UTAH PESTS News

Utah Plant Pest Diagnostic Laboratory and USU Extension Vol. 11, Spring 2008

Bee Healthy in Utah

Bee health is a hot topic in the entomology world, and for anyone depending on pollinating insects. Most likely many of you have heard about widespread honeybee colony death in the United States. The collective term for this poorly understood phenomenon is called Colony Collapse Disorder (CCD).

Waugsberg, http://en.wikipedia.org/wiki/Image:Bienen_auf_Wabe_2.jpg

Bartosz Kosiorek, http://en.wikipedia.org/wiki/Image:Drinking_Bee.jpg

A normal honeybee hive (above) has capped brood and many adult workers. Honeybee drinking nectar (below).

Originally described in North America in late 2006, CCD is also being observed in Europe and possibly in Taiwan. To date, there is no single cause to blame for CCD. But there are a number of developing theories attempting to explain why honeybees are suddenly dying, including malnutrition, pathogens, parasites, pesticides and genetically modified crops. CCD could likely be a combination of several factors contributing to the rapid decline of bee colony health. When a honeybee hive crashes, several simultaneous symptoms associated with CCD are often evident, such as a lack of adult bees in the hive, capped brood (bees do not normally abandon a hive until the brood emerges), and available food stores. In some cases, the hives appear relatively healthy and include an active queen, but there just aren't enough adults present in the hive to take care of the immature brood.

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Mantids
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Black Grass Bugs

Human Lice

Fleas

Russian Wheat Aphid

Utah Home Orchard Pest Management Guide (Revised)

Wheat Stripe Rust

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Bee Healthy in Utah, continued from page 1

Domesticated honeybees in the United States were introduced from Europe in the 19th Century. Since 1971, the United States has seen a gradual decline in domesticated honeybees and a striking decline in native, wild honeybees. Although the number of beehive colonies are decreasing each year, there is still a huge demand for pollinating insects in agriculture and horticulture. Honeybees are responsible for about one-third of pollinated crops in the United States, with total production values exceeding $15 billion each year. Almonds, for example, are worth over $1.5 billion and depend on honeybees for pollination. Honeybees also pollinate apples, blackberries, cherries, cucumbers, peaches, raspberries and watermelons. In Utah, the honey industry is worth more than $1 million each year.

The Utah Department of Agriculture and Food (UDAF) monitors for bee health every year. Bee inspectors not only survey for the number of active hives within the state, but also assess the health of each colony by sampling for pathogens and parasites. Two of the most important problems affecting bee health in Utah include the varroa mite and a bacterial disease called American foulbrood. In 2007, over 3,400 colonies were inspected by members of UDAF. Overall, varroa mites were prevalent, but disease incidence was low (2.6%). Beekeepers actively try to control mites and harmful bacteria so that the hives are in optimal health.

The exact reason for CCD is still unknown. Fortunately, CCD has not been detected in Utah beehives. The Colony Collapse Disorder Working Group, primarily based at Penn State University, is leading the research to stop CCD and improve bee health. To learn more about CCD, visit http://en.wikipedia.org/wiki/Colony_Collapse_Disorder. Local beekeeping clubs can also provide specific information for colony health, pest control, and marketing bee byproducts.

-Erin Hodgson, Extension Entomologist

NEWS FROM THE DIAGNOSTIC LAB

UPPDL Hires New Plant Disease Diagnostician

Erin Frank grew up in northeastern Colorado and attended Colorado State University where she completed her Bachelor of Science degree in 2004. Her major was Soil and Crop Science with a concentration in Plant Breeding and Genetics. In 2005 she moved to Manhattan, Kansas, where she began working on her Master of Science degree at Kansas State University. Her research involved studying gene expression of the prairie grass big bluestem in response to drought and rust infection. She also had a second project which involved molecular studies of a fungal isolate found in bison saliva. Erin defended her Master's thesis in June 2007 and received her Master of Science degree in Plant Pathology. She continued working in the same lab finishing up her other projects before moving to Logan in January.

Erin will process all plant disease submissions and also provide customized management guidelines for the Utah Plant Pest Diagnostic Lab.

USU Extension welcomes Erin Frank to the UPPDL.

Onion Powdery Mildew – Should We Worry?

Although considered a minor disease on onions, powdery mildew is showing up in more onion fields in the western United States. The disease does not appear to be of major concern at present. In Utah, occurrences of the disease have been more noticeable and prevalent in the latter part of the season, after crops have matured. Consequently, crop yields have not been significantly affected.

While there are no recommendations for chemical control, there are reports that some onion cultivars are more susceptible than others. I am unaware of any onion breeding program actively screening for resistance to the disease; however, there are likely onion breeders doing preliminary investigations.

Onion powdery mildew is caused by the fungal pathogen, *Leveillula taurica* (Lev.) G. Arnaud. This pathogen has the ability to cause disease on over 1,000 different plant species including onions, eggplant, tomatoes, potatoes, peppers, and cucumbers. The pathogen was first noted in the U.S. in Florida in the mid 1970s, then later in California. It was observed in Washington in 1996 and over the years has appeared infrequently according to a publication by Dr. Lindsey du Toit in the online Plant Health Progress journal (http://www.plantmanagementnetwork.org/pub/php/brief/2004/onion/). du Toit's report describes the disease on onions in a variety trial planted in Washington; however, the pathogen was also detected in Idaho at about the same time.

