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UTAH PESTS QUARTERLY

NEWSLETTER

Utah Plant Pest Diagnostic Laboratory

USU Extension

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NEW FACT SHEETS

EXTENSION
UtahStateUniversity

Incorporating Insect Fear in Integrated Pest Management

Processionary weevil larvae preemptively form a circular grouping to defend against predators, such as this predatory stink bug.

Predatory insects and parasitoids provide natural pest control by directly feeding on pests. An overlooked aspect of these beneficial insects that has gained attention in pest management is that they do not necessarily need to eat a pest to have an impact.

In the face of a predator, your behavior changes, whether it is an intense feeling to want to flee, freeze in place, or just crap yourself. It turns out that predators affect rodent prey even when they are not present, as their urine provides enough of a cue for rodents to scurry and hide. In agriculture, the threat of predation on insects is an emerging area being recognized as a component of biological control, given that threats, or "fear," can reduce pest damage to plants.

Pest insects detect predators by seeing them, identifying specific odors, and sensing vibrations from movement or sound. Pest responses toward predators vary widely but can involve changes in pest behavior.

In a recent article in the journal *Biological Control*, Dr. Madeleine Dupuy, former USU biology graduate student, determined to what extent predatory ground beetles and wolf spiders fed on various billbug life stages in turfgrass, and how these predators impacted billbug behavior. Despite evidence that predatory ground beetles and spiders are capable of feeding on a variety of pest species, these predators posed little risk

Can fear behavior result in less plant damage? Research has shown that predator-avoidance behaviors can have major implications for the insect pests' fitness, and these effects can be just as strong as the direct consumption of pests.

- Colorado potato beetles that were exposed to damsel bugs and other predators flail their front legs, regurgitate, walk away, and defecate. All of these behaviors detract the beetles from feeding on the plants.
- Pea aphids that were exposed to predators dropped from plants, exposing them to other mortality factors, and also increased the number of wing-formed offspring, as compared to aphids not exposed to predators.
- Japanese beetles placed on leaves containing spider silk reduced their feeding as compared to beetles on untreated leaves or on leaves treated with other natural and artificial fibers.

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When they encounter a predator, diamondback moth larvae drop and dangle themselves from a silk thread, climbing back to leaves when danger has passed (near right).

Colorado potato beetle larvae display several defensive behaviors toward predators including wiggling, regurgitating digested plant juices, and rearing their heads upward and flailing their front legs (far right).

to adult billbugs, with only approximately 6% predation. Billbug eggs were readily eaten by predatory ground beetles, but lab tests found that larval stages were less likely to be eaten when larvae were at least 1cm deep in the soil.

Given that these predators did not consume adult billbugs or larvae within soil, we might tend to think that they are not providing effective biological control. However, Dr. Dupuy's research also found that when adult billbugs were in the presence of predators, they reduced their mating activity and egg-laying, and spent time playing dead. These behaviors diverted the pest from feeding on the turf.

Current USU biology graduate student, Desireè Wickwar, has followed up on Dr. Dupuy's research and has begun evaluating the predator odor on billbug behavioral changes. Preliminary observations show that predator odor alone can alter adult billbug behaviors, and research is ongoing.

There is still a need to know which predator species has what intimidation level in the same way we evaluate the amount of prey any one predator species can consume. As research continues on this front, with evidence that just the predator cues can alter pest behavior, there may be clever ways of isolating and using predator cues or materials in pest management.

Insects' fear toward predators is a less obvious form of biological control than actually being consumed by a predator. It is important to recognize the behaviors of pest insects in avoiding predators and how they can have a negative impact on pests and assist in preventing plant damage, even to the level of direct predator consumption. This emphasizes the point that conserving predators is even more important, given these additional ways they affect pests.

——— Ricardo Ramirez, Extension Entomologist

For more information

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Summer of 2018 Revealed New Plant Diseases and Hosts in Utah

Powdery mildew on carrot was first found in the U.S. in CA and TX in 1975. The pathogen thrives in hot, dry conditions.

Beet powdery mildew affects only plants in the *Beta* genus, including table and sugar beets, and Swiss chard.

Powdery Mildew on Carrot

Powdery mildew (*Erysiphe heraclei*) was found on carrot leaves in both southern and northern Utah. The mildew affects photosynthesis, and with early infections, yield can be reduced. *E. heraclei* affects plants in the Apiaceae family, including carrots, parsley, parsnips, celery and dill.

However, according to published research, the fungus may form "formae speciales." This is similar to "races" in bacteria. The powdery mildew fungus looks morphologically the same on all plant species, but the formae speciales infecting carrots will not infect celery or parsley.

Like all powdery mildews, it grows best under dry condition with a few hours of high humidity and warm temperatures. Chemical control with fungicides such as sulfur works well, but has to be started early when the first sign of powdery mildew develops.

