UTAH PESTS News

Utah Plant Pest Diagnostic Laboratory and USU Extension Vol.VII, Fall 2013

What's Inside

News Highlights

UPDATE ON INVASIVE INSECTS

The Cooperative Agricultural Pest Survey program reports that a few brown marmorated stink bugs have been found in Salt Lake County traps, and a single bug was found in Utah County in September, the first for that county. Spotted wing drosophila is just now showing up in traps in Davis County, in much lower numbers than in nearby states. Also in September, the emerald ash borer, a pest that has killed millions of ash trees in the eastern U.S., was identified in Boulder, Colorado.

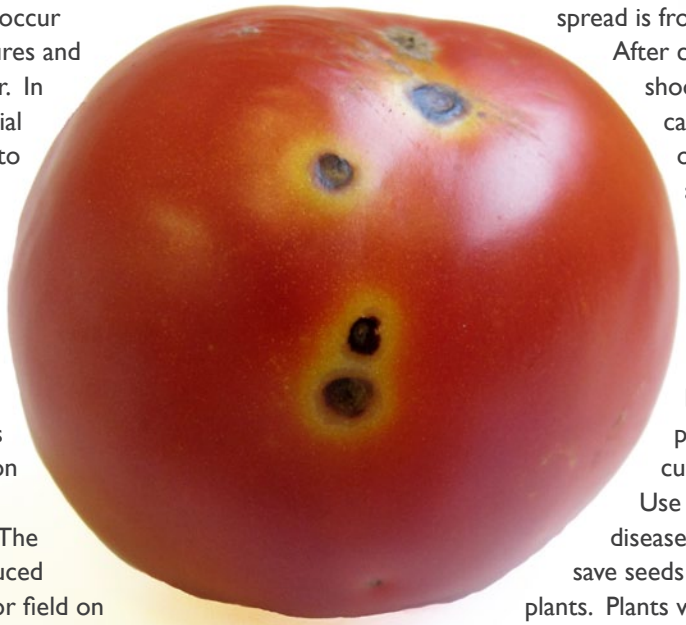
NEW FACT SHEETS

Chinch Bugs
Pest Monitoring Calendars for fruit trees

www.utahpests.usu.edu

Bacterial diseases of tomato

Infections on tomato fruits by bacterial pathogens often occur before fruit matures and symptoms appear. In Utah, two bacterial diseases of tomato have been found in the last two years: bacterial speck and bacterial canker.



Bacterial speck causes black spotting with yellow halos.

Bacterial speck is the most common bacterial tomato disease in Utah. The disease is introduced into the garden or field on contaminated seed or infected transplants. It is caused by *Pseudomonas syringae* pathovar *tomato*. Infected ripe tomatoes have characteristic black spots with yellow halos. Fruit infections occur early in the season, but symptoms are not visible until fruit matures. Foliar symptoms are evident right after infection, consisting of brown spots that may also be surrounded by a yellow halo. If transplants show brown spots on leaves they should not be purchased or planted.

Transmission of bacterial speck occurs through contaminated seed, splashing water, and pruning tools. Plants grown from infected seed will develop brown spots on leaves soon after transplanting. Rain or irrigation water spreads bacteria, causing new infections on nearby plants. The bacteria can also spread from last year's crop residue, where it can survive for up to six months, or from asymptomatic weeds in the Solanaceae family. A final mode of spread is from pruning tools. After cutting infected shoots, bacteria can be left behind on the blades, and may be transferred to healthy plants in subsequent cuts.

Management of bacterial speck is primarily through cultural practices. Use only certified disease-free seed, or save seeds from healthy plants. Plants with suspect symptoms should be submitted to the Utah Plant Pest Diagnostic Lab, and plants with positive diagnoses should be removed and destroyed

On foliage, bacterial speck symptoms may be visible at any time of the season.

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immediately. Rotate tomato every year, and remove plant debris such as old leaves and vines. Control weeds to reduce the potential for inoculum to build up. If the disease had been a problem in the previous year, copper products can be applied as a preventive. However, once symptoms are visible, copper will be ineffective and plants need to be removed. Infected plants should not be composted because the bacteria can survive if the compost does not get hot enough.

Fruit infected by bacterial canker have raised, white spots with a dark brown center known as a "bird's eye."

Another bacterial disease found in Utah this year is bacterial canker. This disease is caused by *Clavibacter michiganensis* pv *michiganensis*. Just like the pathogen that causes bacterial speck, *C. michiganensis* pv *michiganensis* is also seedborne. Symptoms can occur at any plant stage and on any above ground plant parts.

