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UTAH PESTS QUARTERLY NEWSLETTER

Utah Plant Pest Diagnostic Laboratory

USU Extension

IN THIS ISSUE

NEW MEDIA

Nine new presentation recordings posted to our Utah Pests YouTube Playlist

Beyond Antibiotics – Testing Fire Blight Treatments

Fire blight, caused by *Erwinia amylovora*, results in up to 10% tree losses annually in Utah. Bacteria infect open blossoms during warm, rainy conditions, and spread through the phloem killing shoots, branches, and sometimes the entire tree. A bloom-time antibiotic spray is the standard treatment, but research by USU reveals other options–some organic–are just as effective.

The Utah State University IPM Program received funding to evaluate currently-registered conventional and organic products to help reduce fire blight infections. Below are some results of this three-year project.

Blossom-applied Products

In the study, some of the products we tested included two antibiotics, one conventional product, and six organic products. Some are available for residential application.

Streptomycin (Strep) is a commonly-used antibiotic, sold as Agri-mycin to commercial producers and Fire Blight Spray for residential application.

Kasugamycin is an antibiotic only available for commercial operations (Kasumin) with limited application.

Agri-fos and **Garden Phos** are conventional products made from phosphorus acid that can be applied to the trunk or open blossoms, and work by inducing a resistance response within the plant. Monterey Garden Phos is available for residential application.

Blossom Protect is an organic product made from a yeast called *Aureobasidium pullulans*, this product works by competing for space on flowers.

Cueva and **Previsto** are organic copper soaps that can be applied to open flowers.

Regalia is an organic product containing an extract of giant knotweed (*Reynoutria sachalinensis*). Its mode of action is to induce natural plant defenses.

Serenade and **Serifel** are organic products. Serenade is made from the soil-dwelling bacterium, *Bacillus subtilis* and Serifel from *Bacillus amyloliquefaciens*.

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These products work by directly targeting the fire blight bacteria and also by competition for space on flowers. Serenade is available for residential application.

Post-bloom and Pruning Cuts-applied Product

Actigard (acibenzolar-S-methyl) has no direct effect on the pathogen itself, but instead triggers the natural defense system of the plant. It is a convention product only for commercial use.

Blossom Treatment Results

The following individual or combination treatments are listed with the most efficacious first. Each treatment was compared against an un-treated control, which had an average of 35% control (65% blossom infection).

- Strep was highly effective at 79-87% control as a solo treatment (applied once). However, some fruit growers cannot use this product more than once per season due to resistance.
- Blossom Protect can be used in regimes with an antibiotic. We tested three different treatments with this product applied first, followed by strep, and followed by a third product. The third options were Serenade that provided 84% control, copper soap which provided 81% control, and Serifel that provided 77% control.
- Similar to the combination treatments with strep, we used Kasumin as a middle treatment with Blossom Protect applied first. Cueva, Previsto, and Serenade were each tested as a third treatment, all providing 80% control.
- Serifel followed by strep followed by Serifel provided 75% control.
- Serenade mixed with Garden Phos provided 71% control (a residential option).
- As a full organic option, Blossom Protect followed by copper soap (Cueva or Previsto), followed by Serenade provided 68-71% control.
- Another full organic regime was Regalia followed by Serifel and followed by Regalia, provided 69% control.
- Blossom Protect as a solo treatment (applied once) provided 65% control.
- Kasumin provided 58-63% control as a solo treatment (applied once).

Post-bloom Treatment

As shown from the results above, no products provide 100% control. This means that infections will happen, but they should be pruned out, starting about two weeks after full bloom. For this study, we pruned trees later, in mid-June, followed by an application of Actigard versus water to the pruning cuts and nearby bark. On trees treated with Actigard, an average of 3% of the cut branches started growing fire blight again. On trees treated with water, an average of 8.5% of branches started growing fire blight again, and on three of those branches, the infection spread into large branches or into the main stem.