Powdery Mildew on Beets

Powdery mildew (*Erysiphe betae*) was found on foliage of table beets in southern Utah. Like the powdery mildew on carrots, the mildew on table beets affects yield due to the reduced photosynthesis of the affected foliage. Its host range includes *Beta* species such as table beets, sugar beets, and Swiss chard.

Chemical control with fungicides such as sulfur works well, but has to be started early, when the first signs develop.

Curly Top in Zinnia

Curly top (caused by curtoviruses) was rare in its usual Utah hosts like tomato, pepper, or cucurbits. However, it was found in zinnias grown in cut flower production in southern Utah.

The symptoms were similar to symptoms in other hosts. The infected plants turned chlorotic (yellow), but in contrast to other hosts, the zinnias eventually died.

Pythium Root and Fruit Rot of Watermelon

In two separate locations, one in northern Utah and one in southeastern Utah, watermelon were affected by root and fruit rots caused by Pythium. Each location had a different Pythium species – *Pythium aphanidermatum* and *Pythium ultimum*.

The aboveground symptoms consisted of plant stunting, wilting, and death, despite wet soils. The fruit rot symptoms started as brown spots on the undersides, where the fruit came in contact with the ground. Eventually, cottony mycelium developed and the fruit liquefied.

Both *Pythium* species have a large host range, including alfalfa and small grains that are often used in crop rotations. Pythium diseases are more common in wet soil. This soilborne pathogen produces motile spores that are propelled in a film of water by flagella, little hair-like appendages.

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Pythium root rot devastated a melon field in southeastern Utah in summer 2018 (left). The pathogen also causes a fruit rot where the fruit touches the soil (right). Plastic mulch and drip irrigation reduce infections.

Once the plants are infected, there is no cure. Reducing moisture levels may reduce the spread to neighboring plants. In other states, growers have managed Pythium with plastic mulch and drip irrigation. The mulch prevents the fruit from contacting the soil, and thus prevents infection. Drip irrigation reduces the moisture levels in the soil without affecting plant growth.

Chemical control options are very limited. A soil drench with a fungicide containing mefenoxam, as directed on the label, can be used to control the root rot, but it will not help with fruit rot.

— Claudia Nischwitz, Plant Pathologist

Disease Management in Greenhouse Vegetable Production

Greenhouses can be a challenging environment to keep completely sterile and pest-free. Whether it is for commercial or backyard production, pest management is essential to ensure a healthy start for your plants this upcoming growing season.

A common practice is to purchase vegetable starts or transplants for propagative material or for direct field planting. Inspecting all transplants for any disease or insect signs/symptoms is essential before introducing them to the greenhouse. Also, be sure to confirm that the variety you select is compatible for your soil type and climate (Utah's plant hardiness zones range anywhere from 4a to 8b).

For seed-starting, make sure seed is certified disease-free. (Refer to page 11 of the winter 2018 *Utah Pests News* for vegetable varieties and seed companies). Use the appropriate growing media, and ensure that it is sterilized, as various plant pathogens can occur within. The media should also have good aeration and drainage to avoid any standing water. When growing seedlings in the greenhouse, allow enough space for the plants to receive uniform aeration and sunlight, which will lessen the spread of plant diseases.

Vegetable Seed Requirements for Transplant

(Adapted from University of Maine Cooperative Extension)

Crop	Days from seeding to germination	Optimum soil Temp (F)	Weeks from germination to planting
Broccoli	7-10	50-85	5-7
Cabbage	4-10	50-85	5-7
Celery	9-21	50-65	10-12
Cucumber	6-10	65-85	4
Eggplant	6-10	65-85	6-9
Lettuce	6-8	50-65	3-5
Melons	6-8	65-85	3-4
Onion	7-10	65-85	8
Pepper	9-14	65-85	6-8
Squash	4-6	65-85	3-4
Tomato	6-12	65-85	5-7

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There are multiple factors to consider in lowering the risk of diseases in greenhouses. Sanitation of benches, floors, media, and irrigation water is one of the most important defenses. A few common greenhouse diseases that target vegetable seedlings include damping-off, Botrytis gray mold, Alternaria blight, bacterial speck, bacterial spots, and bacterial cankers.

Damping-off


Song Sparrow Nursery – St. Peter, MN

Damping-off can be caused by multiple pathogens (such *Pythium* spp., *Phytophthora* spp. and *Rhizoctonia* spp.). Damping-off attacks roots and the crown, causing plants to collapse at the base. The disease can spread to other seedlings within close proximity through water splash or root-to-root contact. The best way to prevent damping-off is to avoid overwatering. High soil moisture content reduces airflow and creates an optimum environment for infection.

