycelium (relatively thick hyphae that lack cell cross walls) can be observed (photo 4). *Phytophthora cactorum* is the primary species causing this fruit rot; this same pathogen can also cause root and crown rot disease.

Phytophthora rot of fruit, known as leather rot, can affect immature green or pink fruit (photo 1) as well as fully ripened red fruit (photos 2 and 3).

Phytophthora has special overwintering structures, called oospores, that enable it to survive in the soil for lengthy periods of time. In the presence of significant amounts of moisture, the pathogen produces a different spore type, swimming spores called zoospores, that are splashed onto the surfaces of immature or mature fruit and result in infection. Ideal temperatures for production of zoospores are between 59° F and 77° F. Because the zoospores need to be splashed onto the strawberry fruit for disease to occur, this fruit rot phase of the problem is relatively rare in California if rains do not occur. *Phytophthora* is usually more often found causing discoloration and decay of strawberry plant roots and crowns, ultimately resulting in plant collapse and death.

Proper cultural practices play the largest role in reducing the amount of Phytophthora leather rot in strawberry. Elimination of standing water on bedtops is essential for reducing this disease in strawberry. Fields should be leveled prior to planting, and beds should be canted to allow water to flow freely off of them. There should be good air circulation in the field and the field should have adequate sun to facilitate drying after rainstorms. The application of fungicides to protect fruit during rainy years should be considered. However, the usefulness and appropriateness of such applications have not been tested recently by researchers.

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Growers and PCAs should be reminded that anthracnose fruit rot, caused by *Colletotrichum acutatum*, may appear similar to *Phytophthora* infections. However, anthracnose fruit lesions are sunken, oval to round, firm in texture, and brown to dark brown in color (photo 5). In advanced stages and under suitably wet conditions, anthracnose lesions may show white mycelium and salmon to orange colored spore masses of the fungus.

Proper cultural practices play the largest role in reducing the amount of Phytophthora leather rot in strawberry.

Photo 1: Pale gray to brown lesions caused by *Phytophthora* on unripe fruit.

Photo 2 : Pale gray to brown lesions caused by *Phytophthora* on ripe fruit.

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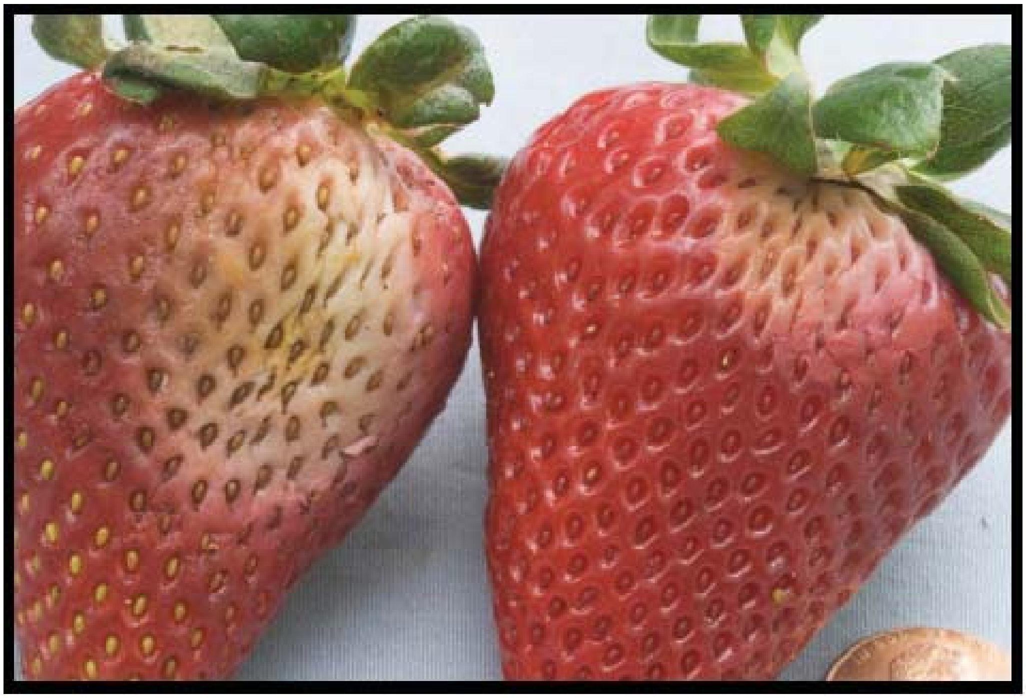

Photo 3: Pale gray to brown lesions caused by *Phytophthora* on ripe fruit.

Photo 4: *Phytophthora* mycelium growing inside fruit tissue, as viewed with a microscope.