There are two types of infections: systemic and superficial. Systemic infections occur when plants are grown from contaminated seed, and the bacteria spread through the entire plant. Superficial infections occur when bacteria splash onto the plant surface, causing lesions. Seedlings with a systemic infection will suddenly die when conditions are right for the bacteria to spread within the plant (moisture or humidity, with temperatures between 75-80°F). However, if conditions for the bacteria are unfavorable, infected plants will continue to grow and appear healthy and vigorous until conditions change in favor of the bacteria. Older plants with a systemic infection will show upward-curling, yellow to brown leaves, and overall wilting. A discoloration of the vascular tissue can be seen on cut tissue.

Superficial stem and foliar infections result in brown spots, while fruit infections appear as white, raised spots with a dark brown center known as a "bird's eye."

Besides being seedborne, *Clavibacter* can survive in plant debris left in the yard or field from the previous tomato crop.

Management strategies for bacterial canker are very similar to bacterial speck. It is important to only use certified disease-free seed and not save seed from symptomatic plants. The bacteria can survive on plant debris, but once it has decomposed, it cannot survive in the soil. Therefore, clean up all plant residue from the garden and apply only fully composted organic matter. Crop rotations for one year will also reduce spread. Old wooden stakes, pruning tools, and any equipment that comes into contact with infected plant material should be disinfected with a 10% bleach solution. Copper products can be used as preventive to protect fruit from superficial infections, but will not control systemic infections.

- Claudia Nischwitz, Plant Pathologist

Challenges of Growing Heirloom Tomatoes

don't let diseases like fusarium wilt hinder growing your favorite heirlooms

This season, the Utah Plant Pest Diagnostic Lab identified many tomato problems, including soilborne diseases and the bacterial diseases mentioned in the previous article. One reason for the increase in these diseases is the popularity of growing heirloom (open-pollinated) tomatoes, which lack genetic disease resistance, leaving them susceptible to epidemics.

Although hybrids are generally more productive and disease-resistant than open-pollinated tomato varieties, many varieties lack the rich fruit flavor that heirloom varieties deliver. There are several horticultural options that can help these plants prosper, resulting in reduced risk of disease, increased productivity, and reduced fruit cracking.

When growing heirlooms, **pick cultivars** that have been shown to be successful in your area, which may take trial and error on your own farm. Some options include:

- **Green Zebra**: a prolific, medium sized variety with good flavor
- **Cherokee Purple**: although a modest producer, this variety performs well in cooler climates, bearing purplish slicing fruit with a smoky flavor
- **Caspian Pink:** beefsteak tomato similar to Brandywine but more prolific and suited to cool climates
- **Wins All**: a disease-resistant heirloom with large, juicy fruit
- **Black Krim**: a productive variety less prone to cracking, with a deep purple skin and flesh producing a salty-sweet flavor

Since many open-pollinated tomato varieties tend to take their time ripening, they grow best where they get enough heat to allow them to fully mature. **Start plants early** in a cold frame, greenhouse, or high tunnel to extend their season. Plants won't grow in the field until the soil has warmed, which can be helped by wall-o-water, cages wrapped with plastic, thick row cover or mulches.

Heirloom tomatoes are vigorous growers and will need to be pruned regularly, and spaced wider than hybrids. **Remove suckers and plant at a wide spacing** to provide better air flow, which helps prevent foliar diseases, and encourages larger fruit production at the top of the plant.

When watering, **avoid overhead irrigation** because it increases humidity within the plants and splashes water, both of which improve conditions for spread of foliar diseases. Provide intermittent watering to reduce splitting skin, a common problem on heirlooms.

Monitor plants regularly for insect and disease problems (more than you would with hybrid varieties) and learn to identify tomato diseases.

Where soilborne diseases or poor production have put the kibosh on growing heirlooms, **consider grafting**. Grafted plants are made up of an heirloom scion (above ground part) and a hybrid rootstock, uniting disease resistance and enhanced vigor with fruit quality and taste. Grafted heirlooms can produce 30–50% greater yields than non-grafted heirlooms. In tube grafting, hybrid and heirloom seedlings are severed with a sterile knife at a slant just above the cotyledon. The heirloom scion is then secured to the root system of the hybrid with a tube or clip, and allowed to heal before transplanting (shown at right).

- Marion Murray, IPM Project Leader

The Cooperative Agricultural Pest Survey is a federal program, administered jointly by USDA-APHIS-PPQ and each state, whose purpose is early detection of invasive species that could threaten U.S. agriculture. In Utah, the program is co-coordinated by Lori Spears (Utah State University) and Clint Burfitt (Utah Department of Agriculture and Food).

Prevention is Key with Invasive Pests

What are invasive species and why should we care?

