Spring 2021
Vol. XV

UTAH PESTS QUARTERLY

NEWSLETTER

Utah Plant Pest Diagnostic Laboratory

USU Extension

IN THIS ISSUE

NEW MEDIA

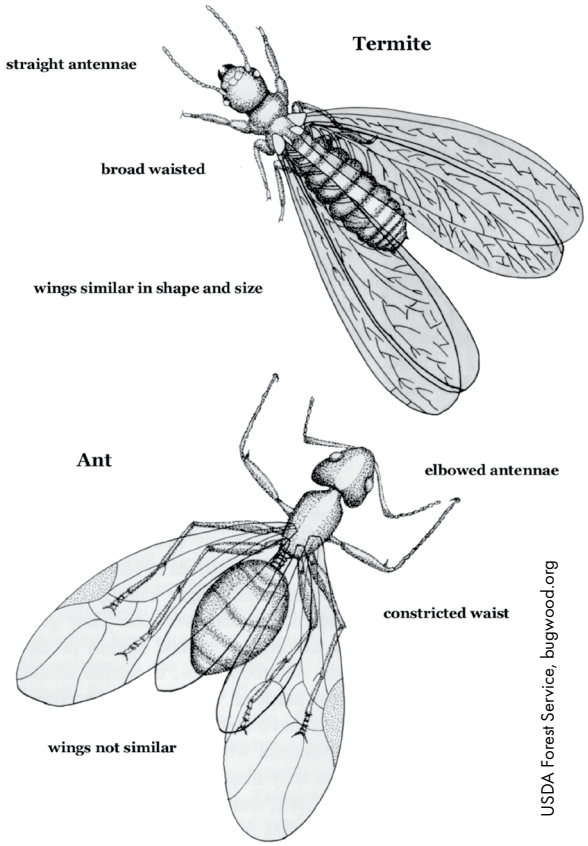
EXTENSION

UtahStateUniversity

Gary Alpert, Harvard University, bugwood.org

Coming to Terms with Termites

This winter, I found termites feeding on a section of wood trim in my home. They had appeared out of nowhere and although I was certainly concerned, termites often aren't as formidable as they seem. Three main types of termites can be found in Utah, including dampwood termites, drywood termites, and subterranean termites.



USDA Forest Service, bugwood.org

Termites are social insects that live in colonies and have a caste system that includes workers, soldiers, swarmers (winged), and queens/kings, each of which has its own role to fulfill. In general, termites are small (0.5 – 2 cm), brown to black insects that superficially resemble ants, and can be either winged or unwinged. Differences between ants and termites can be seen in the antennae and wings. Ants have elbowed (bent) antennae while termites have straight antennae, and ants have two small wings and two large wings while termites have four wings of equal size.

Dampwood and drywood termites are both uncommon in Utah. Dampwood termites infest decaying wood with high moisture content. Because of the need for moist wood to make nests and feed, they are more likely to infest rotting logs than human structures. However, keeping your home free of long-standing water damage is important to prevent infestation. Drywood termites make nests inside of dry wood including wood inside walls and roofs of structures and dry wood in the wild.

continued on next page

UTAH PESTS TEAM

Diane Alston
Entomologist
Head, Dept. of Biology
diane.alston@usu.edu
435-797-2516

Marion Murray
IPM Project Leader
Utah Pests News Editor
marion.murray@usu.edu
435-797-0776

Claudia Nischwitz
Plant Pathologist
claudia.nischwitz@usu.edu
435-797-7569

Ricardo Ramirez
Entomologist
ricardo.ramirez@usu.edu
435-797-8088

Zach Schumm
Arthropod Diagnostician
zach.schumm@usu.edu
435-797-2435

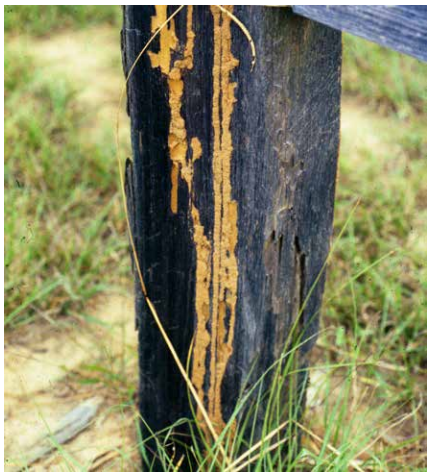
Lori Spears
Prof. Practice Associate Prof.
USU CAPS Coordinator
lori.spears@usu.edu
435-797-0354

Nick Volesky
Vegetable IPM Associate
nick.volesky@usu.edu
435-797-0319

Utah Plant Pest Diagnostic Lab
BNR Room 203
Utah State University
5305 Old Main Hill
Logan, UT 84322

To subscribe, click here.

Subterranean termite is the most common type of termite in Utah. They cannot make nests inside of wood. Instead, they nest underground, sometimes more than 15 feet below the surface. Workers voyage out from the nest to search for food sources such as wood inside human structures. Subterranean termites enter homes through cracks in foundations, or by creating mud tubes that allow them to travel above-ground. Mud tubes protect termites from the air, sun, and other weather conditions that can dry them out. Mud tubes in and around the house indicate the presence of subterranean termites.