Botrytis Gray Mold


Purdue Plant and Pest Diagnostic Laboratory

Botrytis gray mold causes stem cankers and irregular brown spotting or blight of leaves. Botrytis becomes a problem when seedlings form a dense canopy of leaves, keeping the humidity high, and promoting spread. Botrytis relies on moisture on a plant's surface for growth and sporulation. It can be prevented by using fans to increase airflow or watering early in the morning to ensure the plants dry in the sunlight.

Alternaria Blight

Alternaria blight is a fungus that causes leaf spotting and a stem canker on vegetable seedlings. The disease is most destructive when conditions are very moist and when the seedlings start to get bigger and develop foliage.

Bacterial Diseases


Yuan-Min Shen, Taichung District Agricultural Research and Extension Station, Bugwood.org


Cornell Long Island Horticultural Research & Extension Center


Gerald Holmes, CA Polytechnic State Univ., Bugwood.org

Bacterial diseases include bacterial speck, bacterial spot, and bacterial canker. Bacterial speck (*Pseudomonas syringae* pv. *tomato*) symptoms include small dark brown spots surrounded by yellow that appear on foliage. Bacterial spot (*Xanthomonas campestris* pv. *vesicatora*) on pepper and tomato seedlings will have spots or blotches on the leaves and stems (larger than those of

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bacterial speck). Bacterial canker symptoms will result in tiny tan lesions on the leaves and petioles that will lead to cankering.

All vegetable seedlings identified to have any bacterial disease should be removed immediately to prevent spreading. Bacterial diseases in a greenhouse are often spread by overhead watering through splash droplets. Therefore, it is critical to water plants early in the day to ensure dryness by evening.

Viruses

Other diseases of concern are caused by viruses, such as Impatiens necrotic spot virus (INSV). Viral diseases of vegetables in the greenhouse are rare, but can be found where both vegetable seedlings and flowering plants are grown within the same greenhouse. INSV is spread by western flower thrips that may pick up the virus from various flower species and transmit it to vegetables seedlings. The symptom expression is slow, and may not be noticed on seedlings right away. Viruses are best avoided by keeping flowers and vegetables separated as much as possible within a greenhouse.

— Nick Volesky, Vegetable IPM Associate

Pesticides Labeled for Greenhouse Vegetables

(Adapted from Michigan State University Cooperative Extension)

Active Ingredient	Product
Bacillus subtilis	Serenade Max
copper salts	Camelot 58EC
copper hydroxide	Champ DP, Champ Formula 2F, Cuprofix Disperss DF, Nu-Cop 50DF, Kocide 2000
fenhexamid	Decree 50WDG
mancozeb	Dithane DF, Dithane M-45
phosphorous acid salts	Topaz
potassium bicarbonate	MilStop
propamocarb HCl	Previcur Flex
pyrimethanil	Scala SC (tomato only)
sulfur	Micro Sulf, Sulfur 90W

GENERAL IPM INFORMATION

Purchase Pesticides Legally

In 2011, fastpestcontrol.com sold ant bait online containing mirex, a highly toxic chemical banned by the EPA in 1978.

Several U.S. consumers became sick after applying it.

Countless illegal pesticides are sold online, and it is important for consumers to be aware. In 2011, eBay and smaller online companies (that are not in business anymore) sold more than 2,800 ant-control products called Fast Ant Bait. The pesticide, produced in China, contained the highly toxic mirex, which has been banned in the U.S. since 1978. And in 2018, the Environmental Protection Agency announced a landmark $1.2 million settlement with Amazon because of nearly 4,000 sales of illegal pesticides by independent sellers between 2013 and 2016.

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"The Cat Be Unemployed" was the tagline for a rat poison sold in the U.S. in 2011.

It contained brodifacoum, an anticoagulant, in concentrations more than 40 to 60 times the maximum allowable level by the EPA.

It is estimated that hundreds of online sites continue to sell illegal pesticides. Industry leaders and professional applicators are fed up with this practice. Trained professionals invest significant time, money, and care to ensure they follow EPA standards and regulatory requirements, efficacy claims, and to protect public health and property.

Illegal pesticides sold online to a Utah customer may be:

- Banned for use in the U.S. by the EPA.
- Not yet registered with the EPA and Utah Department of Agriculture and Food (UDAF).
- Falsely advertised as "non-toxic" or "safe for families."

  For example, in 2012, a company claimed a cedar oil-based liquid product would treat and prevent bed bug and head lice infestations. The FTC filed deceptive advertising charges against the company.
- Not properly labeled with instructions for safe use.
- Re-packaged products with a separate printed label.

  This problem commonly occurs online. As an example, a third-party seller legally purchases a gallon container of a registered pesticide for $100 and then illegally repackages it into 32, 4-oz. bottles and sells them online for $10 each.