Invasive species are plants, animals, or other organisms that are capable of causing severe damage in areas where they are not normally found. Not all non-native species are bad, but those that become invasive can kill forest trees, outcompete native species for resources, cost farmers and society billions in management and lost revenue, and can even harm human health.

How do invasive species spread?

Invasive species are introduced by a variety of modes, both intentionally and unintentionally. Invasive species can be blown by the wind or transported by plants, soil, birds, and animals. Long distance spread, however, is most often the result of human assistance. Invasive species can arrive by boat, airplane, automobile, and packages we mail.

What can you do to prevent the spread and establishment of invasive species?

There are many things you can do to help stop the spread of unwanted invaders. The first step is to learn which invasive species occur in your local area. The primary goals of the Utah Cooperative Agricultural Pest Survey (CAPS) program are the early detection of invasive pests and to raise public awareness about these pests. If you visit the Utah CAPS program website, you will be able to read about the invasive pests that have been detected in Utah as well as those not currently found in Utah but considered to be our biggest threats. If found, these pests could potentially devastate local agriculture and natural resources.

Each year, the Utah CAPS team sets up traps to detect invasive pests in Utah and determine where they are most active. However, sometimes invasive pests are found by concerned community members who simply find something unusual in their homes, gardens, or landscapes. To support our efforts, we encourage you to become familiar with these pests and report their occurrences. Please contact Lori Spears, USU CAPS Coordinator (lori.spears@usu.edu) if you have questions or for more information.

Ways you can prevent invasive species are:

1. Buy local: Avoid carrying or sending fruit, seeds, live plants, soil, or animals outside their area of origin and don't transport firewood. Moving these things can increase the spread of invasive species.
2. Plant carefully: Avoid using invasive, non-native plants and seed mixtures labeled "wildflowers."
3. Keep it clean: When you travel, make sure to spend some time inspecting your belongings and remove any plants, soil, and insects from your clothing, boots, gear, pets, and vehicles.

The velvet longhorned beetle (*Trichoferus campestris*) has been detected in Utah in parks, nurseries, and orchards, starting in 2009. It has yet to be determined if this tree-boring invasive attacks and reproduces in healthy trees in Utah.

To learn more about invasive species and how to prevent their spread, please visit the following websites:

Hungry Pests
The Nature Conservancy's Don't Move Firewood
Center for Invasive Species and Ecosystem Health
The National Invasive Species Council

- Lori Spears, USU CAPS Coordinator

References:

Pejchar, L., and H.A. Mooney. 2009. Invasive species, ecosystem services and human well-being. Trends in Ecology and Evolution 24:497-504.

Pimental, D., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics 52:273-288.

American Kestrels on Utah Farmlands

By Casey Burns, State Biologist, USDA Natural Resources Conservation Service, ut.nrcs.usda.gov, (801) 524-4566, casey.burns@ut.usda.gov

Attracting Kestrels and Barn Owls for Pest Control

Native predators will rarely completely eliminate a pest problem, but can be part of a multifaceted solution to pest control. Using wildlife to help control pests can improve crop production, cut down on pesticide use, improve water quality, save time, supply important habitat, and provide viewing enjoyment. The concepts outlined in this document are ideal for farmland, but can also be used in parks, golf courses, large gardens and yards, and other open areas.

The barn owl and the American kestrel are easy to attract to farmland by installing nest boxes because natural nesting cavities may be difficult to find. Although many raptor species will hunt on agricultural land, nesting pairs will focus hunting near the nests and will capture increased amounts of rodent and invertebrate prey for their growing chicks.

Barn owls primarily prey on nocturnal rodents, especially voles and gophers. Barn owls are known to kill and stockpile more prey than needed. Kestrels, formerly known as sparrow hawks, will hunt large insects, such as grasshoppers, crickets, beetles, and moths, as well as small mammals and birds. Attracting raptors may also help with avian pests, such as magpies and starlings, by changing their behavior. The presence of predators nearby may make the pest species more cautious and less likely to come into the area to feed or will feed for shorter periods of time.

There are many small details that will make a nest box more suitable to attract and fledge birds. Important factors include the number and location of boxes, timing of box set up, predation and competition, management of the area around the box, and box design. See the fact sheet, "Attracting Wildlife for Pest Control on Farmland" for more detailed information. Ideally, boxes are mounted on wooden or metal poles, but can be installed on other existing structures if safe from predation (see above) and road kill.

Beware, there are many inappropriate designs for these nest boxes on the internet. Be sure to contact NRCS or HawkWatch to get the best designs. The Peregrine Fund kestrel box design is recommended for most situations. There are boxes for purchase on the internet and at some home stores, or you can build your own.