Left: Subterranean termites surrounded by clumpy debris, a common sign of termite infestations.

Right: Subterranean termite mud tubes connecting the soil with an above-ground food source.

You may be concerned that if you find mud tubes or termites that the building is dangerous to live or work in. This is usually not the case. Termite colonies take several years to get to a structurally damaging size. Fortunately, there are effective methods for managing termites.

Yearly termite inspections can be helpful to stay ahead of potential infestations. You can do a quick yearly inspection in and around structures for mud tubes and check for other visible signs of infestation such as bubbling wall paint or clumpy brown debris near decorative or structural wood. Basements and crawl spaces are often key locations to check for termites and signs of infestations. However, only check tight spaces if it is safe to do so, and someone is nearby to assist.

For the best results, a professional pest control technician is the best resource for thorough termite inspections and management. At my house, just a single visit by a professional technician removed all traces of termites inside, and the bait stations they strategically placed around the perimeter of the house will prevent further infestations. The company provided peace of mind by being extremely thorough to ensure the infestation is completely terminated and to prevent a reinfestation.

While termites can do a lot of damage to structures over time, the signs can be easy to spot and treat before it is too late. They are otherwise harmless insects and cannot bite, sting, or harm your pets. You can even eat them, and if prepared properly, they taste like pineapple (speaking from experience)!

If you need help identifying an insect found in or around your home, or want more information, contact the Utah Plant Pest Diagnostic Lab (UPPDL).

——— Zach Schumm, Arthropod Diagnostician

March was Women's History Month

Notable American Women Entomologists

Dawn Holzer is the Utah/Nevada Pest Survey Specialist for USDA, APHIS, PPQ.
She celebrated Woman's History Month by researching five entomologists that impacted the world of insects.

Sophie Lutterlough (1910–2009), American entomologist

Lutterlough began working at the Smithsonian National Museum of Natural History as an elevator operator in the 1940s at a time when discriminatory hiring practices prevented African Americans from working in a curatorial or scientific capacity at the Museum. In the late 1950s, after having gained extensive knowledge of the museum's exhibitions, she asked for and achieved a role in entomological work, eventually restoring hundreds of thousands of insects and classifying thousands. She co-identified 40 type specimens that stand as the representative example of the species. In 1979, the mite, *Pygmephorus lutterloughae*, was named in her honor.

Sophie Lutterlough at a microscope, 1983

Ximena McGlashan Howard (1893 - 1986), American entomologist and butterfly farmer

At the age of 18, Howard, based in Truckee, California, started a business to collect, rear and sell butterfly and moth specimens. This became the first commercial butterfly farm in the United States. McGlashan encouraged other young rural women to earn money selling specimens. She also published a magazine from 1913 to 1914 for amateur entomologists, The Butterfly Farmer. She was able to pay her way to Stanford University from her butterfly money and earned a degree in entomology in 1916. A species of Limacodidae moth, *Sibine ximenans*, was named after her.

Ximena McGlashan, from the 1913 cover of The Butterfly Farmer

Leila Gay Forbes Clark (1887-1964), entomologist and librarian at the Smithsonian Institution

Forbes joined the Smithsonian in 1929 and became director in 1942. She was the second woman to direct the Smithsonian's library. Clark oversaw the merger of the main Smithsonian Library with the U.S. National Museum Library which resulted in the centralized Smithsonian Libraries system currently in place. She coauthored The Butterflies of Virginia in 1951. A new form of golden banded-skipper, *Autochton cellus leilae*, was named for her by her husband.

Leila Forbes Clark sits at a desk in front of a window

continued on next page

Louise M. Russell (1905 – 2009), US Department of Agriculture entomologist

Russell was renowned for her expertise in insect identification and research on using parasites for biocontrol. She conducted field studies in Puerto Rico, El Salvador, India, Pakistan, and Colombia. She was an expert on aphids and discovered more than 30 new species. Dozens of species in 11 different families are named after her. She determined thousands of specimens for use in quarantine programs, pest control, regulatory entomology, and systematics research. Russell formally retired in 1975 at the federal government's mandatory retirement age of 70 with 48 years of government service but continued to work over the following 25 years without pay as a collaborator with the USDA Systematic Entomology Laboratory. She published her last article at the age of 101.

Louise M. Russell collecting in El Salvador, 1967

Mary Lua Adelia Davis Treat (1830 - 1923), naturalist and correspondent with Charles Darwin

Treat's contributions to both botany and entomology were extensive—four species of plants and animals were named after her, including an amaryllis, *Zephyranthes treatae* and two ant species (*Aphaenogaster mariae* and *Aphaenogaster treatae*). She also studied carnivorous plants and helped to refine Darwin's thinking on their ecology. She is credited in his 1875 book Insectivorous Plants. Her book, Injurious Insects of the Farm and Field, originally published in 1882, was reprinted five times. Treat supported herself by publishing popular science articles for periodicals such as Harpers and Queen.