If you have a question about this study including treatment rates or application timing, please contact Mair Murray at mair.murray@usu.edu.

— Mair Murray, Extension IPM Specialist

Management and Research Updates on Balsam Woolly Adelgid in Utah

The balsam woolly adelgid (*Adelges piceae*; BWA) is a relatively new forest insect pest to the Intermountain West and Utah. First detected in Utah's Farmington Canyon in 2017, BWA attacks true fir trees including subalpine fir, a highly abundant species across Utah's higher elevations. A decrease in healthy fir forests may lead to decreased watershed health as well as negative impacts on Utah's ecotourism industry.

Monitoring for BWA includes visual inspection on the bole of fir trees for the white woolly masses produced by the insect or other infestation symptoms such as the swelling of branch nodes, called branch gouting. The Forest Service Forest Health Protection (FHP) program has conducted regular monitoring, confirming BWA in Box Elder, Cache, Rich, Weber, Morgan, Davis, Summit, Salt Lake, Wasatch, and Utah counties. Increased range expansion has led to greater interest in monitoring and management activities in both public and private sectors.

Indirect management of BWA in Utah involves thinning and removal of subalpine fir to favor non-host trees such as quaking aspen, lodgepole pine, Douglas-fir, and Engelmann spruce. Regenerating stands and/or planting to replace subalpine fir with non-host species is another approach. Management plans incorporating the promotion of non-host species have been proposed at several ski resorts in northern Utah including Beaver Mountain Ski Area and Snowbasin Resort. Direct approaches to management include single-tree applications of a pyrethroid insecticide or insecticidal soap during critical periods of BWA's life cycle, a practice typically reserved for small-scale management plans such as those used by homeowners.

Research at Utah State University

A USDA Forest Service Research and Development grant is facilitating research on BWA at Utah State University (USU) to better understand its seasonality and dispersal as well as the forest stand characteristics that may increase subalpine fir susceptibility to BWA. These projects aim to provide pest and forest managers with tools and

Branch gouting, or swelling of branch nodes, is a characteristic symptom of an infestation of balsam woolly adelgid on a fir tree. (***Top***)

A subalpine fir bole infested with balsam woolly adelgid; note the white, woolly masses produced by the insect. (***Bottom***)

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information to better manage and predict the impacts of BWA in northern Utah subalpine fir forests.

One tool in development at USU is a degree day model for BWA. This type of model uses site-specific temperatures insect phenology to predict the timing for pest management. In the case of BWA, the timing is the crawler stage (youngest nymphs). We regularly collected bark samples and temperature data from five subalpine fir stands throughout northern Utah from August 2020 to January 2023. The results of our data indicate that BWA completes two generations per year in these areas. A degree day model is now being developed to predict the timing of each generation, which can then be used by pest managers to predict when to begin monitoring and implement management actions.

Additional research is being conducted to better understand the interactions between subalpine fir stands and BWA. Over 40 BWA-infested fir stands across northern and central Utah and southern Idaho have been sampled to assess forest structure and composition (species composition, tree size, tree health, etc.). Observation of metrics that specifically describe the impact of BWA on individual fir (crown flagging and dieback, gouting, bole infestations) were also collected. Our results suggest that high levels of die-off due to BWA is not yet frequent in Utah. Characteristics describing stand structure and host stocking levels are likely significant contributors to the observed severity of BWA-related damage. These results suggest that specific treatments (e.g., thinning) which target stands with simple structure and high host composition may be effective in lessening the severity of BWA infestation. Accordingly, a hazard rating system that utilizes these common forest assessment data is being developed to help identify and prioritize stands where BWA is present for treatment.

Another study at USU is investigating dispersal of supposed independent BWA within fir stands across northern Utah. While long-range dispersal mechanisms and patterns are of interest for spread across regions and predicting new infestations, very little is known about the dynamics of BWA within a stand once it is present. Fine-scale dispersal patterns and associated tree (host or non-host) and stand conditions (density) likely influence both the spread of BWA within the stand and its trajectory of population change (increase or decrease).