Powdery mildew has been reported on onions in Israel, southeastern Europe, and California. In Utah, Extension Vegetable Specialist Dr. Dan Drost identified the disease on onion grown in a Box Elder County variety trial in September 2007.

Early infection symptoms appear as whitish lesions on leaves and later, when conditions are conducive, the fungus will produce visible mycelium (Figure 1) with prolific numbers of spores (Figure 2). Primary spores, called conidia, are pointed or lanceolate (Figure 3) and secondary spores are more cylindrical and rounded on the proximal ends (Figure 4).

The pathogen can survive from one season to another in crop residues, serving as inoculum to infect susceptible crops the following season. It can also be introduced into an area on infected planting stock. Keep your eyes peeled for this disease. How ever you slice it, my belief is that powdery mildew on onion is not worth shedding tears over just yet.

-Kent Evans, Extension
Plant Pathologist

Figure 1. *Visible mycelium of the powdery mildew fungus on onion.*

Figure 2 *(above right). The fungus that causes powdery mildew (Leveillula taurica) forms prolific spores on plant tissue.*

Figure 3 *(right). The primary spores (conidia) are lanceolate.*

Figure 4 *(far right). Secondary spores are more cylindrical and rounded.*

Watch for "Moldy" Turf This Spring

With all our snow this year, get ready for snow mold to appear in residential lawns and turf areas of parks, businesses, and golf courses. Snow molds are fungi that are psychrophilic, or cold-loving, and will attack plants under a layer of snow. Two of the most common snow molds are pink snow mold, caused by the fungus *Microdochium nivale*, and gray snow mold, caused by *Typhula incarnata* and *T. ishikariensis*. Both pink and gray snow molds can occur together and almost all turfgrass species are susceptible to both diseases.

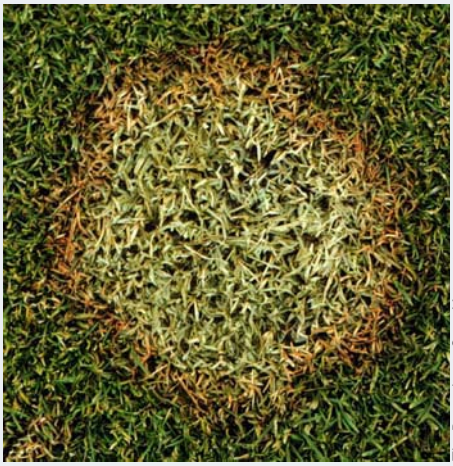
Pink snow mold will survive unfavorable conditions in infected plants and debris of previously infected leaves. The fungus will grow slowly at first, allowing infected turf to go undetected for a long period of time. Once conditions are favorably wet and overcast with cool temperatures, the fungus will spread very rapidly. Sunny and dry conditions cause the pathogen to become inactive. Snow cover is not a requirement for pink snow mold. The disease can occur at any time of the year during cool temperatures and high humidity.

In contrast to pink snow mold, the fungus causing gray snow mold will survive unfavorable conditions as sclerotia (overwintering structures about the size of a pepper grain in this case) during the summer and will germinate in fall once they have been exposed to cool, wet conditions. As the leaves decompose in spring, sclerotia will fall into the thatch layer of the turf. Therefore, the disease tends to appear in the same areas year after year when conditions are favorable. Severe disease outbreaks typically only develop in areas where there is persistent snow cover in the winter.

Pink snow mold spreads slowly when the humidity is low or when there is very little moisture present on the surface of the turf. However, it spreads more rapidly and is more severe in turf that is growing slowly and has a thick layer of thatch. This usually occurs when the weather is cool and wet and when a layer of snow or heavy mulch covers unfrozen turf. The disease is also favored by poor drainage and matted grass, creating pockets of turf where the humidity is higher. Gray snow mold is similar to pink snow mold in that the disease is most severe on unfrozen turf under a layer of snow or heavy mulch. Deep snow is particularly favorable for the development of this disease; the longer the snow cover persists, the more time the pathogen has to be active. The deep snow prevents soil from freezing, increases the local relative humidity, and mats down the turf.

University of Wisconsin-Madison

Gray snow mold (above) typically appears as tan to brown patches on turf, with a layer of mycelium on the leaves.



The Pennsylvania State University

Pink snow mold (right) can have a margin of pink mycelium that give this disease its name.

apsnet.org

A severe snow mold infection on golf course turf.

SYMPTOMS

As the snow melts in spring, turf that is infested with pink snow mold may appear bleached in color, looking very similar to infection by gray snow mold. But pink snow mold begins as a small, orange to reddish-brown circular patch that changes in color to a light gray, and may grow to 8-12 inches in diameter. There may also be a faint growth of white or light pink mycelium at the

Continued on next page

Pink and Gray Snow Mold, continued from page 4

patch edges, but the pink color is usually only noticeable in early daylight hours. Grass in the center of the patches may start to recover from the disease while the pathogen continues to invade the edges, which creates a "frogeye" symptom. Under long periods of low temperatures and leaf wetness, the patches can combine to create large areas of blighted turf, and small clusters of pink spores may be produced on the surface of the leaves.

The symptoms of gray snow mold are a little different. Once snow melt has begun, areas of light yellow, straw-colored turf will appear. The leaves are usually matted down and covered with either a thick or thin layer of white to gray mycelium. As the grass dries, the mycelium will dry out and disappear, turning the leaves gray or silver. Because the crown of the plant is not affected, new leaves will be produced during the spring. A characteristic feature of gray snow mold fungi is the production of sclerotia. These small sclerotia form on infected leaves and are often pink, white, or amber in color when they are young. As they mature, the color darkens to a reddish brown, dark brown or black.