The EPA encourages individuals with knowledge of these types of violations to report them to their respective state government offices that regulate pesticides, such as the UDAF. Or call the National Pesticide Information Center at 1-800-858-7378 for more information.

Buyer Responsibility

When purchasing a pesticide over the internet, be aware that the product label is the law, and its instructions must be followed. If a product label says "Restricted Use" on the front of the label, this means that it can only be used by those with a valid applicator's license (administered in Utah by the UDAF.)

Some changes are in the works to discourage illegal online sales. As part of the Amazon / EPA agreement, Amazon must develop an online training course about pesticides that will train online sellers, and it must also be available to the public in English, Spanish and Chinese. And eBay has already been corresponding regularly with the EPA in order to keep vendors informed of the relevant laws and to remove problematic listings. The problem with these two large companies is that they receive nearly 7 million new posts a day, including the sale of guns and drugs, leaving pesticides low on the priority list.

To avoid any troubles and to help the local community, follow the EPA guidelines. Or better yet, purchase products locally, or from well-known companies that have data and credibility to back up their product claims.

The EPA cautions online buyers to:

- **Make sure the product has an EPA registration number, provides the active ingredient, and is registered in Utah.**
- **Be certain the product has instructions that you can understand and follow.**
- **Be wary of misspellings and products written in fractured English. For example, EPA reports that some of the products sold on Amazon had highly suspicious names:**

  Cockroach Cockroaches Bugs Ants Roach Kills Chalk
  Miraculous Insecticide Chalk
  Highly Effective Cockroach Killer Bait Powder
  R.B.T.Z. Safe Highly Effective Roach Killer Bait Powder Indoor
  Highly Effective Fly Killing Bait Powder
  Green Leaf Powder Fly Killing Bait
  Ars Mat Refil for ARS Electric Mosquito Killer Convenient, Clean & Smokeless
- **Be sure the particular type of plant or site you plan to treat is listed on the label.**
- **Only purchase what you can use, rather than having extra that will need to be disposed.**

— Marion Murray, IPM Project Leader

Biological Control of Brown Marmorated Stink Bug

BMSB adult is seen hiding amongst peaches that have severe feeding damage.

Brown marmorated stink bug (BMSB; *Halyomorpha halys* Stål) is an economically important nuisance and agricultural pest that invaded North America from eastern Asia in the late 1990s. BMSB congregates in and on buildings during the winter, and is known to attack over 170 plant species, including fruit, vegetable, and nut crops, as well as herbaceous and woody ornamentals (see our host plants web page for a list of known host plants in Utah).

BMSB was first detected in Utah in 2012, and populations are now established in Utah, Salt Lake, Davis, Weber, Box Elder, and Cache counties. In 2017, BMSB feeding damage was first reported on some fruit and vegetable plants in multiple counties.

Unfortunately, BMSB is a challenging insect to manage. Both nymphs and adults damage crops, and adults have a tough exoskeleton that is covered with a waxy, water-repellent cuticle that can help protect them from pesticide applications. Further, adults have a strong dispersal capacity, enabling them to easily re-invade previously-treated areas. Adults can theoretically fly more than 70 miles per day, although most adults fly short distances (Wiman et al. 2014; Lee and Leskey 2015). Even nymphs, which are wingless, are relatively mobile due to their strong walking capacity (Lee et al. 2014).

Growers in the mid-Atlantic region with BMSB infestations are relying on weekly, season-long applications of broad-spectrum insecticides, as integrated management programs are still under development. Broad-spectrum insecticides are costly, risk development of pest resistance, may contribute to secondary pest outbreaks, and can be harmful to beneficial insects, including biological control agents.

Natural biological control has been observed in the U.S., but not enough to manage BMSB. Generalist predators (lacewings, mantids, earwigs, lady beetles, assassin bugs, minute pirate bugs, big-eyed bugs, and spiders)

The samurai wasp, native to eastern Asia, is a promising biocontrol agent that has made its way to the U.S. Some states where it now occurs are releasing it.

Elijah Talamas, USDA ARS

feed on BMSB egg masses and nymphs (Lara et al. 2016; Morrison et al. 2016). In addition, although researchers have found at least 12 native wasp species that can parasitize egg masses of BMSB, they typically account for less than 11% mortality of eggs (Rice et al. 2014).

The samurai wasp (*Trissolcus japonicus*) co-evolved with BMSB in eastern Asia, and there, it is highly effective, with egg parasitism rates reported to be as high as 80%. The wasp has been identified as the most promising agent for classical biological control of BMSB in the U.S. Starting in 2007, USDA Agricultural Research Service entomologists reared samurai wasp specimens under strict quarantine conditions with the hope of mass-releases.

