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UTAH PESTS QUARTERLY

NEWSLETTER

Utah Plant Pest Diagnostic Laboratory

USU Extension

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Extension
UtahStateUniversity.

WHERE THE WILD BEES ARE:

Identifying Land-Use and Climate Variables Impacting Bumble Bees in Utah

Wild and managed bees play pivotal roles in maintaining agricultural productivity and wild plant communities by pollinating flowering plants. Bumble bees, for example, increase agricultural productivity of crops grown in greenhouses, which are not typically pollinated by managed bee species such as honey bees. Bumble bees benefit producers by reducing production costs and increasing crop quality and yield, particularly for crops that are predominantly hand-pollinated. Bumble bee communities thrive in semi-natural and diverse habitats which provide a variety of nesting and floral resources.

Unfortunately, bumble bee populations are negatively impacted by human-caused disturbances, such as urbanization, agricultural intensification, and climate change. Specifically, impervious surfaces such as roads and buildings reduce nesting sites and monoculture farming reduces floral resources. Weather patterns impact bumble bee phenology (timing of life history events), distribution, and resilience. As the climate changes, more bumble bee species are being found at higher elevations. This is problematic given the limited resources in these environments and the possibility that bee activity and flowering will not overlap. Bumble bee species that are climate-sensitive, living in fragmented or low-elevation habitats, or are already at their upper elevation limit, have an increased likelihood of local extinction as suitable habitats disappear.

In a study investigating bee captures in pest-insect bucket traps, the golden northern bumble bee, *Bombus fervidus*, was the most commonly collected species.

In Utah, bumble bees are impacted by urbanization around agricultural lands, loss of agricultural lands to development, and a hotter and drier climate, trends that will likely continue in the coming decades. Identifying land-use and climate conditions that influence bumble bee species in Utah could help land managers, researchers, and other interested parties develop more effective and targeted strategies to increase resiliency of bumble bee populations in changing environments.

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To subscribe, click here.

extension.usu.edu/pests

Multi-colored bucket traps have been placed throughout Utah for insect pest monitoring for many years. Sometimes, bumble bees were captured in these traps, and that bee catch data were used for this study.

Morgan Christman and team (USU Biology) researched bumble bee abundance and diversity based on land use and weather variables in Utah agroecosystems. The research team utilized data from bucket traps that were set at the edge of corn and alfalfa fields located in either rural or urbanized areas in Cache, Box Elder, Weber, Utah, and Millard counties. From 2014 to 2018, the team recorded a total of 3,522 bumble bees representing 15 species. The most common species were:

- Golden northern bumble bee, *Bombus fervidus*
- Hunt's bumble bee, *Bombus huntii*
- Red-belted bumble bee, *Bombus rufocinctus*
- Central bumble bee, *Bombus centralis*
- Brown-belted bumble bee, *Bombus griseocollis*

The research team found bumble bee species abundance and diversity was highest in the rural agricultural fields with low temperatures and high relative humidity during the growing season, and lowest in the urbanized agricultural fields with high temperatures and low relative humidity. However, differences in bumble bee species among sites suggest that all corn and alfalfa fields from this study have high conservation value for bumble bee communities. Therefore, management practices to promote bees should be focused in both rural and urbanized agricultural areas to foster future resiliency of bumble bee populations in the face of human-caused disturbances.

Land managers interested in promoting bee abundance and diversity are encouraged to integrate practices that reduce pesticide poisoning of bees, diversify agricultural areas, and increase floral resources and nesting sites. Specifically, pesticides that are non-toxic to bees should be selected and applied following the "Bee Advisory Box" on the label, which provides steps to minimize exposure of pesticides to bees while they are foraging. Planting water-wise native plants such as western prairie clover, Russian sage, and yarrow within gardens and yards diversifies the landscape while providing bees with nectar and pollen, which is needed to feed themselves and their offspring. To provide suitable nesting sites, consider keeping some small patches of well-drained, bare soil surfaces. Additionally, avoiding overhead irrigation during the daylight hours, reducing the use of weed-barrier fabric, and using mulch sparingly can provide more suitable habitats for bees.