Snags, which are standing dead trees, are important for many types of wildlife, especially species that provide pest control on farmland. Snags provide cavities for nesting birds and other wildlife, important foraging sites for woodpeckers, and perching sites for many species of birds. It is important to maintain natural snags whenever possible. Artificial snags and perches can also be installed to benefit wildlife. Materials can be dead trees or branches, or wooden or metal posts. Artificial perches should be 10 to 30 ft high, and benefit from a small crossbar (1 to 3 ft). Different heights and structures will attract different species, so a variety is ideal. Kestrels prefer perching on fence lines and wires. Installing wire perches, where perching wires are not already present, may attract hunting kestrels. Installing wire perches in conjunction with nest boxes can be especially beneficial.

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Pest Monitoring Works in Schools

Mice and cockroaches can vector diseases and create allergy or asthma-related symptoms in children and adults. Unfortunately, these pests are commonly encountered in some Utah schools. Schools that practice regular monitoring, however, are able to rapidly respond to pests like these before they become a problem. These schools are practicing integrated pest management, where they maintain a healthy environment with very little pesticide use. The Utah IPM Program is working hard to help more schools in Utah adopt IPM. Not only will they have a safer environment for children, but as of August 2013, it is the law. Regular monitoring is just one component of IPM in schools.

Why monitor?

Information is power, and power over secretive pests leads to successful control. Not only can monitoring determine the pests that are present, but also their life stage, abundance, and where they are occurring. Without monitoring, controls are reactionary, in response to an "outbreak" of pests. Schools that monitor enact control measures before pests are a problem.

Where to monitor?

The question of where to place monitoring traps depends on each school's situation. Schools typically place traps in Pest Vulnerable Areas (PVA's) to maximize the chance of locating pests. PVA's are those places in and around buildings that provide food, water/moisture, and shelter for a pest, including kitchens, food storage, dumpsters, locker rooms, classrooms with plants or pets, etc. Traps are placed against walls and other structures, as many indoor pests tend to travel along edges. When traps are placed, they are assigned a unique number and date. Schools that practice IPM can also perform visual inspections in all PVA's. Window sills are excellent places to look for dead insects to get an idea of pest issues in the school.

What kinds of traps are available?

For arthropods (insects, spiders, etc.), sticky traps are the standard. Depending on the location and conditions, sticky traps could last weeks to months. Some IPM schools have used light traps in loading dock areas or entry ways to monitor the various species in the area, and in what abundance.

For rodents, there are different types of bait station traps available for different types of locations. Tier I traps are locked, tamper-proof, and can be used outdoors. Tier II traps are tamper resistant and are used indoors, and Tier III traps are only resistant to children (not dogs) and are also used indoors. (Glue boards and sticky traps are not used for rodents in schools.) No toxic pellets or packets are allowed for rodent control in schools practicing IPM, but non-toxic bait blocks are commonly used. All rodent stations are labeled with the date, bait, and active ingredient, and are affixed to the wall or ground.

What to record?

Schools that monitor for pests use site-specific forms on which they record the trap number, date the trap was placed, who placed the trap, and room name or number. The same form is used when inspecting the traps, to record the type and number of pests. Forms and other documentation (pictures, collected insects in vials, etc.) are kept available for use in making control decisions and assessing trouble spots in buildings. School staff that are unable to identify a pest use the services of the Utah Plant Pest Diagnostic Lab.

Thresholds

An important component of IPM is to use thresholds to make treatment decisions. Thresholds are levels of pests that must be present before corrective action is taken. Roaches and mice, for example, are a health

IPM now Mandatory in Utah's Public Schools

The Utah Department of Health's recent amendment to Administrative Rule 392-200 was quietly passed into law in August 2013. While the "School Rule" encompasses a variety of topics, one major change is that now every public and private school (pre-school through grade 12) in Utah must practice integrated pest management.

According to the rule, schools must now:

- adopt an IPM program;
- have a written IPM plan;
- minimize the presence of pests that are vectors of disease or that carry allergens;
- use non-chemical pest management methods whenever possible;
- follow all pesticide laws.

Some IPM schools install lockable, see-through monitoring boxes, in which they can place rodent snap traps and insect sticky traps.

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IN THE SPOTLIGHT, continued

Kestrels, continued from page 7

There are numerous other structures you can build to attract beneficial wildlife to your property. Consider bat boxes to attract insect-eating bats, bluebird boxes to house these attractive insect-eating birds, tree swallow boxes to attract these colonial nesting mosquito-eating birds, and bee blocks to provide nesting sites for these valuable pollinators. Also consider brush piles, downed wood, and rock piles as habitat for terrestrial pest predators.