Newly-formed sclerotia of Typhula *(gray snow mold).*

TREATMENT

Management practices are similar for both pink and gray snow molds:

- Avoid over-applying nitrogen fertilizers late in the growing season. This may facilitate disease by causing the development of succulent leaf tissue.
- Do not leave the grass uncut at the end of the season. In the fall, the cutting height should be 20% higher than previous cuttings. This will allow better winter survival for the turf.
- Avoid extreme thatch buildup.
- Prevent large snowdrifts from forming by using snow fences, windbreaks or other types of barriers.
- Apply a low rate of fertilizer in the spring to promote new growth.
- Fungicides can be useful in controlling disease when applied in the fall, but are not as effective as applications in late winter or early spring. Fungicides for gray snow mold must be chosen carefully because of differences in efficacy between the different species. Chemicals containing PCNB (pentachloronitrobenzene) have worked well in the past but the future looks grim for this chemical option as it is scheduled to be phased out for use on turf in the near future.
- For pink snow mold, it is important to maintain low soil pH and balanced soil fertility. We all know how problematic that can be here in Utah with our high-pH soils. Acidifying fertilizers, such as ammonium sulfate, work to lower pH.

-Erin Frank, Plant Disease Diagnostician

ENTOMOLOGY NEWS AND INFORMATION

Got Frass? Carpenter Ants May be the Culprit

Carpenter ants in the genus *Camponotus* (Hymenoptera: Formicidae) are considered some of the most serious pests to wood structures in the United States and worldwide. With 50 species of carpenter ants found in the United States and Canada, some are likely to be near your home.

BIOLOGY

As with termites and some insects in the bee, wasp, and ant order (Hymenoptera), carpenter ants exhibit sociality. For ants, sociality includes having a queen, multiple generations of worker ants, male reproductive ants, and sharing of responsibil-

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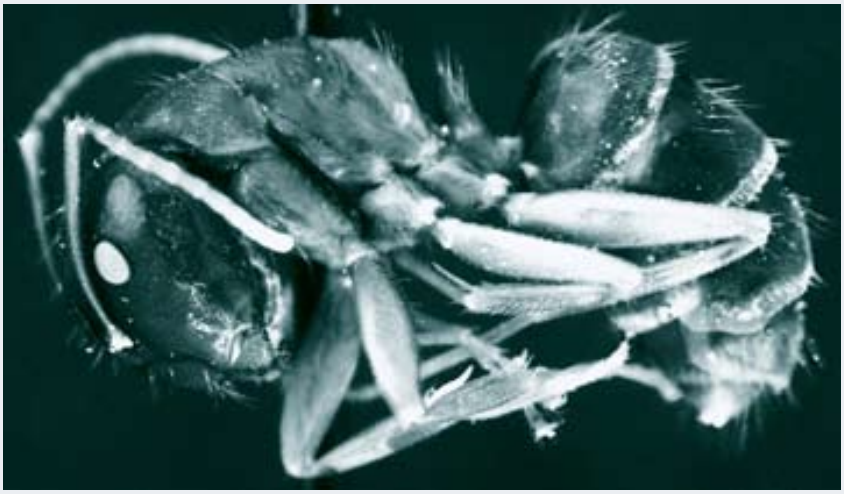

Side view of Camponotus modoc.

Carpenter Ants, continued from page 5

Western carpenter ant (Camponotus modoc) head view.

ities in the colony. Most importantly, the ant social system is dependant upon food sharing (trophallaxis), and the transfer of nutrients through bodily secretions. Carpenter ants have a range of worker sizes from big (majors) to small (minors) and sizes in between (medias), and have multiple queens. Typical carpenter ant colonies can contain from 3,000 to 100,000 workers.

Like butterflies and moths, ants have a complete life cycle consisting of an egg, numerous larval stages and a pupal stage that develops into an adult. In Utah, homeowners are most likely to see carpenter ants swarming in spring when winged males and queens congregate to mate. Often, swarms occur in the late afternoon and early evening on sunny, warm days preceded by rain. If the swarm occurs inside the house, then it is likely that a nest is located inside. Winged ants are often mistaken for termites. If suspected ants or termites are on your property, multiple samples should be collected and submitted to the Utah Plant Pest Diagnostic Lab for proper identification.

Carpenter ants do not need to swarm to form new colonies, but can create new colonies by budding. This process involves a number of worker ants leaving an established colony with at least one queen and starting a new colony. This allows carpenter ants to be highly mobile and start new colonies when established ones are disturbed. Because of this adaptation queens and brood (eggs and larvae) must be eliminated when spray treatments are used.

Another important nesting habit of carpenter ants is the satellite colony. As the name suggests, these are smaller nests that are separate from the main colony and contain all ant castes. For example the main nest may be in the back yard, while a satellite of that nest may be located in a wall void. When treating carpenter ants, the main nest along with the satellites must eradicated. Remember that carpenter ants usually nest at the bottom of wall voids, above doors in the wall void, in large structural beams, or outside in the ground or in trees.

All aspects of carpenter ants are not negative, however, as these organisms play vital roles in maintaining a healthy environment. Carpenter ants are voracious predators in the forest ecosystem. The often consume large prey consisting of stink bugs, leaf beetles, spittle bugs, and scavenge on dead insects. Ants help speed the decomposition of wood by perforating wood cells allowing moisture and other wood decaying organisms to invade. Ants are also a food source for many bird species.