However, starting in 2014, adventive (wild) populations started to occur in many states, including Maryland, Virginia, Ohio, Michigan, Washington, and Oregon. It is speculated that the wasps arrived within stink bug egg masses on plant cargo shipped from Asia. Many of those wild populations became established, and because of this, some states are now able to release samurai wasps for control and research purposes, bypassing the lengthy procedures needed for introducing a new species.

In Utah, surveys for the samurai wasp and other natural enemies of BMSB are underway. To date, several native wasps have been observed parasitizing BMSB eggs:

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The samurai wasp targets brown marmorated stink bug eggs. Female wasps lay a single egg within a stink bug egg. The wasp egg hatches into a larva that consumes the stink bug egg contents, and eventually emerges as an adult. A healthy mass of BMSB eggs (left) are whitish-gray in color. Stink bug eggs that have been parasitized will turn black (right).

Anastatus mirabilis, Telenomus podisi, Trissolcus euschisti, Trissolcus erugatus, and *Trissolcus utahensis.* Until the samurai wasp establishes in Utah on its own accord, state and federal regulations prevent its release. Once it is detected in Utah, however, researchers may then be allowed to redistribute it in areas with BMSB infestations.

The public can assist with detecting the samurai wasp in Utah. BMSB eggs are barrel-shaped, 1/16 inch wide, and translucent, white, or light green in color. As eggs mature, dark triangular-shaped spots become visible. Eggs are typically laid on the underside of leaves in clusters of 20 to 30. If parasitized, however, BMSB eggs turn dark brown to black in color.

If you find eggs that appear to be parasitized, carefully place the leaf with the egg mass into a sealed container, store the container at room temperature, and then contact Lori Spears (lori.spears@usu.edu).

——— Lori Spears, USU CAPS Coordinator

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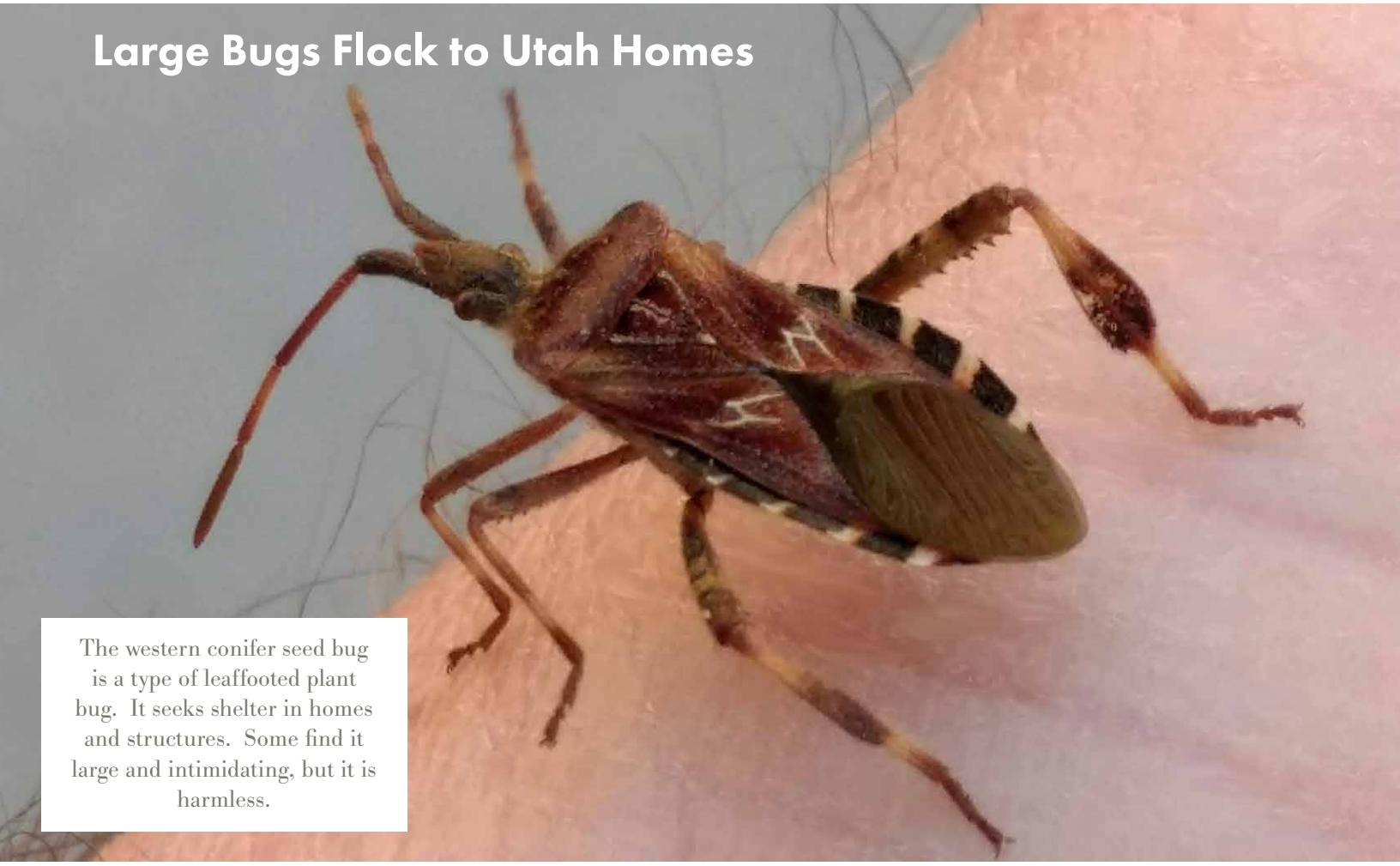
Survey on Invasive Species and Classical Biological Control