American Kestrel Nest Box Study

America kestrels populations have declined approximately 65% across North America in the last decade, and experts are not sure exactly why. Theories on what has precipitated the recent decline are climate change and pesticides. The species can be considered an indicator species for ecosystem health, due to its position higher on the food chain. The NRCS has recently joined with the American Kestrel Partnership, coordinated by The Peregrine Fund, to help better understand kestrels and search for a solution to the decline. The Partnership is a network of nearly 600 organizations, individuals, and agencies establishing and monitoring kestrel nest boxes for occupancy and nesting success. With data from across the continent, the cause and solution to the decline is more likely to be discovered. HawkWatch International, based in Salt Lake City, is a member of the Partnership, and will also be contributing data into the national data set. However, HWI is gathering more in-depth information using its volunteer citizen scientists. HWI is looking to better define the variables associated with quality kestrel habitat in Northern Utah.

In order to understand the decline of the kestrel and figure out a solution, landowners with suitable, open field, habitat are encouraged to get involved in the effort by establishing kestrel boxes and joining the monitoring effort. In addition to contributing toward this valuable goal, landowners will receive the pest control benefits of hosting kestrels.

NRCS staff are able to assist landowners in planning kestrel boxes as part of integrated pest management plans, and/or as part of wildlife habitat enhancements plans. Funding may be available for landowners, particularly on agricultural land, to install and monitor the boxes. Monitoring would be optional to the landowners, and would contribute to the Partnership database. More intensive monitoring could be done to support the HWI effort and the Partnership. HWI volunteers may be available to monitor kestrel boxes.

- Casey Burns, USDA NRCS

For More Information:

HawkWatch International: hawkwatch.org, Shawn Hawks, (801) 484-6808

American Kestrel Partnership, kestrel.peregrinefund.org

GENERAL PEST MANAGEMENT NEWS AND INFORMATION, continued

Monitoring in Schools, continued from previous page

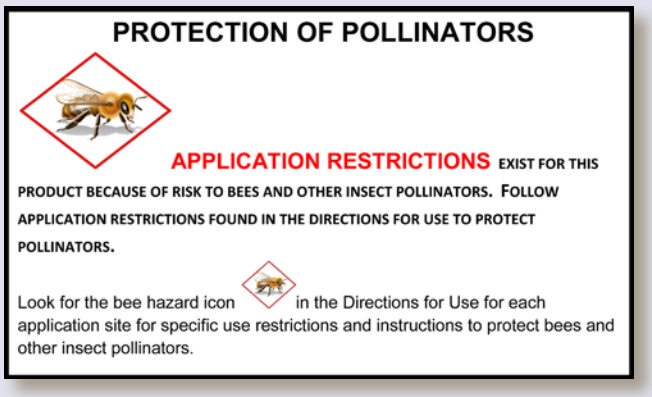
risk and have a zero-tolerance policy. The roly-poly, stink bug, ground spider, or ground beetle, have minor health and pest significance and have higher thresholds for whether or not to treat.

To assist school districts in complying with the new rule, USU, the Utah Department of Health, and the Utah School IPM Coalition are writing model IPM plans that schools can adapt to their own situation. They are also developing educational programs to help school districts and health inspectors learn about implementing IPM.

To inquire about how the school IPM team can assist your school district or for questions regarding the School Rule, please contact Ryan Davis (ryan.davis@usu.edu). The new Utah Pests School IPM website will summarize the new rule.

- Ryan Davis, Arthropod Diagnostician

Pesticide Labels will Now Have Pollinator Advisory



EPA requires that all new labels of products containing imidacloprid, dinotefuran, clothianidin, and thiamethoxam include a bee warning. Click here for more information.

Barriers and Exclusion Techniques for Arthropods

This is the second article in a two-part series on trapping and excluding arthropod pests. The first article appeared in the Summer 2013 issue of Utah Pests News, and focused on common methods to attract and trap arthropods (insects, spiders, mites, and relatives) for monitoring and management. This article will cover common techniques to keep arthropods away from plants and out of buildings.

Barriers can be physical or chemical in nature. Use of arthropod barriers can be a good fit for home gardens, buildings, and small-scale agricultural settings. The time and labor required to install and maintain barriers can limit their use for large-scale pest management.

Physical Barriers - Exclusion from Plants

Placing barriers over or around plants can be highly effective in reducing injury from some arthropod pests. In many cases, barriers are best suited for use during the seedling, bloom, or fruiting stages when plants are most susceptible to pest damage. Using barriers during targeted, limited time periods will reduce the amount of labor to maintain the barriers.

- **Sticky barriers** can be placed as a band around a trunk, limb, or stem to exclude climbing insects and mites. Example pests include earwigs, spider mites, ants, codling moth, elm leaf beetle, and others. Sticky adhesives, such as Tangletrap, can be purchased or made by mixing one part petroleum jelly and one part household detergent. For tree trunks, apply the adhesive on a surface, such as duct tape, to protect the bark. Remove accumulated insects and debris from bands and add fresh adhesive added as needed.