——— Morgan Christman, graduate student, Biology (PhD), Lori Spears, USU CAPS Coordinator, and Ricardo Ramirez, Entomologist

For more information

Cane, J.H. (2015). Gardening and landscaping practices for nesting native bees. [Fact Sheet] Utah State University Extension.

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Watch out for the Invasive Spotted Lanternfly

Rkillcrazy, CC BY-SA 4.0, via Wikimedia Commons

Spotted lanternfly (SLF) is an insect that is native to northern China. In 2014, it was detected in Pennsylvania and likely arrived as egg masses on imported landscape stone. As of September 2021, SLF has been found in varying degrees in Connecticut, Delaware, Indiana, Maine, Maryland, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia. California and Oregon authorities have reported dead specimens in shipments. SLF is not known to occur in Utah; however, this pest can spread to new areas through the unintentional movement of life stages (eggs, nymphs, adults) on plant material such as nursery stock and firewood, on vehicles and other modes of transportation, and on objects such as outdoor furniture that are transported by humans.

SLF is a nuisance pest that can congregate in large numbers in and around homes and structures. It is also a plant pest that feeds on the phloem (sap) from at least 103 plant taxa, including fruit trees (e.g., apple, apricot, cherry, peach), grapevines, hops, and various hardwood and ornamental trees (e.g., maple, walnut, poplar, aspen, oak). Adults show a strong preference for tree-of-heaven, an invasive plant from China that is widely established in the U.S.

Extensive feeding causes weeping wounds of sap on the bark, leaves, and trunks of host plants, as well as plant wilting and death. SLF excretes sugary honeydew as it feeds, and this and the sap from oozing wounds can attract other nuisance insects, such as ants and wasps, and provide a medium for sooty mold to colonize and grow.

Pennsylvania Department of Agriculture, Bugwood.org

Emelie Swackhamer, Penn State University, Bugwood.org

Top: 1st through 3rd instar nymphs are black with white spots; 4th instars are black and red with white spots.
Middle: Adult spotted lanternfly.
Bottom: Partially covered egg mass.

Sooty mold can negatively affect plant growth and crop yield.

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Adults are about one-inch long. They have forewings that are gray with black spots, with a brick-and-mortar pattern on the outer tips. The hindwings, which are visible during flight, have striking red, black, and white patches. Their legs are black, and their abdomen is yellow with broad black bands on the top and bottom surfaces. Females lay 1-2 egg masses, each containing 30-50 eggs that are seed-like and deposited in 4-7 parallel rows beneath a waxy cover. Egg masses are about one inch long and white in color when first laid, later turning brownish-gray. Nymphs (immature life stage) are wingless and undergo four instars. The first three instars are black with white spots; the last instar is black and red with white spots.

SLF has one generation per year and overwinters as an egg. Eggs hatch from late April to early summer. Nymphs then begin crawling and feeding on host plants. Adults are present and feeding on host plants by mid-summer (mid to late July), and the females lay eggs from September to early December on a variety of substrates. Adults die with a hard frost.

Although this pest has not been detected in Utah, be sure to keep an eye out for it and contact the Utah Plant Pest Diagnostic Lab or the Utah Department of Agriculture and Food with suspicious finds. Early detection helps state and federal authorities in Utah manage pests and citizen involvement is key to program success.

——— Lori Spears, USU CAPS Coordinator

For more information

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Dara, S.K., Barringer, L., & Arthurs, S.P. (2015). *Lycorma delicatula* (Hemiptera: Fulgoridae): a new invasive pest in the United States. Journal of Integrated Pest Management (6)20.

GENERAL IPM INFORMATION

Utah Pests Opens Text Line for Photo Diagnostics - 385-367-3773

We get it. It's a hassle to take a photo on your smartphone, find an email address, open your email app, and send a photo while you're out in the field or garden. It's important to have diagnoses for your plant and insect issues as quickly as possible. The Utah Plant Pest Diagnostic Lab (UPPDL) is here to help with a new text line!

You can now text insect and plant disease images to **385-367-3773** to make your diagnostic efforts more convenient. Once we receive it, entomologists and plant pathologists in the UPPDL will assist you as quickly as possible.