TREATMENT

Carpenter ants may be located from the dust (frass) they deposit when chewing through wood. Piles of frass can be found below carpenter ant nests or tunnels. Another indication of nest presence is seeing ants in the house. Nests can be located by observing ant activity and following lines of ants (ant trails) back to their source. Often, ant trails are located beneath baseboards and under carpets and aren't obvious. Difficulty tracking ants occurs when trails enter wall voids, usually along plumbing or electrical pathways. Ant nests can be difficult to locate, and may occur outside the house, even in your neighbor's yard. If ants are found, it is best to call a professional pest inspector so that the main, and satellite nests are located before treatment. The Field Guide for the Management of Structure-Infesting Ants has a list of all areas where nests may be located:

- Firewood
- Landscape timbers
- Tree stumps
- Dead tree limbs
- Fence posts and rails

Carpenter ant (*Camponotus*) species occurring in Utah

Scientific Name	Major Structural Pests
C. vicinus	yes
C. herculeanus	yes
C. laevigatus	no
C. modoc	yes
C. noveboracensis	no
C. essigi	yes
C. hyatti	no
C. nearcticus	yes
C. semitestaceus	no
C. sayi	no

Continued on next page

Carpenter Ants, continued from page 6

- Under hot tubs
- Decking materials
- Voids above porches
- Voids above bay windows
- Under attic insulation
- Roofing boards
- Wall voids
- Tree holes
- Hollow wooden doors
- Hollow curtain rods
- Hollow shower rods
- Hollow ceiling beams
- Under bathtubs
- Sill plates and floor joists
- Styrofoam sheeting
- Attic eaves
- Under insulation in crawl spaces

Once nests are located there are various treatment options depending on their location:

- Carpenter ants located inside *structural wood* are treated by drilling into the nest and injecting insecticidal dust or aerosol formulations.
- For ants nests located in *firewood*, infested wood is removed from the property.
- If ants are located in *insulation*, the insulation may need to be removed before insecticide treatment, otherwise, aerosol formulations are used.
- When ant colonies occur *outside the house,* insecticidal barrier treatments may be placed around the perimeter of the foundation. If mounds are found outdoors, then a complete insecticidal soil drench of the mound can provide effective control.

Ant baits may only be partially effective at controlling carpenter ants, and should be used in conjunction with other methods for increased control. Spraying worker ants outside the nests will *not* get rid of them; the nest must be treated by a professional.

While insecticidal treatments might provide a temporary solution, treating the conditions favorable to carpenter ants is paramount to long-term control. Carpenter ants prefer wood with high moisture content, especially when the wood is infested with mold/fungi. Some suggestions on reducing moisture in ant-prone areas are to increase ventilation in crawl spaces, basements and attics, use a poly-sheet to cover 75 to 80% of exposed soil in crawl spaces, fix leaky plumbing fixtures, use a dehumidifier in the house, make sure there are no leaks in the foundation, roof, or any part of the house, and in extreme cases, a sump pump may be needed in areas where there is a high water table.

Other cultural controls that are critical include sealing all cracks in the walls and roof, using weather stripping on the bottoms of windows and doors, trim trees and shrubs so that they are not in contact with the house, and creating seals where cable, electrical, or plumbing hardware enter the house. Since carpenter ants tend various insects (e.g. aphids) for their sugar-rich honeydew excretions, controlling those organisms will reduce potential food sources. Vacuuming and cleaning regularly will help keep ants from coming into the house looking for food and will reduce the temptation to colonize in wall voids.

Carpenter ants are major players in ecological systems throughout the world and should only be viewed negative when they are causing damage to a house, business, etc. If ants, or signs of ants are noticed on the property, samples should be collected and identified; many household ants are not carpenter ants. A professional pest inspector should be contracted to locate ant nests and implement the proper control procedures. In addition to insecticide use, long-term control must include cultural methods which can usually be done by the homeowner.

-Ryan Davis, Arthropod Diagnostician

Cankerworms Inching Their Way Here

In Utah and much of the West this past season, we saw localized outbreaks of cankerworm in many urban areas. Trees such as boxelder, elm, maple, cherry, linden, and honeylocust were almost completely defoliated. The good news is that all the trees re-foliated within six weeks. The bad news is that cankerworm will be back this spring.

Both fall (*Alsophila pometaria*) and spring (*Paleacrita vernata*) cankerworm occur in Utah, although the fall cankerworm is most common. The small, brown adults of both cankerworms fly when you would least expect them: the fall cankerworm in

Cankerworms are in the family Geometridae, related to other "inchworms." The females are flightless, and can lay 100 eggs or more.

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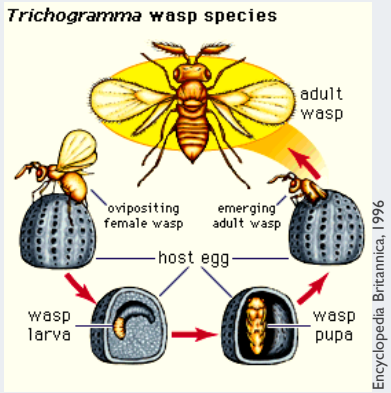
Cankerworms, continued from page 7

In Utah, the fall cankerworm (top) is most common. The larva differs from the spring cankerworm (bottom) in that it has three prolegs instead of two, and has three small stripes down its side instead of one large one. Larvae of both species can range in color from green to brown.