This study will map BWA-infested subalpine fir stands and measure BWA infestation intensity on each tree as well as other tree and stand characteristics. Individual trees in each stand will be monitored for two growing seasons to detect changes in infestation levels. By using spatially explicit data, tree characteristics can be identified that influence new infestations, support current infestations, and predict future infestations. Fine-scale dispersal patterns and associated tree and stand conditions will inform ecological understanding of how insect pests of sessile plants select hosts and disperse in an environment after initial invasion. This knowledge will also inform future management strategies that target stand structural components and tree-level characteristics to control BWA more effectively in the region.

Liz Rideout (M.S. student in Dept. of Biology, USU), Grayson Jordan, and Mike Wayman (M.S. students in Dept. of Natural Resources, USU)

Water Your Pollinators

Pollinators rely heavily on water for their survival. This group of insects—including about 1,000 native bee species in Utah as well as butterflies, moths, wasps, and flies—provide essential ecosystem services for plants, and it is certainly thirsty work. A single bee will visit up to 100 flowers in a single foraging trip and will typically make 10 to 15 trips a day. That's at least 1,000 flowers per day!

Pollen and nectar, however, contain very little moisture, so it is essential for these insects to locate a water source. While worker honey bees will drink water for their own thirst, they will also collect it internally to haul back to the


Nicolefoto/IStockPhoto

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hive to use in their other hive tasks like caring for developing larvae, regulating the temperature of the hive, and diluting hardened honey to make it soft and edible again.

Providing a simple bee watering station in your garden is a simple and meaningful way to support local pollinators in Utah. Plus, it's a fun summer activity to try out with the whole family!

Here are some tips to have a safe and effective bee watering station:

Start Early.
As soon as outdoor temperatures start rising and flowers are blooming, bees will start foraging for nectar and pollen. This is an important time for bees to become healthy and strong. Bees are also great learners, where once they find a water source, they are likely to return. Put out your water station early on in spring before the bees establish an alternative water source.

Location is Everything.
Once you have a well-established water source, you may receive a lot of bee traffic. Be sure to place the watering station away from areas of high human or pet traffic early on. Choose a spot in or near your garden with plenty of attractive flowers.

Shallow is Better.
Bees can't swim or land on the surface of water so be sure to provide a shallow dish or something for them to land on. You can add rocks, marbles, or even corks to provide safe landing pads.

Keep it Clean.
Standing water can attract mosquitoes and become dirty quickly. Be sure to scrub the container and replace the water at least once a week (more often during warm weather when mosquitoes are breeding). Be sure not to let the container dry out, or your bees may opt for a new source of water.

Make it Salty.
Bees prefer salty water because, like for us, salt water provides important minerals. All you need is a pinch. Sprinkling a little in initially will help bees find and remember the water source. Once bees are returning regularly, you can stop adding the salt.

Building a DIY bee water station is easy and can be a great family activity. Any container can work as long as it is shallow or filled with objects to land on. Here are some ideas for creating a homemade station:

- Make a shallow bird bath bee-friendly with some added stone perches
- Use a gravity pet waterer with marbles or pebbles in the bottom
- Turn over a clay plant pot and place the saucer on top as a water dish

Keep in mind that wasps may also visit the water source, but will not chase away other pollinators.

Kate Richardson, Arthropod Diagnostician

Spring Cleaning with Insects in Mind

Increasing temperatures make many people feel the itch to start spring cleaning. As you take the steps to tidy your house and yard this year, be sure to keep in mind not only pests, but also beneficial insects located on your property.

Pest management inside the house starts with prevention measures outside the house. Check all areas where pests may enter such as window and door frames, foundation cracks, and where electrical, gas, or water lines enter the home. Clean out any debris and seal all gaps.