When sending a message, we ask that you include your **name and county** in the message so we know who you are and where the issue is being seen. Also include any other pertinent information that may help with diagnosis. The line is set up to accept text and images, but not phone calls. If you need to get in touch with a diagnostician via phone, please visit the UPPDL web page to find acceptable numbers.

Save our number to your contacts and send away! (Message and data rates may apply.)

——— Zach Schumm, Arthropod Diagnostician

Blue Hubbard Squash as a Trap Crop to Suppress Squash Bug

Trap cropping involves growing plants alongside target crops that are more appealing to certain pests, thereby protecting the target crop. It is an important cultural control method within integrated pest management (IPM). Various research studies have shown blue hubbard squash to be an effective trap crop in suppressing squash bug (*Anasa tristis*) such as a [1997 study] from Oklahoma State University and a [2009 study] from the University of Massachusetts and the University of Connecticut.

In 2021, the USU Extension IPM program conducted trials at the USU Kaysville and Greenville research farms in northern Utah to determine if hubbard squash is a viable trap crop for Utah's climate. At both locations, we planted two plots with 25 Howden pumpkins (*Cucurbita pepo*) in 5 rows on plastic mulch and drip irrigation. One plot at each site was also planted with New England blue hubbard squash (*C. pepo*) at the ends of each pumpkin row, for a total of 10 additional plants (see diagram at right).

The hubbard squash was planted two weeks prior to the pumpkins, in the last week of May, and pumpkins were planted in early June. In northern Utah, overwintering adult squash bugs emerge in May to find host plants, and allowing the hubbard squash to start growing earlier provided a more appealing host to this overwintering generation.

In the study, we visually inspected each plant in both plots and both locations for squash bug adults, nymphs, and egg masses. The scouting process was conducted three times in June, July, and August. During the June and July counts, we hand-picked and killed (by dumping in soapy water) squash bug adults and nymphs and removed eggs with duct tape from all blue hubbard squash plants and not from pumpkins. We harvested pumpkins in September and removed all plant residue from the site to reduce overwintering areas for the squash bugs.

Results of the squash bug counts showed that there were significantly more adults, nymphs, and eggs on the pumpkins in the plots without the trap crop than on the pumpkins with the trap crop. In addition, in the treated plots, the blue Hubbard squash plants had more squash bugs and eggs than the pumpkins (see figure at right) in June and July.

Treated Pumpkins with Trap Crop | **Untreated Pumpkins**

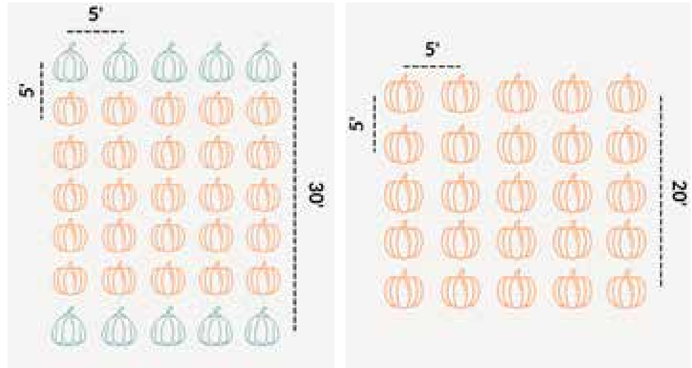
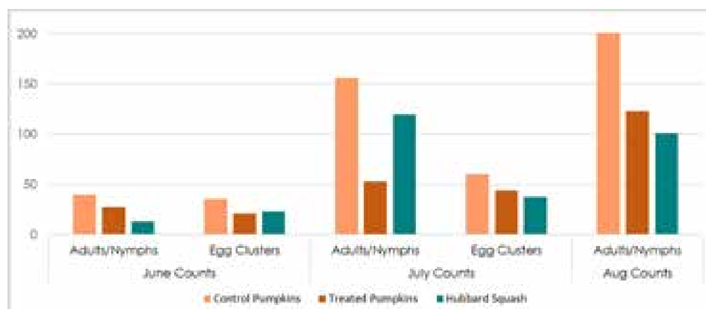


Diagram of a field study conducted on two research farms in Utah. Each farm had two plots of pumpkin plantings, where the Treated plot (left) had hubbard squash plants (trap crop) at the end of each row and the Control plot (right) did not.