Washington State University Extension, the University of Alaska, and the Washington State Department of Agriculture are conducting a survey to understand public attitudes about the benefits, risks, and administration of classical biological control as a tool for managing invasive species. The survey should take 15 to 20 minutes for most participants, and includes an introduction and some background information.

Participation is voluntary and anonymous. The link to the online survey is: http://uaa.co1.qualtrics.com/jfe/form/SV_b2TiEKKA7POakC1

If you have any questions about this survey, please contact Jennifer Andreas (jandreas@wsu.edu or 253.651.2197) or Chris Looney (clooney@agr.wa.gov or 360.902.2042).

Large Bugs Flock to Utah Homes



The western conifer seed bug is a type of leaffooted plant bug. It seeks shelter in homes and structures. Some find it large and intimidating, but it is harmless.

Leaffooted bugs (family Coreidae) have long been present in Utah; however, encounters with overwintering leaffooted bugs are on the rise. Fall of 2018 was no exception. The diagnostic lab received numerous calls, emails, and reports of leaffooted bugs on and inside structures. Most people are concerned that their homes are being invaded by kissing bugs (i.e., Reduviidae *Triatoma protracta*) but are relieved to learn that overwintering leaffooted bugs are harmless.

The most commonly encountered – and loathed – leaffooted bug in Utah is the squash bug. Squash bugs are a major pest of squash, pumpkins and other cucurbits, but do not become a nuisance pest.

The primary leaffooted bug found on and in homes in the fall is the western conifer seed bug, *Leptoglossus occidentalis*. Of the 12 species of *Leptoglossus* occurring north of Mexico, *L. occidentalis, L. zonatus* and *L. clypealis* occur in Utah. While all three are similar in appearance, *L. zonatus* and *L. clypealis* feed on a variety of plants while the western conifer seed bug feeds primarily on conifer needles and seeds.

The western conifer seed bug was first described in 1910 in both Utah and California and its original western U.S. range spanned from Canada to Mexico. Since that time, with the help of transportation and commerce, its range expanded to many states across the northern U.S., east to Pennsylvania, and north into Ontario. It was detected in Italy in 1999 and over the past few decades has been detected in many European countries and in Turkey and Japan.

Western conifer seed bugs may be alarming due to their size. As adults, they are about ¾ inch-long. They have long legs, and the hind legs have an expanded tibia that looks leaf-like, hence "leaffooted" bug.

Adults are predominantly brown with a faint white zig-zag across the back. When in flight, the back of the abdomen is visible and is yellow-orange with 5 black stripes. They

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The western conenose bug is the species of kissing bug that occurs in Utah. It can be distinguished from the western conifer seed bug by the lack of leaf-like hind tibia.

are similar in appearance to *L. zonatus* and *clypealis*. They have piercing-sucking mouthparts which they use to feed on needles, and seeds within developing cones. Douglas-fir, pine species, and other conifers are common hosts.

The bugs consume individual seeds within the developing cone, leaving damaged cones that are shrunken and deflated. Western conifer seed bug can be a pest in pine seed nursery production, but in Utah, it is primarily a nuisance pest.

Western conifer seed bug has one generation per year in Utah. Adults emerge from their overwintering sites in May and June and begin to lay eggs on needles. Newly hatched nymphs feed on needles and the succulent tissues of cone scales. Older nymphs and adults feed on the seeds. Adults lay eggs throughout summer and both nymph and adult stages can be found simultaneously. By fall, most of the population are adults, and cold weather prompts them to relocate to overwintering sites, which include homes and structures.