- **Shields** (6-inch diameter) made from tar paper or foam rubber can be placed on the soil around seedlings in the cabbage family, bean, pea, corn, beets, and tomato to prevent egg-laying by the cabbage and seedcorn maggot flies. Shields can also serve as hiding places for predatory ground beetles that will eat maggot eggs and larvae, as well as other pest insects in the garden.
- A ¼ inch thick layer of **diatomaceous earth** or crushed egg shells placed around vegetable and ornamental plants (4-6 inch diameter circle) can deter crawling pests, such as caterpillars, earwigs, snails, and slugs. These "mine fields" of sharp shards tear holes in the outer protective body layer, causing them to desiccate.
- **Cutworm collars** can reduce losses to vegetable seedlings from caterpillars in the cutworm family. Collars can be constructed from metal, plastic, foil, cardboard, or other sturdy and flexible materials. They should be at least 4 inches tall, and placed securely into the soil to about 1 inch depth. The top edge of the collar can be bent outwards to enhance its effectiveness in preventing cutworms from crawling over the top.

- **Bagging fruit** to exclude codling moth, peach twig borer, yellow jackets, European paper wasp, and other pests can be highly effective. Fruit clusters must be thinned to a single fruit and bags applied before the target insect is active. Nylon mesh fruit bags are available from horticultural suppliers or can be homemade.

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Arthropod Exclusion, continued from previous page

- **Covers or cages** placed over plants can prevent feeding damage and egg-laying by many insect pests, including leafminers on leafy greens, caterpillars and cabbage maggots on cole crops, flea beetles on mustard crops, aphids, beet leafhoppers that vector curly top virus, and others. Floating row covers are made from a strong, permeable fabric, and should be secured over plants before pests are present. Row covers are permeable to air, light, and water, and allow continued plant growth. Cages can be large enough to cover an entire crop row, such as a ventilated plastic or row cover suspended on a frame, or small enough for a single plant, such as a cone constructed from window screen. If the crop requires pollination, covers and cages must be designed for removal, or vented to allow bees access to plants during bloom.
- **Copper bands** or strips can be placed around tree trunks, raised beds, and other structures to exclude snails and slugs. The copper ions carry an electric charge that repels the gastropods.

Physical Barriers - Exclusion from Buildings

Many insects and spiders become nuisance pests when they enter buildings to seek shelter. Prevent their entry by caulking cracks and crevices in foundations, walls, and especially around basement doors and windows; install weather-stripping around doors; screen attic vents; and repair window and door screens and ensure screen frames fit tightly. Remove thick vegetation, debris, and heavy mulches next to foundations, especially around basement doors and window wells. Keep firewood stacks and other debris where arthropods may hide at least 20 feet away from inhabited buildings. Don't store firewood indoors.

Techniques such as these and similar ones can be highly effective as physical barriers in preventing entry of pests into the home or workplace.

Chemical Barriers

In most cases, use physical barriers and other non-chemical techniques before resorting to insecticides. For prevention of structural damage to a building, such as from termites, chemical controls are often needed in addition to physical barriers and cultural practices to reduce the attractiveness of the site to the pest. To conserve beneficial insects, only apply insecticides when deemed necessary.

Insecticides can be applied as a chemical barrier around buildings or plant beds. Populations of migrating pests, such as grasshoppers, can be reduced by placing at least a 6 ft wide barrier of granular insecticide formulated as a bait. Granular bait formulations of spinosad, a bacterial insecticide, can be applied as barriers around fruit trees and berry bushes to exclude earwigs. Insecticides can be applied to the soil around the foundations of buildings to exclude insects and spiders.

Use of barriers are one component of an integrated pest management approach. The goal of IPM is to achieve balanced and sustainable pest management while preserving the environment and human health. For small-scale pest management situations, barriers can provide a low cost and simple way to reduce pest problems.

- Diane Alston, Entomologist

References:

Cornell University Horticulture Diagnostic Laboratory. 1992. Insect traps and barriers (3 pp.). Cornell University Cooperative Extension of Suffolk County, Riverhead, NY.

Flint, M. L. 1998. Pests of the Garden and Small Farm, 2nd ed. (276 pp.). Statewide Integrated Pest Management Project, University of California, Division of Agriculture and Natural Resources Publication No. 3332, Berkeley, CA.

Plants and Karate? Using Self-Defense in IPM

When we think about plants being aggressors toward insects, the insect-devouring Venus flytrap or pitcher plant may come to mind. Most plants, however, do defend themselves against attacking pests and have adapted ways to overcome being completely eaten. These defense traits can be useful when developing resistant varieties and new tools in pest suppression.