A good practice to keep pests out of the home is to maintain a 2 to 3 foot buffer around the foundation where there are no plants or mulch. Trim off any tree or shrub limbs that can form bridges to the house and clean out gutters thoroughly. If you have a wood pile, try to locate it as far from the house as possible. Everything from spiders to ants and termites love to live in wood piles and then invade the home.

Other steps outside the home you can take to minimize pests are to reduce clutter outside and remove any objects that might gather standing water. This commonly includes buckets, tires, planters, trash containers, and children's toys. Mosquitoes need standing water in order to complete their life cycle and typically go from egg to adult in 8 to 10 days. This means that any containers with standing water outdoors such as bird baths and pet bowls should be dumped out and scrubbed weekly.

Watch Out for the Good Bugs!

Many pollinators and beneficial insects require shelter like leaf litter and dead plants for overwintering. In fact, most native bees nest either underground in soil or in cavity nests built in hollow stems of plants. While you might be itching to get an early start on your garden, a good rule of thumb is to wait until evening temperatures are reliably about 50 °F. This makes sure that last year's leaf litter still protect insects against late season frosts.

If you do need to remove old plant material, consider carefully inspecting and removing stalks that may have cavity-nesting bees. You can bundle these stalks together and place them in a protected area of your garden or yard until temperatures increase. Insects will still utilize the plant materials if it is cut and moved as long as it is kept within the landscape.

Mosquito larvae can only live in water, and removing standing water can disrupt their life cycle. (***Top***)

As you clean, be sure not to disturb any overwintering praying mantis egg cases (oothecas) which may be found on plants or structures. In late spring, up to 300 small nymphs will hatch and only about one-fifth of these beneficial predators make it to adulthood. (***Bottom***)

Consider participating in "No Mow May" to allow grass and wildflowers in your lawn to bloom. The early season is a difficult time for beneficial insects to find flowers and lawns can provide this important resource. When it is time to mow, consider reducing the frequency, as many studies have demonstrated that the greatest diversity and abundance of beneficial insects occur in lawns mowed every two to three weeks.

Check out the Beneficial Insects of Utah guide for more information on beneficial insects and how to attract and conserve them.

— Kate Richardson, Arthropod Diagnostician

The Insects of Capitol Reef

Insects play an important role in all ecosystems and Capitol Reef National Park is no different. Despite being a desert environment, a multitude of insect species are able to thrive there. In fact, the Park's unique landscape and ecology make it home to species of insects that can be found nowhere else in the world. Capitol Reef is encompassed by the Colorado Plateau, a geologically and historically important land feature that stretches across Utah, Colorado, Arizona, and New Mexico. The plateau is home to a total of 8 national parks and 18 national monuments, further showing its significance.

Until recently, very little was known about the insect species and their abundance within the Park. Over the past five years, undergraduate students at Utah Valley University (UVU) partnered with Capitol Reef National Park to document the diversity of the insects in the park. This not only gave them opportunities to study the insects in the field but students were given special permission to collect specimens to further study in the lab with the help of lab equipment. This collective effort resulted in a collection of over 4,900 specimens representing more than 150 families!

Under the direction of Dr. T. Heath Ogden at UVU, a number of undergraduate students have organized and identified most of the specimens within the collection. Jeremy Jensen (recent UVU graduate) and Kelsey Stone (current UVU Biology major) recently brought together all these efforts to create a field guide that will be published later in 2023. This guide will highlight some of the most prominent and unique species that are within the park. It will have pictures and illustrations that can help experts and novices to identify these insects.

The collection, currently housed at UVU, can now act as a library for researchers to study the insects that are in Capitol Reef National Park, and Dr. Ogden's lab will continue to identify more species, updating a website that anyone can go to in order to identify species they find within the park that aren't included in the field guide.