References and more information

Sayah, Olivia. (February 16, 2016). It Won't Be Easy to Leave after 40 Years: Sophie Lutterlough's Career at the National Museum of Natural History. Smithsonian Institution Archives. Smithsonian Institution. Retrieved 18 March 2017.

Miller, Douglass R. and Gary L. Miller, Gary L. (2011) Louise May Russell 1905–2009. Proceedings of the Entomological Society of Washington, 113(1):79-89.

Henson, Pamela. (March 13, 2018). "Muse of Scientific Literature": Leila Forbes Clark. Smithsonian Institution Archives. Retrieved 2019-03-31.

Mark McLaughlin. (June 24, 2015). Ximena McGlashan: Truckee's Butterfly Farmer. Tahoe Weekly

McGlashan, Ximena. (1913). The Butterfly Farmer: A Monthly Magazine for Amateur Entomologists.

Wikipedia. Mary Treat.

Image Credits

Sophie Lutterlough: Dougherty, Harold E, July 1983, Smithsonian Archives

Ximena McGlashan: The Butterfly Farmer: A Monthly Magazine for Amateur Entomologists 1(1913): cover.

Leila Forbes Clark: Ruel P. Tolman, September 1935

Louise M. Russell: Proceedings of the Entomological Society of Washington, 113(1):79-89 (2011)

Mary Treat: Unknown author - https://www.darwinproject.ac.uk/mary-treat

Basics of Soil Health

Matt Yost, USU Extension Agroclimate Specialist
Grant Cardon, USU Extension Soils Specialist
Brad Crookston, USU Graduate Student

What is soil health and why am I hearing so much about it?

Interest and discussion regarding soil health has increased in recent years. For decades, soil and scientific communities have researched and debated the issues and benefits of soil sustainability and conservation. From those efforts, "soil health" has emerged as the educational face of efforts to protect and improve the quality and productivity of this crucial, life-sustaining resource.

Soil health has been defined by the USDA-Natural Resource Conservation Service (NRCS, 2018) as "*... the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans.*" Several other similar definitions exist. Of course, only living things can have "health" and the educational effort surrounding "soil health" is to emphasize the critical nature of the life of soil beyond the inherent physical and chemical properties.

Why would soil health matter for plant health?

Soil health directly impacts crop health in many complicated ways – the two are inseparably connected. Healthier soils usually result in healthier plants. Healthier plants are usually better able to defend against pests and pathogen. Thus, focusing on improving the health of your soils could be another great tool to add to the IPM toolkit that could result in less headaches down the road as you strive to fend off pests.

What makes soil healthier?

Many practices can promote soil health. Four practices with high potential to improve soil health include:

- Adding organic matter amendments
- Returning crop residues
- Reducing or eliminating tillage
- Regular and diverse crop rotations

These practices are really all about building soil structure—or the formation and stabilization of soil aggregates and preventing degradation or erosion. Organic matter is only about 3%, at most, of the solid material in arid and semi-arid environments but is important for at least three major reasons:

1. forms and keeps soil aggregates stable
2. provides a "food" or carbon for decomposers
3. absorbs and retains nutrients and water in soils.

continued on next page

Increasing organic matter is one of the best ways to enhance soil properties and function as a plant growth medium. Cover crops, organic amendments, retaining residue, and reducing or eliminating tillage all help promote higher soil organic matter content in soils.

The natural decomposition of organic matter ensures that its supply needs regular replenishment. One must annually introduce organic matter into the soil at a minimum to maintain soil properties, and preferably to enhance them over time. Regular additions of organic matter include root and above-ground tissues of plants growing in the soil (crops and cover crops) or through amendments (manure, compost, residue, other organic materials). How much, you ask, is too much to add? When it comes to organic matter addition (unlike many other amendments) there is generally no "too much" as long as care is taken to account for the properties specific to each type of amendment.

How is soil health measured?

Many recent local, regional, national, and international efforts are occurring to define "soil health" and determine the measurable indicators of its status. These indicators are generally used to quantify the physical, biological, and chemical properties of the soil.

While the debate is ongoing and many indicators exist, five leading indicators of soil health are emerging. These include:

- Soil aggregate stability
- General biological activity
- Microbial diversity
- Active carbon content
- Organic nitrogen availability

Chief among these indicators is soil aggregate stability, which is universally seen as the integrator of many other indicators. In other words, soil structure is a function of the interplay of soil minerals, carbon and nitrogen cycling, and diverse, active microbial communities.

Combinations of these five and some other indicators have been developed into "soil health" tests or scoring criteria, some of which have been recently commercialized. Prices for these tests are higher than most routine soil fertility tests and range from about $35 to $110 per sample.

Conventional tillage (*left*) leaves very little residue on the soil surface. No-till (*middle*) keeps the soil covered with residue, and cover crops plus no-till (*right*) increases soil organic matter and reduces impacts from weeds.