While western conifer seed bugs can emit a defensive odor, they are not harmful to humans. There has only been one documented human bite from this species, and that was in Hungary. Concern does exist when they enter homes, due to their similar appearance to kissing bugs (which in Utah is the western conenose bug), but are readily separated from them by the presence of the leaf-shaped hind tibia. (Conenose bugs are assassin bugs and do not have this character).

Management of western conifer seed bug should focus on exclusion. Make sure screens, doors, doorsweeps/thresholds and weather stripping are in good repair and that entryway cracks and crevices are appropriately sealed, especially on south- and west-facing sides of a structure. Bugs that make it into the home can be captured and removed to the outside, or vacuumed. A fall application of a synthetic pyrethroid insecticide directed around windows, doors, under eaves and exterior cracks and crevices could reduce the number of conifer seed bugs and other fall nuisance pests entering the structure.

If you are concerned that you may have a kissing bug (or another insect of concern) in your home, please take one or more pictures and email them to ryan.davis@usu.edu for verification.

——— Ryan Davis, Arthropod Diagnostician

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IPM In The News

Samurai Wasp Parasitoid Inhabiting Europe

U.S. entomologists agree that the samurai wasp (*Trissolcus japonicus*), a native of eastern Asia, is one of the most promising biocontrol agents against the brown marmorated stink bug. The findings of this wasps' habitation in Switzerland apple orchards is good news for many U.S. orchards which have a similar climate. Scientists with the Centre for Agricultural Bioscience International discovered the first populations of the samurai wasp in three apple orchards in southeastern Switzerland in 2017, and in 2018, it was found again in each location, marking the first time samurai was re-discovered in Europe.

Novel Technique to Determine Weevil Activity

Researchers at Penn State University's Center for Turfgrass Science have been working to improve management methods for the annual bluegrass weevil (*Listronotus maculicollis*), but a key challenge is to determine when the insects are most active. The weevils are small (4.5 millimeters long) and difficult to monitor. In 2015, the team learned about flashes and camera filters made by NightSea, which are used for photographing underwater sea life at night because they block white light and reveal fluorescence. Over the next several years, the researchers marked weevils with fluorescent ink and used still photography taken at one-hour intervals within the turf, during April, May, and June. The results offered a new understanding of the weevils' daily behavior patterns and are reported in *Environmental Entomology*. The study showed that temperature, not light, drives the weevils' behavior. They found that the weevils' activity was greatest when temperatures were between 57-63 degrees F, and declined as the temperature rose. Their prime activity period occurred during the day in the spring but during early morning, right after sunrise, in the summer. The findings will help golf course managers better time their monitoring efforts to detect weevil infestations, and their insecticide applications for the pest's most active periods.

Decline of Monarchs by 80 Percent in Florida

Entomologists in Florida and New York published results from a 37-year survey of monarch populations in north-central Florida, showing a steady population decline since 1985, with a dramatic drop of 80 percent in the last 13 years. The decline in Florida parallels monarchs' dwindling numbers in their overwintering grounds in Mexico. While the drivers of the decline are not clear cut, the researchers said shrinking native milkweed populations, climate change, and plantings of non-native tropical milkweed are part of the problem. Native milkweeds are the optimal hosts for the larval stage of monarchs, and the butterflies "time" their migratory arrival to Florida with optimal growth of milkweed. This delicate match-up could be disrupted by climate change, which can skew plants' springtime schedules. Monarchs lay hundreds of eggs on milkweed over their brief lifetimes, but just over 2 percent of eggs survive to become fully grown caterpillars. The study's lead author, Lincoln Brower, died shortly before its publication. A lifelong butterfly expert, Brower began studying monarchs in the 1950s and made his first trip to the fir forests in Mexico where the butterflies spend the winter, in 1977. To prevent monarchs from requiring protection under the Endangered Species Act, the authors recommend increasing pesticide-free native milkweed populations in Florida yards and roadsides.

Improving Rust Resistance in Wheat

Yellow rust is a serious disease of wheat that occurs worldwide. The fungus evolves quickly to produce new, virulent strains, so there is a constant race to develop disease-resistant varieties of wheat. For more than 20 years, researchers from Aarhus University and international collaborators have investigated the function and genetics of Yr15 resistance, one of the most effective resistance genes against yellow rust. The researchers published in *Nature Communications* that they found that Yr15 has a unique mode of action, where it produces defense responses early in the infection process, and in resistance testing, it was overcome by the pathogen only once. The researchers' new knowledge is an important piece in the puzzle regarding the development of new cultivars of wheat that are resistant to yellow rust.