Total number of squash bug adults/nymphs and egg clusters found on pumpkins at two Utah farms on sites with (Treated) and without (Control) a hubbard squash trap crop. Overall, the fewest bugs and eggs were found on the Treated pumpkins with the squash trap crop.

These results indicate that the hubbard squash trap crop was effective in reducing squash bugs on the cash crop. For a trap crop system to be effective, it is important to treat the pest on the trap crop. Our trial was on a small scale and we could remove squash bugs by hand. For larger operations, growers could use an insecticide such as carbaryl, bifenthrin, esfenvalerate, permethrin, or zeta-cypermethrin. Review our [infographic on squash bug management] for additional cultural, mechanical, biological, and chemical control options.

— Nick Volesky, Vegetable IPM Associate

Managing for Drought and Summer Insect Outbreaks in Turf

As a part of the National Turfgrass Evaluation Program, turfgrass cultivars are evaluated for their performance. Researchers from universities across the nation, including at Utah State University, measure everything from resistance to drought, insects, and disease, to texture and color of the plants. Each year trials include cultivars that are industry standards, as well as promising new cultivars.

Drought poses a serious challenge to turf managers trying to keep grass thriving, particularly in the West where spells of hot, dry weather are often coupled with irrigation bans to conserve limited water resources. In 2021, yellow-to-brown patches in lawns were considered badges of honor, demonstrating efforts at water conservation, where the commonly-planted cool-season grasses went dormant during the heat of the summer. However, while these grasses can recover from drought-induced dormancy once provided with water and cooler temperatures, hot, dry weather has also fostered insect outbreaks that can cause lasting damage. This interplay between drought and insect stress in causing headaches for turf managers throughout the U.S.

Turf managers have long noted that damage from billbugs, a major root pest of turfgrass in the Intermountain West, appears to be worst in areas already suffering from drought stress. This may be the case for multiple reasons, but fortunately there are also multiple solutions.

Some insect pests may become more abundant under hot, dry conditions.

The Problem: As insects are "cold blooded", the ambient temperature plays a large role in determining how well they survive and how quickly they develop. This means that population growth may simply be greater in hot areas. Also, insects may show preferences for, and congregate in, dry areas. As plants lose water, the concentrations of valuable nutrients increase and surface temperature of their leaves increase, making some water-stressed plants a particularly nutritious snack and warm safe-haven for some insects.

The Proof: A survey conducted by recent Utah State University graduate Desireè Wickwar (M.S., Biology) found that billbugs were far more abundant in dry areas, with soil moisture being a good predictor of adult billbug abundance.

The Solution: Targeting management efforts to such dry areas where outbreaks and damage are more likely to occur may dampen pest issues. For instance, checking that sprinkler heads are functioning appropriately with the proper coverage can reduce dry, damage-prone patches.

Plants already suffering from drought stress may be more susceptible to insect damage.

The Problem: Though some responses of plants to water-stress are highly apparent (i.e. dormancy turning plants brown) some responses to water-stress are less visually apparent (i.e. accumulation of different

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chemicals, changes in root structure, etc.). When water is limited, many plants have to expend a lot of energy just to survive, leaving them with less energy to spend producing costly chemical defenses that can deter pests. Some plant traits that make them susceptible to drought stress may also make them susceptible to insect stress. For instance, thin and soft leaves tend to lose water rapidly, and make a tender mouthful for plant-feeding insects.

The Proof: Wickwar's work, comparing almost 350 different Kentucky bluegrass cultivars, showed that drought-resistant cultivars tended to suffer less billbug damage than drought-susceptible cultivars. Though not all drought-resistant cultivars suffered less billbug damage, many of the best-performing cultivars showed resistance to drought stress, billbug stress, and many other stressors.

The Solution: Fortunately for those looking to manage both drought and insect stress, turfgrass breeders continue to develop high-performing cultivars that can contend with both drought and insect stress, and planting such cultivars is highly recommended. Seed and sod producers can help provide guidance on what varieties and cultivars are best suited for different regions and different stressors.