Learn more about measuring and building soil health

Many other considerations need to be determined when measuring and building soil health. Please see our Soil Health fact sheet on this topic, which includes a summary of some of the most common indicators of soil health and how they are measured, as well as a list of soil health labs and costs.

Please reach out if you have additional questions – matt.yost@usu.edu.

Extended Drought May Cause Acceleration of *Ips* Bark Beetles in Spruce and Pine

As the current drought in the western U.S. stretches into multiple years, be on the look-out for sustained stress in native and ornamental conifers. A prolonged drought in the early to mid-2000s led to outbreaks of several species of *Ips* bark beetles, killing ornamental conifers in parks, cemeteries, nurseries, and home landscapes. Dry soils in the spring and fall, when supplemental irrigation is typically absent, can be especially stressful to trees.

There are at least 25 species of *Ips* native to the Intermountain West. They have been traditionally considered secondary invaders of forest trees attacking those already succumbing to other factors and infesting limbs in slash piles following logging operations. In combination with drought stress, *Ips* function more as primary pests and have become a major factor contributing to conifer mortality, in landscapes and nurseries and in native lower elevation pines (e.g., pinyon pines) on dry slopes.

Ips adults are small, 1/8 – 3/8 inch in length with tooth-like spines on their hind end. They attack trees in large masses by releasing aggregating pheromones. Mass attack allows them to overcome a tree's natural defenses, such as pitch tubes. Flights of adults are most synchronized in the spring when they emerge from over wintering and to a lesser extent in the fall. Adults preferentially attack smaller diameter limbs at tops of trees. They can move down the trunk within several months and kill a tree within a growing season. A life cycle can be completed in six to eight weeks, resulting in several generations within a tree and up to five generations in a season.

Beetles feed in conductive tissues of the cambium just under the bark creating characteristic Y- or H-shaped tunnels, called galleries. They disrupt the transport of nutrients and water. Adult males invade first and then attract females with species-specific sex pheromones. Adults form a central tunnel in which they will mate and lay eggs. When larvae emerge from eggs, they form narrow side tunnels as they feed. Larvae pupate at the ends of tunnels and emerge as adults through a small "shothole" they bore through the bark.

A primary management strategy is to prevent stress. Trees that are most at risk for stress include crowded plantings, trees on dry sites (e.g., slopes with fast-draining soils), those affected by compaction or injury from construction, and trees not receiving adequate and deep irrigation into the root zone. Established trees typically need 2-4 inches

continued on next page

of water every month. Avoid and prevent mechanical injuries and infestation by other pests. Once an *Ips* population becomes established in a local area, other susceptible conifers nearby are especially at risk for attack. Transport of infested logs can distribute infestations to new areas.

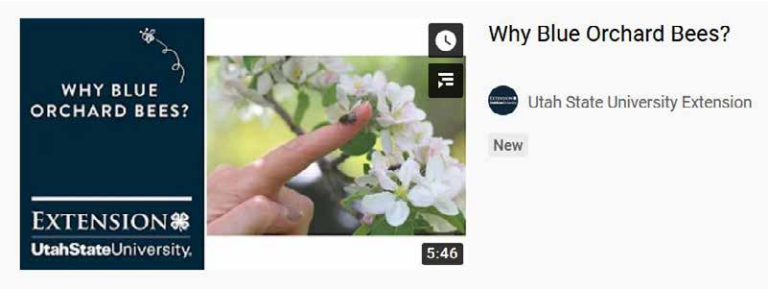
Because infestations usually begin at the tops of trees, it can be difficult to diagnose *Ips* from the ground. Top kill and a rapidly descending dieback are common symptoms. Use binoculars to look for adult emergence holes in the upper trunks of tall trees. If a tree is less than half infested, it may be saved by insecticide treatment, although loss of the central leader will permanently distort the tree's shape. Dead and heavily infested trees require prompt removal. If the wood contains live beetles it should be disposed of in a site at least 2-3 miles from host trees or treated to kill the beetles. To kill beetles within wood, remove the bark, chip, and spread the chips to dry thoroughly. Or logs can be covered for several months with clear plastic to generate lethal temperatures on warm and sunny days.

To learn more about specific *Ips* management recommendations, including insecticide treatments, read the USU Extension fact sheets Bark Beetles and Spruce Health in Utah Landscapes.

Ips-killed spruce trees in a Garland, UT, cemetery, 2004.

Diane Alston, Entomologist

Video Series on Blue Orchard Bees



Entomologists at the USDA Bee Biology and Systematics Research Lab ("The Bee Lab") in Logan, UT and the Foothill Bee Ranch in California, have prepared a series of videos on the use of rearing blue orchard bees for pollination. The informative videos range from 3 to 6 minutes each:

- ***Why Blue Orchard Bees?*** explains the life cycle of the bees, and the advantages of using them for pollination.
- ***How to Provide Blue Orchard Bee Nesting Materials*** explains the recommended timing for deploying nesting tubes, where to hang them, and how high to hang them in orchard trees.
- ***Types of Blue Orchard Bee Nesting Boxes*** and ***Common Nesting Materials for Blue Orchard Bees*** both show several options for nesting structures and materials, from straws to tubes to wood blocks, for large and small orchard operations.
- ***Cleaning Blue Orchard Bee Laminate Nests*** provides a step-by-step visual guide to separate diseased cocoons from healthy cocoons, and how to identify other cocoons that might be in the nests.
- ***How to Remove Blue Orchard Bee Nesting Materials*** shows how to remove paper straws from cardboard tubes or wood blocks, and the best way to open the straws and remove the cocoons.
- ***How to Wash Blue Orchard Bee Cocoons*** explains how to clean cocoons in bleach water after they have all been removed from their nesting tubes.