The application of fungicides to protect fruit during rainy years should be considered. However, the usefulness and appropriateness of such applications have not been tested recently by researchers.

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Photo 5: Anthracnose lesions on strawberry fruit.

DEVELOPMENT OF AN AREA-WIDE LYGUS BUG MONITORING PROGRAM FOR THE CENTRAL COAST AND SANTA MARIA VALLEY

Jian Bi[1], Surendra Dara[1], Mark Bolda[1] and Frank Zalom[2]

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[2]Professor and Extension Specialist, UC Davis

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 Santa Maria Valley, they feed on strawberries and many flowering weed species and alternate crop hosts such as mustards, pepper weed, wild radish, vetch, alfalfa, and fava beans. The adult bugs usually overwinter in these weed species while some overwinter 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.

Even at moderate densities, Lygus bugs cause economic loss to strawberry growers.

Pesticides remain the primary tool for 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 the 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. A degree-day model was

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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 and their PCAs.

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,

The specific objectives in this project are: (1) to monitor the population dynamics and developmental biology of Lygus bugs in the Central Coast and Santa Maria Valley, (2) to identify the migration pattern of Lygus bugs to/from strawberries in the Central Coast and 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 improve their Lygus bug 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 currently sampling four sites in the Central Coast and two sites in the Santa Maria Valley. These sites cover a variety of climate.

Sampling in the strawberries is being 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 bug present. Weeds that are flowering or have seeds present are preferred.

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 are 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/. The username is LDDmem and the password is Membugs.

The resulting data are entered at the UC IPM Pest Monitoring web site and the web site is updated frequently.

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

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Frank Zalom Tel: 530-752-3687; Email: fgzalom@ucdavis.edu

California Poultry Federation presents:

Poultry Supervisory Training Seminar

9 a.m. – 12 p.m., June 18, 2010
Stanislaus County Agriculture Center, Harvest Hall

Check-in 8:30 a.m., Continental Breakfast Included
Seminar Begins at 9 a.m.

Presenters:

Gregorio Billikopf – UC Agriculture and Natural Resources
Ryan Boothe – Labor Consultant

Focus:

Helping supervisors take responsibility;
Dealing with difficult disciplinary situations;
Learning to give positive feedback

Audience:

Supervisory and Labor Management
Poultry Processing Plant and Live Production

Included Materials:

Labor Management in Agriculture: Cultivating Personnel Productivity
By Gregorio Billikopf
(Seminar will be in English, but participants may choose English or Spanish book)

$25 registration fee; $15 if you register by May 28

Registration Form:

Name: ____________________

Company: ____________________

Address: ____________________

Email: ____________________ Phone: ____________________

Make Checks Payable to CPF, 4640 Spyres Way, STE 4, Modesto, CA 95356
Or fax registration to 209-576-6119

BLOG: SALINAS VALLEY AGRICULTURE

University of California Cooperative Extension in Monterey County has initiated a blog that will address current developments and issues in Salinas Valley Agriculture. A range of production issues on vegetables, strawberries, wine grapes, and ornamental crops will be covered. You will have an opportunity to respond and ask questions.

The blog is available at: http://ucanr.org/blogs/SalinasValleyAgriculture/

FROM GREGORIO BILLIKOPF, LABOR MANAGEMENT FARM ADVISOR

(gebillikopf@ucdavis.edu)

1. New employee discipline video for Spanish-speaking supervisors. We have posted the third video in the employee discipline series. Make sure that your supervisors have been able to view and practice the materials in 14-001 and 14-002, first. Video 14-003. La disciplina - Puré de Papas. http://www.cnr.berkeley.edu/ucce50/agro-laboral/7libro/002s.htm
2. Supervisory training seminar for English-speaking supervisors. On 18 June 2010, there will be a supervisory training seminar in Modesto, on such topics as helping supervisors take responsibility, dealing with difficult disciplinary situations, and learning to give positive feedback. It will be a three-hour morning seminar. Even though the California Poultry Federation is the sponsor, foremen and supervisors from vineyard, orchard, dairy and other agricultural industries would be most welcome. The presentation will be in English. See flyer for more details.
3. Party-Directed Mediation: Helping Others Resolve Differences PDF download. I have been asked to package all the individual PDF chapters for the book into one PDF. For those who are interested, you may download it from: http://www.cnr.berkeley.edu/ucce50/ag-labor/7conflict/ For those who are interested, you may follow a link with training videos on the Negotiated Performance Appraisal.

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FROM THE UNIVERSITY OF CALIFORNIA, AGRICULTURE AND NATURAL RESOURCES
JUNE 8, 2010

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