The most noticeable plant traits to deter feeding are physical. Thorns on stems of raspberries, for example, may deter neighbors from picking every berry. On a smaller scale, some plants have dense mats of trichomes (plant hairs) that make it difficult for insects and pathogens to reach the nutritious plant tissue. These hairs are sometimes accompanied by a sticky substance that traps insects or alters their movement. For example, hairy varieties of beans and strawberries reduce eating or egg-laying by aphids, leaf hoppers, and whiteflies. And glossy or waxy leaf varieties of cabbage reduce the ability of diamondback moth larvae from mining the leaves, leaving them exposed to predators.

Inconspicuous defense traits include plant-produced chemicals that make them less suitable as a food source. Several plants, like Sacred datura (jimsonweed) and foxglove are harmful if eaten by animals because of specific plant chemicals. And it has long been known that crushed chrysanthemum flower heads and seeds have insecticidal properties (pyrethrum). Some other examples of plant chemicals that deter pests are the soap-like saponins in alfalfa, the bitter tasting glucosinolates in mustards and Brussels sprouts, nicotine in tobacco, and cucurbitacins in cucumbers.

In some cases, when the plant is attacked by an insect or pathogen, levels of these chemicals become elevated. This added protection can help slow additional feeding and prevent complete death of the plant. Plant breeding has been used to select plants with high levels of these chemicals and breed them for pest resistance. The trade off, however, is that high concentrations of these chemicals can lead to a less palatable plant. In cases where pests are specialized on a particular group of plants, like cucumber beetles, these elevated chemicals can alert the pest to the location of its food source.

When plants are damaged by insects, researchers have found that saliva of the attacking pests can cause plants to release a plume of specific blends of volatile chemicals, called herbivore induced plant volatiles. This "call for help" leads to an increase of predators and parasitoids that are attracted to these plant volatiles, and then feed on the pest. The volatiles in the air sometimes create a spiral effect by promoting neighboring plants to produce the same defense chemicals.

Plant breeders use molecular tools to determine mechanisms of plant resistance, such as with a cabbage selection found to be resistant to whitefly (***top***). Before feeding on milkweed leaves, monarch caterpillars overcome the plant's defenses by trimming trichomes and severing leaf veins to bleed out the toxic latex (***right***).

Several plant hormones are involved in the production of defense chemicals and volatiles. Methyl-salicylate is a plant hormone that has been synthesized and is available as a lure (e.g., PredaLure). Several studies show that this lure is effective in attracting predatory insects and parasitoids that aid in pest suppression. There is on-going work being done to evaluate the complex interactions of plants and insects when using these lures.

The plant traits described above have been exploited for the development of resistant varieties, insecticides, lures, and other pest management strategies. For example, some large scale production farms are using mustard green manure as a bio-fumigant to suppress pathogens in the soil. With advances in science and technology, we are gaining a better understanding of plant resistance mechanisms, plant defense chemicals, and their interactions with pests. With this knowledge, we can improve on their use as a tool in integrated pest management.

-Ricardo Ramirez, Entomologist

References:

Zehnder, G. 2010. Host plant resistance and tolerance to insect pests. eOrganic article 2564.

Freeman, B.C. and G.A. Beattie. 2 008. An overview of plant defenses against pathogens and herbivores. The Plant Health Instructor.

Mortensen, B. 2013. Plant resistance against herbivory. Nature Education Knowledge 4:5

In the National News

SOUNDS IDENTIFY DROUGHT

At the spring 2013 American Physical Society conference, physicists at Grenoble University in France reported their findings on ultrasonic sounds made by trees under drought stress. Pressure inside trees that lack water builds within xylem cells, sometimes leading to the formation of air bubbles that block the flow of water, called cavitations. Trees can withstand some cavitations, but too many can be deadly. These cavitations can be heard with a microphone, but no one has ever been able to distinguish a cavitation from general creaking until now. The scientists conducted a lab study mimicking a drought-stressed tree, and were able to assign a distinct sound wave to cavitations. The findings could lead to the design of a device that would attach to a tree and constantly listen for sounds of "thirst." If needed, the device could then trigger an emergency-watering system.

BEETLES SUBVERT DEFENSES

Plants may defend themselves from insect feeding by producing chemicals within plant tissues that interfere with the insects' digestion and growth. Entomologists at Penn State University have been studying the Colorado potato beetle, and found that sometimes, feeding by the beetle "turns off" the plant defense response, allowing the beetles to be healthy and productive. They reported in the *Proceedings of the National Academy of Sciences* that 3 species of bacteria living in the beetle's gut are able to suppress the plant's anti-herbivore response. The researchers will next determine if these bacteria are present in Colorado potato beetles all over the U.S. and in Europe.