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Aphid Nymphs Piggyback on Adults to Safety

Researchers at the University of Haifa, Israel, published in *Frontiers in Zoology* that they observed young pea aphids riding on the backs of adult aphids to get to safety. The authors reared colonies of pea aphids on fava bean plants. They then simulated a plant-eating mammal by tipping the fava bean plant and gently tapping the base of the stem, causing the aphids to immediately drop from the leaves. Following the escape, young aphids then hitchhiked on the backs of adult aphids to get back on the plants. They were no more likely to select a related adult over an unrelated one. And surprisingly, the adults frequently attempted to remove the young aphids, but were not always successful. This supports the idea of a lack of parental recognition among this aphid species.

Attract-and-Kill for Managing Brown Marmorated Stink Bug

A study by USDA Agricultural Research Service and multiple eastern U.S. universities has shown an effective attract-and-kill method to manage brown marmorated stink bug in apple orchards. The concept involves putting out a large amount of the species' aggregation pheromone with a pheromone synergist called methyl decatrienoate in areas outside the orchard. Those areas are then sprayed with an insecticide to reduce the overall population. Conversely, the need for insecticides could be eliminated completely by using long-lasting insecticide-treated nets as the killing agent. The trials showed a 90 percent reduction of the stink bugs in the area sprayed and a two- to three-fold decrease in stink bug damage in apples compared with grower-standard techniques. Going forward, researchers will work to improve economic feasibility.

Bee Species in Grand Staircase-Escalante

Utah is home to more bee species than most states in the U.S. About half of them are found within the original boundaries of the newly reduced Grand Staircase-Escalante National Monument. USU entomologists reported 660 species occur in the original region, in *PeerJ*, and published a follow-up paper a month later that examined what the newly reduced monument boundaries mean for the pollinators. The good news is that 87 percent of the 660 species are found within the newly reduced boundaries. This still leaves about 84 species no longer inhabiting protected land, plus some potentially new, undescribed species. The authors conclude that it is unknown if the reduction in the monument size will have an effect on pollinators, but certainly development could have an adverse effect.

Polyculture Shown to Boost Natural Biocontrol of Insect Pests

In a study published in the *Annals of the Entomological Society of America*, China Agricultural University ecologists and colleagues in the U.S. and South Africa tested whether polyculture (multiple crops) could help farmers manage pests in their fields. Over three seasons, the researchers surveyed 50 mini-fields planted with one, two, four, eight, or 16 crops for three groups of insects: pests, natural enemies, and others. Each plot was planted with 484 plants and no pesticides or herbicides were applied. Over the course of the study, more than 250 insect species were identified. Researchers found that higher plant species richness was associated with higher insect species richness and higher populations in each insect group. More importantly, the ratio of natural enemies to pests increased with the number of plant species in the plot. The researchers conclude that on this micro-landscape experiment, increasing plant species richness can enhance natural biocontrol of crop pests.

New Publications, Videos, Books, and Online Tools

- Washington State University recently posted a document on *Hosting a Vegetable Grafting Workshop*, containing step-by-step guides, handouts, and survey.

- *Organic Practices for Climate Mitigation, Adaptation, and Carbon Sequestration*, by the Organic Farming Research Foundation, provides practical advice for reducing an organic farm's "carbon footprint" and adapting to climate disruptions already underway.

- *Survey and Analysis of the U.S. Biochar Industry* explores biochar's industry potential, and provides recommendations to help make it a success.

- Iowa State University developed a tool to Predict Return on Investment for Cover Crops. It evaluates economics of using cover crops for a variety of scenarios, and can be used in any state.

- Living Soil is a 60-min documentary produced by the Soil Health Institute captures soil health from a historic perspective, with stories of today's farmers managing their land to enhance soil health.

Featured Picture of the Quarter

The Utah Plant Pest Diagnostic Lab received the potato samples shown above from a county Extension office in northern Utah, and no concrete diagnosis came to mind. A virus was suspected, so the potatoes were sent to a commercial lab (Agdia) that specializes in molecular testing of plant pathogens. The test for the suspected virus – Potato mop top virus – came out negative. The next cause to question was herbicide exposure. To test for herbicides, sprouts are required from the tubers, but Agdia found that the tubers did not sprout, which can actually be a symptom of herbicide damage. They then developed a special buffer to test the potato tuber itself, and the herbicide, glyphosate, was implicated as the cause.

Glyphosate is the chemical found in Round-up and other brands. It is commonly applied for perennial and annual weeds. If drift contacts potato foliage, the plant may become slightly stunted and chlorotic, and tubers can develop cracks. Many times, though, the foliage and tubers may not show any symptoms at all. However, tubers that are saved and used for seed (daughters) will contain carry-over glyphosate residues. The subsequent plants will be stunted and the majority of tubers will be cracked and misshapen. Notably, any tubers saved from the daughter plants for seed (granddaughters) will not contain any glyphosate residue.

——— Photo by Claudia Nischwitz, Plant Pathologist

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WPDN Western Plant Diagnostic Network
NPDN National Plant Diagnostic Network

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

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