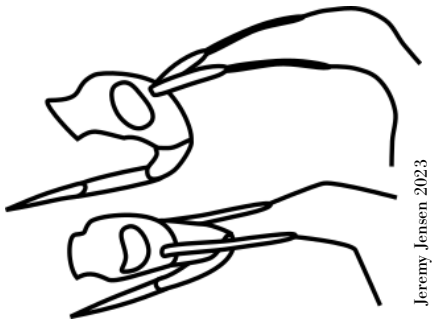
Jeremy Jensen (Technician, Utah IPM Program),
Kelsey Stone (Utah Valley University and Thanksgiving Point),
and Dr. T. Heath Ogden (Department of Biology UVU)

Jeremy Jensen 2020

The insects within Capitol Reef are well adapted to their desert home. However, their great abundance often goes unnoticed, with visitors walking by hundreds of insects such as this juvenile grasshopper (*Trimerotropis* sp.).

Jeremy Jensen 2022

The short-horned walking stick (*Parabacillus* sp.) was an exciting new insect find in Capitol Reef. These insects have been documented elsewhere in Utah but are rarely seen due to their camouflage and limited habitat.



Jeremy Jensen 2023

The field guide will include illustrations that can be helpful to show identifying characteristics. For example, distinguishing kissing bugs like *Triatoma protracta* from other assassin bugs requires viewing the side profile of the head, where kissing bugs (bottom) tuck their proboscis tight against their heads while other assassin bugs don't have such a sharp angle in their proboscis.

Bolster Your High Tunnel Against Pests

Cutworms overwinter as larvae amongst protected areas inside high tunnels.

High tunnels are passive solar structures used to extend a growing season and increase production by protecting crops from damaging weather conditions. The warmer air temperatures in high tunnels allow crops to reach maturity more quickly. Unfortunately, these conditions also create an ideal environment for various arthropod, pathogen, and weed pests. To avoid economic loss, it is important to manage high tunnels for pests such as aphids, thrips, cutworms, and slugs.

Aphids are a common pest that can be found on fruits, vegetables, ornamentals, grasses, and weeds. Four aphid species commonly found in high tunnels are green peach aphid (*Myzus persicae*), melon aphid (*Aphis gossypii*), potato aphid (*Macrosiphum euphorbiae*), and cabbage aphid (*Brevicoryne brassicae*). Also common are thrips including western flower thrips (*Frankliniella occidentalis*) and onion thrips (*Thrips tabaci*).

Cutworms are one of the first species found in high tunnels as they overwinter in the larval stage and emerge as early as January into April. They are most destructive during the spring and early summer months and species include army cutworm (*Euxoa auxiliaris*), black cutworm (*Agrotis ipsilon*), glossy cutworm (*Apamea devastator*), pale western cutworm (*Agrotis orthogonia*), and variegated cutworm (*Peridroma saucia*). Lastly, slugs feed on a wide variety of plants and can be particularly damaging to new seedlings and maturing vegetables that touch the soil.

Several simple strategies can be used to prevent and manage high tunnel pests.

1. Remove plant debris both inside and outside the high tunnel at the end of the growing season, as it may serve as an overwintering site for various growth stages of caterpillar pests.
2. Remove weeds growing inside or outside high tunnels as they can provide an alternative food source for many of these pests.
3. Tilling the soil in spring or fall in the high tunnel may help disrupt and destroy the overwintering life stage of some of these pests and reduce population for the following season.
4. Carefully inspect transplants for any pests to avoid introducing new populations to the enclosed space.

—— Nick Volesky, Vegetable IPM Associate

Additional Resources

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USU Fact Sheet Series - High Tunnel Pests (Aphids, Caterpillars, Strawberry Pests, and Thrips)

Tropilaelaps Mites: A Mighty Undesirable Honey Bee Pest

Tropilaelaps mites have not been detected in North America or Europe, but honey bees, such as this worker bee with deformed wings, could be threatened if establishment occurs.

N Soakaew

Tropilaelaps mites, also known as Asian bee mites, are a genus of honey bee parasites native to tropical and subtropical Asia that have a similar life history to the Varroa mite (*Varroa destructor*), the most damaging parasite of honey bee colonies worldwide and a factor in colony collapse disorder.