Cutworms in Utah Vegetables

Despite their name, cutworms are caterpillars as opposed to worms. They are the larval stage of moths in the Noctuidae family (owlet moths). Utah is home to many different species. They are early-season pests of vegetable crops, especially in high tunnels. Cutworms have a wide host range including corn, tomato, beans, beet, brassicas, and leafy greens. Although cutworms get their name for their feeding behavior of cutting the stems of young seedlings, many species also feed on other plant parts. If infestations are high, seedling cutting can drastically reduce yield. In a field setting, this appears as skips or sections of rows where several seedlings are missing.

Description of Cutworm Species Found in Utah Vegetables

Species	Larva	Adult
Army Cutworm *Euxoa auxiliaris*	6-7 instars, 40 mm long, grayish-brown, numerous white and dark brown spots, light brown head with dark spots	35-50 mm wingspan, wings are dark with white-rimmed spots, forewings marked with broad yellowish stripes
Black Cutworm *Agrotis ipsilon*	5-9 instars, 45-50 mm long, light gray to black, brown head with dark spots	40-55 mm wingspan, forewings are uniformly dark brown; hind wings are white-gray
Bronzed Cutworm *Nephelodes minians*	6-7 instars, 35-45 mm long, distinctive shiny bronze color with 5 white-yellow stripes	35-50 mm wingspan, red-brown, front wings with irregular dark-brown band in center of wings
Clover Cutworm *Discestra trifolii*	dull green, broad yellow/pink band below spiracles, black spots above the lateral band	31-35 mm wingspan, front wings are yellow-brown with spots, hind wings gray with brown
Darksided Cutworm *Euxoa messoria*	6-8 instars, gray with brown longitudinal lines, wavy dark band above spiracles	30-40 mm wingspan, gray-brown front wings, hind wings are gray-white
Dingy Cutworm *Feltia jaculifera*	6-7 instars, grayish-brown, grayish-brown head	35-42 mm wingspan, brown, front wings are brown-gray, hind wings are uniformly brown
Glassy Cutworm *Apamea devastator*	35-40 mm long, white-gray with brown-red head (similar appearance to white grub)	35-45 mm wingspan, light gray to brownish-gray with mottled pattern, narrow white line present on forewings with dark triangles on inner margin
Pale Western Cutworm *Agrotis orthogonia*	6-8 instars, 36 mm long, gray-blue with a yellow head marked with two brown bars	25-40 mm wingspan, attractive with yellow-brown spots on forewings with white on the veins, hindwings are white
Redbacked Cutworm *Euxoa ochrogaster*	6 instars, gray, distinctive dark red stripe along the back separated by narrow pale stripe, yellow-brown head	35-40 mm wingspan, dark red-brown wings with bean-shaped spots with light border
Variegated Cutworm *Peridroma saucia*	6 instars, brown-gray to gray-black, dorsal yellow spot present on each of the first four abdominal segments, orange-brown head with dark spots	43-50 mm wingspan, front wings are gray-brown with hind wings are pearly white with brown veins
Western Bean Cutworm *Loxagrotis albicosta*	5-8 instars, 35, mm long, pinkish-brown, dark brown-black stripes on thoracic plate	35-40 mm wingspan, brown wings with distinctive white stripe along anterior margin, well-marked spots on forewings

continued on next page

Depending on the species and location, cutworms overwinter in the larval or pupa stage. Larvae begin feeding early in the season on turf, weeds, and other early plants, and move to plants in gardens and fields. Adult moths are strong fliers and may disperse over a wide area. Eggs are usually laid in large clusters on stems or sometimes structures such as fences or buildings. Life duration is dependent on species and environmental factors.

To prevent damage, start monitoring for cutworms early in the season, especially when seedlings are first emerging. On larger farms, pheromone traps are available to detect adults of certain species. Managing cutworms should start with field sanitation; removing weeds and plant residue in and around the field can reduce cutworm overwintering and feeding sites. Thoroughly tilling crop residue and the soil can also disrupt overwintering stages. There are various generalist predators that attack cutworms, however management tends to require other cultural, mechanical, and chemical options as well. Home gardeners may place cardboard "collars" around transplants to exclude larvae. Various insecticides are available to commercial and home growers, such as carbaryl, malathion, pyrethrins, spinosad, *Bacillus thuringiensis, Chroimobacterium subtsugae,* azadirachtin, zeta-cypermethrin, and cyfluthrin.