Canadian Biodiversity Information Facility



Encyclopedia Britannica, 1996

There are a number of natural enemies of the cankerworm such as the "caterpillar killer" (Calosoma frigidum, left). This pest is mostly controlled by egg parasites, primarily Telenomus alsophilae, but also Trichogramma sp. (right), and Euplectrus mellipes.

November-December (after a hard freeze), and the spring cankerworm in February-March. The males seek out the flightless females for mating. Eggs are laid primarily on small twigs near buds.

Both species of cankerworm larvae hatch in early spring, just as the leaves break bud (around 120 DD after March 1). Initial feeding causes the leaves to appear tattered, but toward the end of the season, many host plants are completely defoliated. Once food dwindles, they use silk threads to move to adjacent trees or to lower canopy vegetation. They have just one generation per year, feeding for approximately 6-8 weeks before dropping to the soil to pupate.

Most healthy trees can tolerate one to two years of spring-time defoliation, and treatments are usually not required. Stressed trees, however, will have a harder time recovering and may become more susceptible to other insect or disease attacks. Branch dieback and reduced growth are common symptoms.

TREATMENT

The safest materials for suppressing cankerworm are spinosad (a fermentation product from a bacterium) and Bt (the bacterium, *Bacillus thuringiensis*). These products are only effective on the youngest caterpillars (less than ½ inch in size), so early detection is critical. Examine your trees for feeding as the leaves emerge, and/or shake branches in several locations over paper or a flat tray to look for dislodged larvae.

If you miss the early treatment and want to suppress the older caterpillars, there are several products available (pyrethroids, pyrethrin, permethrin, carbaryl, etc.). Insecticides must be applied to taller trees by a commercial applicator.

And as is always recommended in an integrated pest management program, keep trees healthy with optimal watering, fertilization, replacing turf with mulch, and maintenance pruning.

PROGNOSIS

Cankerworm populations are typically on a 5-7 year cycle, and the population will soon dwindle. Because it is a native insect, it has evolved with several predators, parasites, and diseases. As the cankerworm population increases, natural enemies also rise. Predation, combined with reduced food supplies and severe weather, predisposes the cankerworm to a population crash. Expect to see continued damage through the 2009 season, with a gradual decline over the following 2-3 years.

-Marion Murray, IPM Project Leader

Preventing Pesticide Resistance in Insects

Problem: Utah farmer Joe Gardener has used malathion for the last 10 years to control western tarnished plant bug. The last few years, it had not been working as well, so he applied the material at a higher rate and more often. But in 2007, the insect problem was worse than it's ever been.

Explanation: There is a strong likelihood that the plant bug population on Joe's property has developed resistance.

Resistance is happening around the world; over 500 species have shown pesticide resistance. In Utah alone:

- Pear psylla, codling moth, white apple leafhopper, and McDaniel spider mite have all shown resistance to Guthion
- Alfalfa weevil is resistant to over five different pesticides

HOW RESISTANCE DEVELOPS

Pesticide resistance begins with over-applying one kind of chemical. For example, a pesticide sprayed on a colony may leave two resistant survivors. The survivors pass on their genetic predisposition to resistance to their offspring. Each time that same pesticide is applied, the number of survivors increases. As the use of the same pesticide continues over several seasons, a large population of insects becomes resistant, and the efficacy of the pesticide is reduced. Higher rates and more frequent applications become necessary until eventually nothing works.

How did those first two individuals survive? The two primary mechanisms of resistance in insects are decreased sensitivity, and detoxifying enzymes. Like humans, not all insects of the same species are identical. For example, some insects may contain a form of an enzyme that a pesticide targets that tolerates the pesticide, or have an enhanced metabolic ability to detoxify certain chemicals.

Some insects may develop cross-resistance. This is when a specific mechanism that is causing resistance to a certain pesticide also causes resistance to other pesticides in the same chemical class. An insect that is resistant to a certain pyrethroid and is also resistant to other pyrethroids to which it has never been exposed, has developed cross-resistance.

A scarier form of resistance is multiple resistance. This occurs when insects have acquired two mechanisms, independent of each other, for surviving two different pesticides (one mechanism per pesticide). The pesticides may be of the same or different classes. This may occur through the overuse of two pesticides over many insect generations.

GETTING OFF THE PESTICIDE TREADMILL

Lately, chemical companies have increased their testing of new products on a variety of insect populations, and often include resistance management strategies on their labels. Both commercial and residential growers should manage pesticide resistance by taking proactive steps:

Practice IPM to lower pesticide use

Pest monitoring, proper timing of applications, accepting higher insect thresholds, and using non-chemical treatments will significantly reduce reliance on pesticides.

Rotate chemical classes

Pesticides are grouped into chemical classes, each with a specific mode of action on a pest. Using a single or variety of pesticides with the same mode of action over several seasons will promote the build-up of a resistant population. Tank mixing more than one chemical with the same mode of action will significantly speed up the resistance process. Additionaly, continuous application of mixed chemicals from two different classes may result in multiple resistance.

Learn the chemical classes of pesticides and rotate from one class to another. For insecticides, switch to a new class every six-eight weeks. Switching at each application may increase the likelihood of the insects developing multiple resistance. We are fortunate in that a whole new arsenal of insecticides of multiple classes have been developed in the last 10 years that provide excellent control using less toxic chemicals.