In their native range, Tropilaelaps mites parasitize giant Asian honey bees, and two species (*Tropilaelaps mercedesae* and *T. clareae*) also attack the economically important European honey bee (*Apis mellifera*). These mites have caused significant honey bee losses in Thailand, the Philippines, and Pakistan, and have successfully expanded into Afghanistan and South Korea which have colder winter climates similar to northern North America. Spread occurs from adult bee drift, moving infested materials including combs or bees, and illegally shipping queens and packaged bees around the world.

Adult mites are elongated (about 1 mm long and 0.5 mm wide), reddish-brown, and their bodies are covered by a dorsal shield. Immatures (nymphs) are white. In contrast, Varroa mites are wider (about 1 mm long and 1.5 mm wide), adult females are reddish-brown to black, males are yellowish with light tan legs and a roundish-shaped body, and nymphs are transparent white.

Female mites lay eggs on partially-capped brood cells that each contains a late-stage honey bee larva. The eggs hatch, and the young mites feeds on the developing bee's hemolymph (blood-like circulatory fluid) for about a week, where they tear many small feeding wounds and undergo three growth stages before the final adult molt. Adults live for one to three days when only adult bees are present, or up to four weeks when feeding on larvae.

Compared to Varroa mites, Tropilaelaps mites are smaller, have a faster reproductive rate, and are highly mobile, as seen in a video in this Entomology Today article. Tropilaelaps adults are incapable of attaching to adult bees or feeding upon them, whereas Varroa adults can attach to and feed upon adult bees for many months. Adults have recently been shown capable of surviving up to three days in dry pollen and up to six days in honeycomb, suggesting a potential threat of global spread from international shipping.

Tropilaelaps mites dominate Varroa mites where the species co-occur, and Tropilaelaps infestations result in significantly higher bee wounds, virus infection rates, and maimed bees. Colony damage includes weakened and dead bee brood, bee colony decline, and viral infections of surviving adult bees including deformed wing virus.

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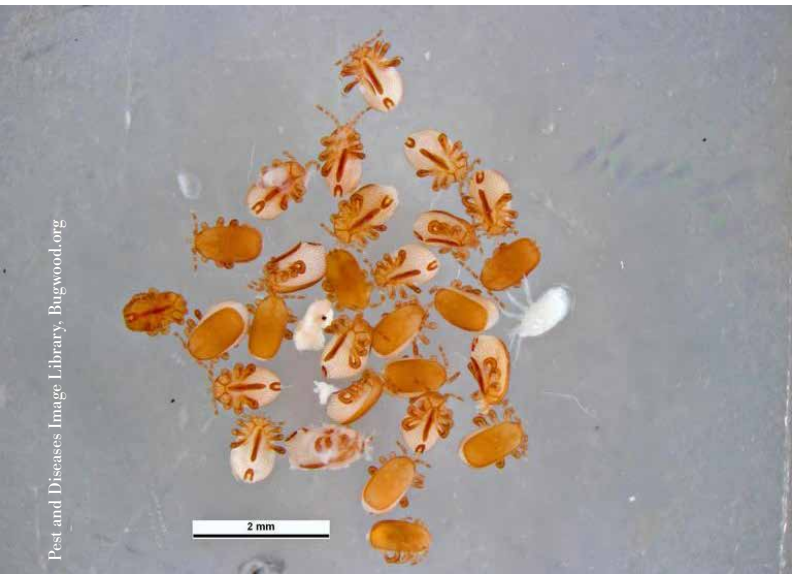
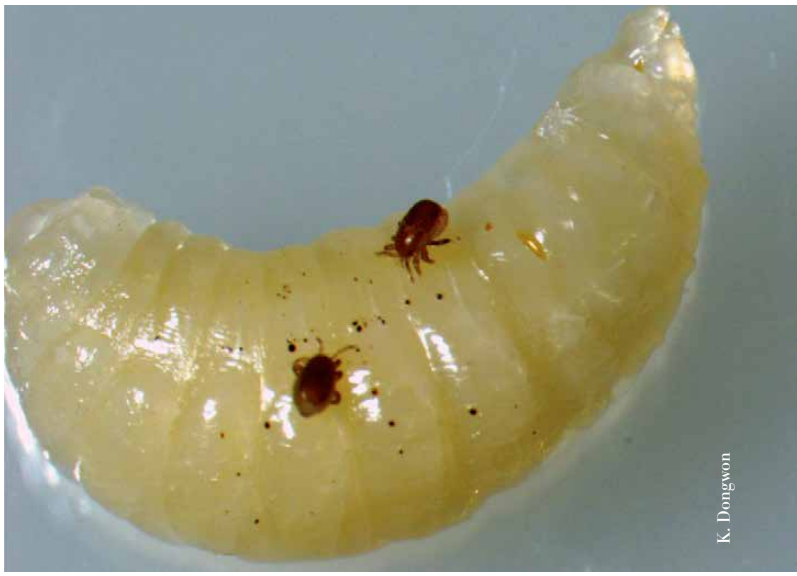