— Nick Volesky, Vegetable IPM Associate

The western bean cutworm is a late-season pest that feeds on foliage and other plant parts. It overwinters as a pupa deep in the soil (*top left*). Moths emerge in early summer (*top right*), and females lay round eggs in clusters of up to 200 (*bottom left*). After hatching and dispersal, larvae (*bottom right*) feed on a variety of crops, especially corn.


J. Boute, Ontario Ministry of Agriculture IPM


Adam Sisson, Iowa State University, bugwood.org


University of Nebraska Extension


J. Obermeyer, Purdue University

Bacterial Bulb Rot Diseases in Utah

Utah State University is part of an international effort through a USDA Specialty Crops Research Initiative grant to identify and manage bacterial pathogens that cause bulb rots. Researchers from 12 U.S. states and the University of Pretoria, South Africa, are participating in the project. Due to Utah's dry climate, very few bulb rot samples come to the Utah Plant Pest Diagnostic Lab. Part of the grant includes surveying commercial onion fields to collect symptomatic plants to identify causal bacterial pathogens. During last year's survey, we found four diseases that had not been reported in Utah previously, although the pathogens probably have been in the state for a long time.

Center Rot

Center rot is caused by two species of *Pantoea* – *P. allii*, which was found in Utah in 2020, and *P. ananatis*. *Pantoea* species are common in the guts of thrips. The bacteria can also be seedborne and found as epiphytes, surviving on the plant surface of weeds. Infection occurs frequently when thrips feed on onion leaves near the neck, creating wounds. The thrips defecate on the leaves, and bacteria in the feces are washed into the wounds by irrigation water or rain, entering the leaf. The disease usually starts on the center leaves in the neck with small, water-soaked lesions that rapidly expand into bleached white streaks that kill the leaves. When the bulb is cut open, the scales associated with the affected leaves usually have a wet, brown rot. Disease development occurs during high temperatures (82-95°F) combined with rain or overhead irrigation that provide the necessary moisture for infection. Management is difficult and includes weed control to reduce *Pantoea* reservoirs and insecticides to reduce thrips populations. Since the pathogens can be seedborne, pathogen-free seed or transplants should be used.

Bacterial Leaf Necrosis (Occasionally Bulb Rot)

Bacterial leaf necrosis is caused by another species of *Pantoea* – *P. agglomerans*. It can also cause a bulb rot. In contrast to center rot, bacterial leaf necrosis causes lesions that result in quickly dying leaf tissue. Tissue further away from the lesion may remain green. As with center rot, the bacteria move from the point of infection to the neck, colonizing the bulb. Decaying scales are often light brown. There is little known about the disease cycle of the bacterial leaf necrosis pathogen, but the pathogen can survive on weeds, can be seedborne, and is found in the gut of thrips. A study in Georgia showed that thrips can transmit *P. agglomerans* to onion seedlings.

Internal Brown Rot

Internal brown rot is caused by *Pseudomonas aeruginosa*. The bacteria enter through wounds in the neck area. The field in Utah which the infected bulb was found in 2020 had been hit by hail earlier in the summer. Symptoms of the disease are more commonly found in storage than in the field. It is possible that infection occurs during harvest. The bacteria can live as epiphytes on weeds and are moved by splashing water over short distances. The infected scales turn brown and a soft rot develops. Good weed control is important to reduce inoculum that could splash on onion plants.

Slippery Skin

Slippery skin is caused by *Burkholderia gladioli*. *Burkholderia* is a soilborne bacterium that infects onion leaves and bulbs through wounds caused by hail or insect feeding. Early during the bulb infection process, only one or two fleshy scales may be infected, and appear water-soaked with a yellow-brown discoloration. Infection does not spread directly between adjacent scales but other fleshy scales can be infected when the bacterium reaches the basal plate. Eventually, the scales become dried up and shriveled in appearance. To minimize disease incidence, onions should be harvested at the optimum maturity and stored at temperatures of 36°F or less. There is no evidence the slippery skin pathogen can be seedborne in onion.

All of these bacteria are splash-dispersed, and infection of bulbs is favored by moisture in the necks of onion plants,

continued on page 15

Watch out for Invasive Zebra Mussels on Moss Balls - Destroy! Don't Dump!

Moss balls are beloved, velvety algal plants that decorate aquariums. Unfortunately, they may be aiding the movement of a destructive invasive. The zebra mussel (*Dreissena polymorpha*) is a fresh-water mollusk native to Eurasia that disrupts aquatic ecosystems and water infrastructure. In early March 2021, it was discovered in moss balls sold at aquarium and pet supply stores in Canada and the U.S. (including Utah) (USGS 2021). The U.S. Fish and Wildlife Service and Utah DWR urged these stores and aquarium owners to destroy moss balls to mitigate the risk of introduction (see next page). The message was that all moss balls should be treated as though they are infested with zebra mussels.