Using Metabolic Synergists—New Research

Scientists in the UK and Australia have recently developed a formula for combating pesticide resistance. The synergist PBO (piperonyl butoxide), which is derived from sesame oil, inhibits the production of detoxifying enzymes that allow for resistance. Surprisingly, mixing this chemical with pyrethrins (which has been done for many years) still results in resistance.

Scientists have discovered the problem: it takes 5 hours for the PBO to "shut down" the detoxifying enzymes in the insects. Two sprays spaced 5 hours apart, is cost- and resource-prohibitive. To solve this, the scientists developed a microencapsulated pyrethroid mixed with PBO. The PBO attaches to the insects immediately, while the "insecticide crystals" take 5 hours to dissolve, thus releasing the pesticide at the right time. The formulation was tested in the field on the highly resistant silverleaf whitefly, a serious pest of cotton, and resulted in close to 100% mortality.

-Marion Murray, IPM Project Leader

Soil and Tissue Fertility Testing: Get the Most out of Your Orchard Crops

Authors Grant Cardon, Extension Soils Specialist, and Brent Black, Extension Fruit Specialist, are in the College of Agriculture at Utah State University.

Good decisions begin with a strong base of information—any other way is simply trial and error. Years of experience working with a particular soil and crop may get you by in any given year, but many conditions resulting in long-term productivity or crop longevity problems can be avoided with regular nutrient monitoring and adjustment of fertility management practices.

Soil fertility testing is recommended no less frequently than every other year in perennial crops like orchards. The results allow one to monitor changes in soil fertility level, pH, organic matter content and other important soil conditions that affect not only annual production, but also root system health, winter survival and spring-time recovery of the plants, and soil physical conditions (aeration, compaction, etc.).

For orchard crops, in-season tissue testing is also an option. Tissue testing allows the grower to monitor levels of nutrients at important stages of plant growth and fruit development. This allows for mid-season correction of deficiencies that may occur as a result of differences in environmental conditions, fruit load, age of the trees in certain areas of the orchard, or other in-season factors.

The USU Analytical Laboratory (USUAL) offers a wide range of testing services designed to address the routine and not-so-routine needs for information. A complete list of services for plant, soil and irrigation water testing, along with on-line forms for submitting samples, can be obtained at: www.usual.usu.edu.

SOIL SAMPLING

One of the most important aspects of soil testing is proper soil sampling. The basic concept behind a good soil sample is to form an adequate "physical" average representing the area being tested through proper sample compositing.

Compositing soil samples involves taking soil from multiple, representative locations within the cropped area, mixing the soil together, and then collecting a sub-sample for testing. Done properly, sample compositing results in a physical average of the soil conditions within the cropped area using a single soil sample. A well-composited soil sample can adequately represent up to 25 acres. Here are a few tips for making sure that the composite sample is representative of the area in question.

- **Take soil from the proper depth.**
  For orchards, the most active root zone occurs in the top two feet of soil. In general, soil samples should include soil along the length of that two-foot zone, including surface, one-foot, and two-foot depth. Taking soil only from the surface will not properly reflect the soil conditions experienced by the plant. In all cases, use a sampling tool that is least invasive of the root zone (causes the least amount of disruption to the roots). Sampling probes can generally be checked out from your local USU Extension office.

- **Choose an adequate number of sample locations in a zigzag, random pattern.**
  The number of separate soil samples included in each composite sample should be no less than 5-10 for small areas (less than ¼ acre), 10-15 for mid-sized areas (up to 5 acres), and 20-30 for large areas (no more than 25 acres). A zigzag, random pattern covering the whole cropped area should be used when selecting a sample location (see Figure 1). In orchards, most of the sub-samples should be taken from the outside edge of the drip line of the trees, inward toward the trunks.

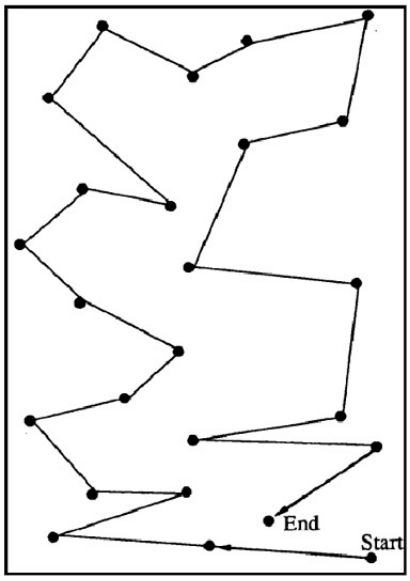


Figure 1. Zigzag, random sample pattern.

- **Clean sampling equipment between samples.**
  Some effort should be made to reduce the potential for cross-contamination between soil samples that can result from soil being left in or on the sampling equipment. Brush or scrape off any soil residue between sampling locations.

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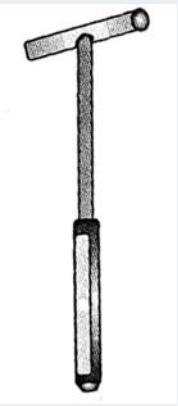

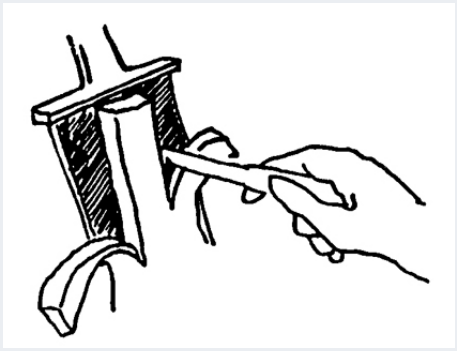

Figures 2 and 3. Tube-type soil sample probe (left); sample collection using a shovel (right).