Pest and Diseases Image Library, Bugwood.org



K. Dongwon

Asian bee mites, *Tropilaelaps mercedesae*. (***Top left***)

Two adult *T. mercedesae* mites feeding on a honey bee prepupa. (***Top right***)

A comparison of the Varroa mite (left) and a Tropilaelaps mite (right). (***Bottom right***)

Zachary Huang, www.beetography.com

Heavily infested colonies may have crawling bees and discarded brood at the hive entrance, and absconding can occur. In India, *T. mercedesae* has been observed infesting native *Xylocopa* carpenter bees, although damage incurred is unclear. In areas where Tropilaelaps mites have invaded, populations are most successful in warm areas where honey bees produce brood throughout the year.

In North America, strict quarantines exist to protect the honey bee industry, and controlling mites within hives is critical for the health of honey bees and native bees that share floral resources. As these mites are a relatively new pest, research is lacking in many key areas. If you suspect Tropilaelaps mites in your hives, please contact the Utah Plant Pest Diagnostic Lab or the Utah Department of Agriculture and Food.

— Ann Mull, Technician, USU Extension Associate

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IPM In The News

Ancient Gene Could Protect Plants

A new study by Washington State University researchers and published in *eLife*, found that some plants have lost a protective gene that protects them against caterpillars. The researchers discovered a single, 28-million-year-old gene that perfectly corresponds with the plant immune response to caterpillar peptides often found in legumes. Scientists are hopeful that this finding can lead to more genomic discoveries that can help protect crops in the future.

New Host for Pine Ghost Canker

University of California researchers report in *Plant Disease*, three new hosts of a disease prevalent in citrus, nuts, and other crops. The pathogens, *Neofusicoccum mediterraneum* and *Neofusicoccum parvum*, were identified from trunk cankers of 30 Monterey, Eldarica, and Aleppo pines in Orange County. The fungi enter trees through wounds that are caused by insect damage or pruning. When infected, the lower canopy of trees are targeted first before the trunk. The detection of these pathogens in urban forests raises concerns of potential spillover events to other forest and agricultural hosts in Southern California.

Fall Armyworm Occurs Year-Round on Africa's Maize Crop

In Africa, fall armyworm causes the highest annual yield losses in maize at $9.4 billion. Scientists from University of Minnesota assembled 3,175 geo-tagged occurrences of this pest worldwide and spatially assessed its global climate suitability. They found that in 92% of Africa's regions growing maize, the fall armyworm is present year-round. To further compound the problem, they also found that 95% of the crop areas also supports least three or more pests year-round, over half of the acreage is suitable for an additional nine pests, and over a third of the acreage is suitable year-round to an additional 10 pests. The authors of the *Frontiers in Insect Science* paper conclude that with multiple pests in question, crop pests be addressed based on a "multi-peril" pest perspective, rather than by each individual pest.