In North America, zebra mussels were first identified in the Great Lakes in 1988 in discharged ballast water from large ships arriving from Europe. The mussels spread to all five Great Lakes and New York's Hudson River within five years of their arrival. Currently, zebra mussels occur in all large navigable rivers in the eastern U.S. and hundreds of inland lakes in 28 states (Benson et al. 2021). In Utah, immature zebra mussels (veligers) were found in Emery County in 2008 in Electric Lake and Red Fleet Reservoirs, but subsequent sampling efforts have yielded no zebra mussels (R. Gibbs, Utah DWR Aquatic Invasive Species Biologist, pers. comm.).

Mature zebra mussels are 1 to 1.5 inches in length. The two shells are symmetrical with a straight midventral line, and are black or brown with variable white to yellow zebra-like stripes or zigzag patterns. The zebra mussel is closely related to the invasive and more competitive quagga mussel (*Dreissena bugensis*) which currently occurs in Utah in Lake Powell. Immature quagga mussels were previously found in Sand Hollow (2012) and Deer Creek (2015) Reservoirs but have not been found since (R. Gibbs, Utah DWR Aquatic Invasive Species Biologist, pers. comm.). Zebra mussels can be distinguished from quagga mussels by having a flattened underside that enables them to remain upright when placed on a flat surface.

Top: Adult zebra mussels.

Bottom: A moss ball sold in pet stores containing a young invasive zebra mussel.

continued on next page

Adult zebra mussels release eggs into fresh water (lakes, reservoirs, rivers, ponds, and quarries). After the eggs hatch, they develop into microscopic free-swimming larvae that move passively downstream on flowing water. Eventually they attach to surfaces such as rocks, pipes, docks, cement, wood, and boat hulls where they feed primarily on algae and phytoplankton. Adult mussels are sessile and can live for up to 5 years; each female can produce over one million eggs per spawning season.

Zebra mussels filter and clean the water at unprecedented rates, resulting in decreased food for native fish and invertebrates, and increased light penetration into the water that can allow explosive growth of bottom algae and nuisance weeds. They can suffocate native mussels by anchoring onto them by the thousands, and have caused a severe decline of native mussels in some areas. They can rapidly clog pipes and other water inlets and outlets, and can cost the water industry up to $1 billion annually for management, which typically entails physically dislodging them from surfaces.

Once a water body becomes infested with invasive mussels, eradication is unlikely. They have few natural predators in North America, and current control methods involve inspections and mussel removal. In some areas, potassium chloride has been used to successfully eradicate zebra mussel in localized settings.

To prevent their spread, stop at mandatory inspection stations if you are transporting watercraft. Inspect all watercraft, as well as fishing and SCUBA gear. For boats, remove debris, remove drain plugs to drain completely, allow the boat to dry, and leave drain plugs removed during your trip home. Keep in mind that zebra mussels are excellent hitchhikers and can live several days outside of water.

Ann Mull, Research Technician and
Lori Spears, USU CAPS Coordinator

For more information

Benson, A.J., D. Raikow, J. Larson, A. Fusaro, A.K. Bogdanoff, and A. Elgin. (2021) *Dreissena polymorpha* (Pallas, 1771): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL. nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=5

USFWS. 2021. Destroy! Don't Dump! U.S. Fish and Wildlife Service, Access Date: 15 March 2021.

USGS. 2021. Invasive Zebra Mussels Found in Pet Stores in 21 States. U.S. Geological Survey, Access Date: 15 March 2021.

WGFD. 2021. Zebra Mussels Found in Several WY Pet Stores. WY Game and Fish Department, Access Date: 15 March 2021.

Zebra mussels enveloping a shopping cart after just a few months in infested waters.

Dispose of Moss Balls to Prevent Zebra Mussel Spread

Recently-purchased moss balls and other plants in the aquarium should be disposed of by freezing for 24 hours or boiling for at least 5 minutes, and then placing them in a sealed container prior to disposal in the trash. Most importantly, do not flush the moss balls, mussels, aquarium water, or other suspect materials down the toilet or dump them outside. Place fish and other living organisms in a separate container with water from an uncontaminated source, then decontaminate your aquarium and accessories by soaking all surfaces in 120°F water. Pour down a household drain once water has cooled. Under certain situations, quarantining your aquarium is an option (click here for details) (USFWS 2021, WGFD 2021).

IPM In The News

Flowers Protect Bees Against Insecticides

Researchers from the University of Göttingen and Hohenheim found that a higher diversity of flowering plants increases the breeding success of wild bees. In their experiment, they monitored reproduction rates of *Osmia bicornis* (red mason bee) and measured reproductive success of the bees by the number of their brood cells and emerged offspring. They found that when bees had access to a species-rich mix of flowers, they were twice as reproductively successful compared to bees where only one type of flower was available. The results, published in *Ecology Letters*, indicate that a high diversity of flowering plants could help to compensate for some of the negative impacts of insecticides on wild bees.