- **Collect a uniform volume of soil from each sample location.**
  This is most easily accomplished using a tube-type sample probe (see Figure 2) or by trimming samples taken with a shovel or spade (see Figure 3).

- **Avoid anomalous areas within the cropped area.**
  Low spots, areas of different soil texture, or other anomalies in the condition of small areas within the crop should not be included in the composite sample. If these areas are large enough that they warrant separate management, then sample these separately as an area of their own, and submit a composite sample representative of the anomaly.

TISSUE TESTING

Much like soil sampling above, the most important characteristic of a good tissue sample is that it be representative of the general condition of the area in question. To determine a nutrient problem, sampling should occur when the first symptoms are expressed. To determine general nutrient sufficiency at given stages of growth, sampling should occur two to three weeks in advance of that stage to allow for sample processing and timely correction of fertility conditions if necessary.

To collect and send tissue samples:

1. Collect 40-50 leaves from at least 10 plants.
2. Choose leaves with similar appearance and avoid those that may be discolored due to other factors. Select the most recently expanded leaves first.
3. Rinse leaves, gently dab dry, and allow to air dry for several minutes. Over-drying can alter the eventual analysis so simply ensure that surface water is removed before mailing.
4. Send samples immediately to the lab. Generally, mail services are rapid enough that samples will arrive in proper condition if sent in a paper envelope. Plastic bags or mailers can be used, but can cause condensation and possible molding of the tissue sample during shipping.

INTERPRETING SOIL AND TISSUE RESULTS

Nitrogen

The dynamic cycling of nitrogen (N) and the competition that occurs for this nutrient between all living things in the soil system, require annual management according to the prescribed needs of the plant. Nitrogen fertility is best managed on field history and tree age rather than on soil or tissue test levels.

However, more is not always better, especially for nitrogen. In orchard crops there is a trade off between vegetative growth and fruit yield. Too much vegetative growth as a result of excessive nitrogen levels, will reduce fruit set and yield.

In general, typical nitrogen needs for fruit crops are between 0.01 to 0.04 lbs N per tree, per year of age, with a limit of 0.3 lbs N per tree. Vegetative growth is the primary indicator for adjustment of N application rate. New growth in younger trees should be between 16 and 24 inches, on older trees it should be 12 to 15 inches. If the growth is greater than this, adjust the N rate down in subsequent additions and conversely if the rate of growth is too low.

Tissue sufficiency levels vary with crop. The sufficiency ranges for July/August tissue levels are between 1.70 and 2.50% (on a dry weight basis) for apple, 2.30 to 3.30% for cherry, and 2.50 to 3.80% for peach. In-season additions of N can be made, but should be made at least six weeks before fruit ripening to ensure optimum fruit quality at harvest. Splitting N applications 2/3 in the spring and 1/3 in the early summer allows the nitrogen to remain at sufficient levels through the most critical stages of tree and fruit growth.

Phosphorus and Potassium

The need for these nutrients is best determined by soil testing. The level of these nutrients in the soil doesn't change as rapidly as that of nitrogen, so their management is more effectively monitored using soil testing and periodic tissue sampling for sufficiency.

Phosphorus (P) is critical to root growth and function and the proper cycling of energy in the plant. Hence its sufficiency at the time of planting a new orchard, or renovation of orchard sections, is important for seedling establishment. Sufficient P should be applied and incorporated within the root ball area of new trees before planting. In older plantings, excess P can cause imbalances in the uptake of zinc (Zn) and iron (Fe) and adjustment is best made on soil test levels. Mid-season adjustment of P levels in soils is generally not practical, so providing adequate levels at the beginning of the season is the best strategy for management.

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Potassium (K) is critical in the water relations of plants and in the assimilation and cell-to-cell transfer of other nutrients, particularly calcium (Ca) which is so important for fruit quality, particularly in pome fruits. Levels of K in Utah soils are regulated by the weathering of clay minerals and are generally sufficient without fertilizer application. However, on sandy or gravelly soils low in clay content, K deficiencies do occur and will often be expressed by Ca or other micronutrient imbalances in the plant. In-season adjustment of K nutrition is possible with foliar sprays of potassium chloride or potassium sulfate solutions.

Adequate soil test levels of P and K for fruit trees in Utah are 10 to 30 parts per million (mg per kg of soil) for P, and 75 to 400 ppm (mg per kg soil) for K. The summer-time tissue sufficiency level for P for most of the fruits grown in Utah is between 0.15 to 0.40 % (on a dry weight basis). Summer-time tissue sufficiency levels for K vary with crop and are generally about 1.20 to 1.90 % for apple, 1.00 to 3.00 % for cherry, and 1.50 to 2.50 % for peach.

Micronutrients

Sulfur (S) deficiencies in Utah are not very common. There is generally sufficient sulfate dissolved in irrigation waters to supply sufficient sulfur. However, deficiencies do occur on sandy and gravelly soils that do not accumulate and store sulfur efficiently. Sulfur can be added with many of the other nutrients such as K, Zn and Fe which are often applied as the sulfate salts of these nutrient elements. Under low S test levels (below 8 ppm or mg/kg soil) 25 to 50 lbs S per acre should be applied. Tissue testing for sulfur is not generally effective.