NEW BIOCONTROL MAY HELP MONARCHS

Swallow-wort is an aggressive invasive weed that forms dense patches in a wide variety of habitats in eastern North America, and may have negative impacts on monarch butterfly populations. Monarchs readily lay eggs on the milkweed-relative, but the hatched larvae do not survive. In 2006, a University of Rhode Island graduate student discovered a moth pest of swallow-wort in southern Ukraine, and for the past 7 years, he and colleagues have conducted a rigorous study of its biology and host range, and petitioned the USDA and the Canadian government for its use as a biological agent. The moth only feeds on swallow-wort, and the first release of 500 larvae occurred in Canada in early fall 2013.

A VENOMOUS INSECTICIDE

The venom from tarantulas is now being considered as a biopesticide. In a paper published in *PLOS ONE*, researchers from the University of Queensland, Australia, found that venom extracted from Australian tarantulas was found to be as deadly to termites and cotton bollworms as the common pesticide, imidacloprid. Scientists say that venom from insect-eaters like centipedes and scorpions may also be used as biopesticides in the future, or perhaps may even help breeding plants to resist insects.

CLIMATE CHANGE AIDS IN PEST DISTRIBUTION

Researchers at the Universities of Exeter and Oxford have seen a strong correlation between the geographical spread of crop pests and recent climate changes. A new study appearing in the journal *Nature Climate Change* compared published distributions of 612 crop pests collected over the past 50 years. The results suggest that the warming climate has allowed a variety of pests to spread toward the North and South Poles at almost two miles a year. Currently, 10-16% of global crop production is lost due to pests, and losses are predicted to increase with continued warming.

STINK BUGS SPREADING IN CALIFORNIA

California Department of Food and Agriculture reported that brown marmorated stink bug has become established in Sacramento, making it the first new location in California outside of Los Angeles. This insect is classified by the state as a Class B pest – a detriment to the economy and environment, yet limited in distribution. Because of this distinction, the state has not funded an eradication program.

GRAPEFRUIT MAY TRIUMPH OVER PESTS

Nootkatone, a component of grapefruit oil, has been used for years in fruit-flavored juices and perfumes. In the past, scientists at the U.S. Centers for Disease Control and Prevention showed that it safely and effectively controls ticks, mosquitoes, and other insects, but until now, it was too expensive to manufacture as a biopesticide. The renewable chemical company, Allylix, recently developed a proprietary protocol to develop nootkatone, making it possible to develop nootkatone biopesticides.

Useful Publications and Apps

- Stopbmsb.org has posted a list of 170 host plants for brown marmorated stink bug. The site includes distribution maps, educational info, and monitoring and identification videos.
- Check out the videos available from UC Davis on mosquitoes, bedbugs, ants, pesticides, and more.
- Uncommonfruit is a new website out of Wisconsin highlighting research trials of new and unusual fruit.

Featured Picture of the Quarter

Colorado potato beetle is the single most important defoliator of potatoes. A single adult female lays up to 800 eggs and consumes close to 1.5 square inches of leaf material per day. If the beetles manage to consume all the foliage of the host plant, they move to the stem and exposed tubers, but these are not their preferred sources of food. Unfortunately, potatoes have not evolved any resistance mechanisms (see page 10), and after more than 100 years of breeding efforts, no resistant plants have been identified.

Image by Claudia Nischwitz, Plant Pathologist

Calendar of Events

November 4 - 5, Ninth Continental Dialogue on Non-Native Forest Insects and Diseases, Pittsburgh, PA, www.continentalforestdialogue.org

November 10 - 13, Entomological Society of America's 61st Annual Meeting - "Science Impacting a Connected World", Austin, TX, www.entsoc.org/entomology2013

November 13, Southern Utah Green Conference, Washington, UT, www.utahgreen.org/events

December 3 - 5, 4th International *Phytophthora capsici* Meeting, Duck Key, FL, reg.conferences.dce.ufl.edu/PCAP

December 5 - 6, Global Bed Bug Summit, Denver, CO, www.bedbugcentral.com/events/npma-global-bed-bug-summit-2013

January 8 - 9, Orchard Pest and Disease Management Conference, www.tfrec.wsu.edu/pages/wopdmc

January 21 - 23, Utah State Horticultural Association Annual Convention, Spanish Fork, UT, www.utahhort.org

January 27 - 29, Lawn Care Summit 2014, Nashville, TN, www.landcarenetwork.org/events

January 27 - 29, Utah Nursery and Landscape Association Green Conference, Sandy, UT, www.utahgreen.org/events

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NPDN National Plant Diagnostic Network

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