Fungi Help Plants Tolerate Aphids

Certain fungi have been found to influence the defense responses in wheat and bean plants against aphid pests, as shown by research at the University of Copenhagen. The scientists compared three types of fungi on wheat and bean plants and found that two types reduced aphid infestations. The fungi were inoculated onto the plant seeds, and colonized the plant roots and stems. Plants with the fungi were able to compensate for aphid-feeding by growing more roots while the non-treated plants suffered. The inclusion of the fungi increased plants' natural defense measures, and when combined with other ecologically focused agriculture methods, could help to reduce insecticide usage in the future.

Preventing Bees from Sleeping

Neonicotinoid insecticides contain ingredients that prevent exposed insects from getting enough sleep to function properly. Two studies by scientists at Bristol University found that reduced pollinator activity could be linked to insecticides that affect the amount of sleep of bumblebees and fruit flies. They found that the typical application rates of neonicotinoids affected the insects' ability to remember, throwing their 24-hour cycle of day and night out of sync. Currently, these neonicotinoids are banned in the EU, and researchers on this project are stressing the importance of the continuation of this ban.

Eliminating the Pink Bollworm

In the United States and Mexico, the invasive pink bollworm, *Pectinophora gossypiella*, has caused tens of millions of dollars in losses annually to cotton crops, making it one of the world's most damaging crop pests. In recent years, a collaborative effort between the University of Arizona, cotton growers, and government and industry partners has effectively eradicated the pink bollworm from cotton-producing areas of the U.S. and Mexico, according to a study published in *Proceedings of the National Academy of Sciences*. The eradication program, involving computer simulation, genetically engineered cotton, and release of sterile pink bollworm moths, has saved cotton growers $192 million from 2014 to 2019 and reduced insecticides against cotton pests by 82%.

Range Expansion of an Old-World Lacewing Species

The larvae of green lacewings from the genus *Chrysoperla* provide valuable biocontrol against aphids, mites, and similar soft-bodied pests. A study published in the *Annals of the Entomological Society* showed that an Afro-Asian species, *C. zastrowi*, has naturalized in the Americas over the last decade. Field surveys detected this drought- and heat-tolerant species in arid areas from Guatemala to the southwestern U.S. The authors suggest that the spread is likely a result of climate change.

A Rescue for Citrus Greening

Research from the University of California, Riverside, has found a peptide that can kill the bacteria that causes citrus greening disease (Huanglongbing, or HLB for short), a deadly disease of citrus trees worldwide. The stable anti-microbial peptide (SAMP) is produced by HLB-tolerant citrus relatives, such as the Australian finger lime. The researchers published in *Proceedings of the National Academy of Sciences* that the SAMP targets and kills the bacteria directly, and activates the plant's immune response to prevent future HLB infection. The peptide has been licensed by Invaio Sciences, as well as the method of application (injection).

Bacterium in Rice Prevents Plant Disease

Despite its water-intensive cultivation, rice is still an important crop world-wide. The pathogen, *Burkholderia plantarii*, kills rice crops and produces a biotoxin that can cause organ damage and tumors in persistently-exposed humans and animals. An international research team which includes the Institute of Environmental Biotechnology at Graz University of Technology has been trying to determine why some rice plants appear resistant to the disease. They discovered a bacterium (*Sphingomonas melonis*) inside the rice seed that produces anthranilic acid, providing complete resistance. Another plus is that the bacteria is carried over to subsequent rice seed. The findings were published in *Nature Plants*.

Featured Picture of the Quarter

The syrphid fly is one of the first beneficial insects we see in spring. It seeks out egg-laying sites containing aphids and other soft-bodied insects for its larvae to feed on. The fly, whose yellow bands resemble a honey bee, feeds only on pollen, nectar, and honeydew, so early-blooming flowers are important to sustain these and other spring beneficials.

Syrphid fly larvae feed for 7 to 10 days, and in that time, a single larva can consume almost 400 aphids.

Image by Mair Murray, IPM Specialist

New Tools

Crop-CASMA (Crop Condition and Soil Moisture Analytics), is a free tool created by USDA National Agricultural Statistics Service in collaboration with NASA and George Mason University that maps soil moisture from the topsoil surface to roughly 3 feet underground and can be utilized for spring planting and monitoring crop health.

What is Sustainable Agriculture is a new animated, 8-part video series launched by SARE, that highlights some common practices farmers and ranchers across the country use to improve profitability, quality of life and environmental stewardship.

Bulb Rots, continued from page 7

particularly once the tops start to fall over. Production practices that speed up drying of the necks after tops start to fall over all help reduce the incidence of bulbs that become infected. This includes avoiding late applications or excessive amounts of fertilizer, terminating irrigation in a timely manner, and undercutting bulbs to speed up field curing and limit the risk of the bacteria moving from infected leaves down the neck and into the bulb.

This work is supported by the USDA SCRI Award 2019-51181-30013 from the USDA National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Claudia Nischwitz, Extension Plant Pathologist

UTAH PESTS people and programs are supported by:

Extension Utah State University

WPDN Western Plant Diagnostic Network

NPDN National Plant Diagnostic Network

APHIS

USDA United States Department of Agriculture National Institute of Food and Agriculture