For the micronutrients such as Zn, Fe, Ca and boron (B), soil test levels are not always adequate indicators of sufficiency. The cycling and release of these nutrients is so heavily affected by in-season soil temperature, moisture and pH conditions that plant tissue testing is often the best indicator of sufficiency. All of these nutrient elements can be effectively delivered as foliar sprays of zinc and iron sulfate solution, calcium chloride solution, and sodium borate or boric acid solutions. The summer-time tissue test sufficiency levels for these nutrients are given in Table 1.

-Grant Cardon, Extension Soil Specialist
Brent Black, Extension Fruit Specialist

IPM Advisories Expand

The IPM Tree Fruit Advisory program started over 12 years ago, and has helped hundreds of fruit growers manage their insect and disease problems, emphasizing IPM techniques for management.

Continuing in this vein, we have expanded the IPM advisory service to include landscape ornamentals and small fruits and vegetables.

To sign up for any of these advisories, click on the following links:

- Landscape Advisory (April - Nov.)
- Small Fruit and Vegetable Advisory (April - September)
- Tree Fruit Advisory (March - Sept.)

Or, go to lists.usu.edu, and scroll down to "PestAdvisories" to select.

Featured Picture of the Quarter

A small-operation greenhouse grower of poinsettias in Utah contacted Extension Plant Pathologist, Kent Evans, last fall with an unusual case of pesticide damage on his plants. Workers had sprayed his lawn for weed control including the outer edges of his greenhouse. Fumes from the herbicide seeped into the greenhouse. Because of the cooler day, the fans weren't running, and the volatile compounds settled onto the plants and destroyed the grower's seasonal crop of poinsettias.

-Photo by Kent Evans

In the National News

IMPORTANCE OF FARMS AND FORESTS IN GLOBAL CLIMATE CHANGE

Farms and forests play a critical role in stabilizing global warming by absorbing carbon dioxide from the atmosphere and "storing" it in plants and soil. A study from the Pew Center on Global Climate Change found that changes in agricultural practices, including re-foresting farm edges, could reduce current U.S. greenhouse gas emissions by 1/5.

LIGHT BROWN APPLE MOTH CONTROL AND MONITORING

USDA will grant $75 million in funding for control of light brown apple moth, a recent pest introduction occurring in eleven California counties. California has initiated an aggressive trapping and control program using sprayable and twist-tie application of mating disruption, release of beneficial insects, and possible ground sprays of Bt and spinosad. The money from USDA will also be used for a national detection survey to look in "hot spots" of introduced nursery stock, urbanized areas, and orchards.

NEW PROGRAM ESTABLISHED TO HELP SAVE THE HONEYBEES

All the Federal bee laboratories in the nation have established a five-year "Areawide Program to Improve Honeybee Health, Survivorship, and Pollination Availability," and will work with universities, apiculturists, and others to establish specific recommendations to help beekeepers manage their colonies.

Some of the research includes: improving longevity of queens, controlling *Nosema* protozoa and varroa mite, genetic selection and colony size management, disease management, and reducing stress in migratory colonies.

NOVEL MOSQUITO CONTROL

A molecular pesticide developed by the Agricultural Research Service may prove to be a safer alternative control of mosquitoes than insecticides, without worry of resistance.

A molecular pesticide has nucleic acids as its active ingredient, and targets only the pest in question. They work by preventing the insect from producing essential amino acids necessary for their survival. It is a safer alternative to chemicals because it only harms the pest, and has no effect on beneficial insects or other organisms.

CONSUMER PESTICIDE USE INCREASES

A recent market study predicts that demand for home and garden pesticides will increase by almost 5% per year over the next 4 years, approaching $1.7 million in sales by 2011. Newer active ingredients, more convenient packaging, super-concentrated formulations, and ready-to-use products will drive demand.

Publications

- "Building a Sustainable Future: Ecologically Based Farming Systems" (http://www.new-ag.msu.edu/pdf/E2983.pdf) is a publication through Michigan State University that examines community-based food systems, agricultural landscapes, and IPM.

- "A Pocket Guide to Common Natural Enemies of Crop and Garden Pests in the PNW," Oregon State University, is a free, printable guide to 19 different groups of insects: extension.oregonstate.edu/catalog/pdf/ec/ec1613-e.pdf.

- A report on the "Global Status of GM Crops" is available at: www.isaaa.org/resources/publications/briefs/37/executivesummary/default.html.

Calendar of Insect, Disease, and IPM-Related Events

March 25-27, SARE 20th Anniversary Conference, "New American Farm: Advancing the Frontier of Sustainable Agriculture," Kansas City, MO, www.sare.org/2008conference/

April 1-2, Women in Agriculture Educators Conference, Oklahoma City, OK, www.agrisk.umn.edu/wia/Conferences/WIA2008/

May 13-15, Western Region Pesticide Meeting, Scottsdale, AZ, pep.wsu.edu/wrpm/WRPM_08.html

June 25-27, Pacific Division APS Meeting, Jackson Hole, WY, www.apsnet.org/members/div/pacific/

July 26-30, APS Centennial Annual Meeting, Minneapolis, MN, meeting.apsnet.org/

September 14-18, Biodiversity in Agriculture: Domestication, Evolution, and Sustainability, Davis CA, harlanii.ucdavis.edu/index.htm

March 24-26, 2009, 6th Annual IPM conference, Portland, OR