Hanging Mosquito Repellent Device Found Effective

Mosquitoes are always a concern for military personnel in more humid climates. University of Florida scientists developed a device for the U.S. military that releases transfluthrin, an organic insecticide that is safe for animals and humans. Testing of the controlled-release passive device, hung on the outside of tents, revealed that it created a protective space from mosquitoes for four weeks. Future devices, which utilizes a tube-shaped polypropylene plastic and two smaller tubes with chemical-soaked cotton, will be built through a 3D-printing process, could extend that period up to three months.

Repellents Against Fruit Flies

Researchers at the University of California, Riverside, tested volatile repellents as an insect control against mosquitoes and fruit flies. The researchers focused on ammonia, a basic volatile compound found in insect environments and found that it "shuts down" the olfactory (smell) system and gustatory (taste) systems of these insects. Because ammonia can be corrosive to skin, it could be applied to surfaces such as windowsills, eves, entryways, outdoor areas, etc. This discovery, published in *iScience*, could be used to make effective insect repellents in the future.

Spotted Lanternfly Effects on Native Trees

The invasive pest, spotted lanternfly, likely co-evolved with its preferred host, tree-of-heaven, in its native range. However little is known about the insect's effect on the health on native U.S. trees. Penn State entomologists conducted a two-year study on three native trees exposed to light or heavy densities of varying stages of insect development. The team's findings, recently published in *Frontiers in Insect Science*, show that only adult or late-stage nymph feeding reduced photosynthesis and caused stunted growth of young red and maple saplings but not black walnut. Feeding by young nymphs was not as damaging. The next step is to test other trees, including willow and birch and to test mature trees.

Air Pollution Affects Beneficial Insects

Scientists from the University of Reading led a study to measure the impact of diesel exhaust and ozone on oilseed rape plants on beneficial insects. The team used special equipment to deliver controlled amounts of pollutants to the plants and then added aphids to measure the reproductive success of parasitoid wasps. They found that these pollutants made it harder for most wasps to locate aphids for egg-laying, which reduced the wasp population. One species of wasp, however—*Diaretiella rapae*—performed better in the presence of both pollutants, which was attributed to changes in the plants that produced more compounds that attracted this wasp.

Register Here for the Vegetable Twilight Meetings

Featured Picture of the Quarter

Grasshoppers abounded in residential settings in summer 2022, even feeding on flowers such as this dahlia. What is the prediction for 2023?

Grasshoppers overwinter as eggs in soil, and survival depends on egg-laying and egg-hatching weather. Late summer 2022 provided some wonderful rains and the coming spring appears to also be rainy. These conditions could lead to a much lower population for 2023.

However, there will be some grasshoppers that should be treated early and widely. The company that makes NoLo bait predicts to ship product to retailers in May 2023. Another bait option is EcoBran (search for it online).

—— Image by Claudia Nischwitz, Plant Pathologist

New Publications, Websites, Apps, and More

Biointensive Integrated Pest Management is a tipsheet on organic pest management basics. It includes a guide to the tools that are available to organic producers.

Several publications and videos have been released by the National Center for Appropriate Technology's ATTRA Sustainable Agriculture program on agroforestry (a combination of agriculture and forestry).

Can Birds Be Incorporated as Biological Control Agents into Integrated Pest Management Programs? is a new publication that discusses the potential benefits and concerns of incorporating birds into IPM strategies for farmers.

Pest in the House: Interactive Common Household Bugs Identifier is an online tool to identify pests found in and outside the home.

Sustainable Pest Management Roadmap for California describes the roadmap for the state of California's plan to incorporate sustainable pest management, which was created over a span of two years by different stakeholders including researchers, tribes, communities, and government.

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NPDN National Plant Diagnostic Network

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