On top of warming temperatures fostering outbreaks, these changes also make predicting the best timing for pest management difficult. As spring temperatures begin to heat up earlier and seasonal fluctuations become more unpredictable, the timing of management efforts for pests like the billbug will also change each year and throughout a season. To help find the best timing for management efforts, researchers at USU created a predictive model to track the development of billbugs, which can be accessed through the website or mobile app called Utah TRAPS (Temperature Resource and Alerts for Pests). The model uses temperature data to determine how quickly or slowly billbugs are likely to develop based on local weather. Specifically, it shows the accumulation of degree days, or days that are warm enough to foster billbug activity and development. To use the model, select the closest weather station location on the map, then 'Landscape and Turf', and finally 'Billbug'. Based on the number of accumulated degree days, indicators provide information on when billbug adults are first active, and predicted time for insecticide application, if necessary.

Billbugs are weevils that dwell in turfgrass. Though you may see the adults (***top***) walking around on the surface, it is actually the soil-dwelling larvae (***bottom***) that cause visible damage to turfgrass.

Drought events are forecast to become more frequent and more severe in coming years, promising to change the pest management landscape. However, tools exist, and are continually being improved upon, to help turf managers contend with drought stress and the other stressors that may accompany it. Intentional selection of cultivars that are well-suited for multiple stressors, and careful, data-based timing management efforts, could help managers avoid damage while also limiting the need for precious resources like water.

— Desireé Wickwar, M.S. (Biology)
and Ricardo Ramirez, Entomologist

Fusarium Diseases in Tomato

Tomatoes affected by Fusarium diseases permanently wilt, then die (***far right***).

Those with Fusarium wilt have brown vascular tissue (***right***).

In Utah, two diseases caused by Fusarium species are found on tomato – Fusarium wilt and Fusarium crown and root rot. Fusarium wilt is caused by *Fusarium oxysporum* f sp. *lycopersici* and Fusarium crown and root rot is caused by *Fusarium oxysporum* f sp. *radicis-lycopersici.*

Both pathogens are soilborne but their symptoms differ.

Symptoms of Fusarium Wilt

The first symptoms usually appear after flowering. Plants start to wilt during the heat of the day and initially may recover after cooler evening temperatures. As the disease advances, leaves turn yellow and permanently wilt and eventually, the plant dies. When the stem is cut vertically, vascular discoloration can be observed (see above). There is no root or crown rot associated with Fusarium wilt.

Symptoms of Fusarium Crown and Root Rot

Aboveground symptoms can superficially look similar to Fusarium wilt. Plants may wilt in the heat of the day and recover in the evening and some of the leaves, especially the lower leaves, turn yellow. In addition, when wilted plants are pulled up, the roots are visibly rotten and a four to five-inch, dark brown lesion can be seen on the main stem above the soil line (shown at right). There is no vascular discoloration in the stem but the lower stem and root cortex (interior part of the tap root) can be discolored. Occasionally, adventitious roots develop on the stem.

Tomato plants affected by Fusarium crown and root rot have discoloration in the lower stem and visibly rotted roots.

Management

Management options are limited. To prevent introduction, the best option is the use of resistant varieties. There are many tomato varieties resistant to Fusarium wilt but only a few resistant to Fusarium crown and root rot. If a tomato variety is listed as resistant to Fusarium wilt, this does not mean it is also resistant to Fusarium crown and root rot as they are two distinct diseases. Cornell University has a list of tomato varieties and their resistance levels to various diseases. Other ways to prevent introduction to the field include starting with disease-free transplants and avoiding wounding plants, as wounds provide entrance points for Fusarium species.

Where the disease has been identified, the field must be rotated for several years to a non-host crop to reduce inoculum in the soil.

— Claudia Nischwitz, Plant Pathologist

2021 MASTER GARDENER PEST SCOUTING

Although the COVID-19 pandemic and subsequent lockdowns hindered almost all aspects of life worldwide, it did force many of us to become intimately familiar with virtual conferencing. This newer form of communication has opened doors for interaction to wider audiences and teams that previously was not possible. The Utah IPM Program took advantage of this, and started a group of Master Gardener IPM Scouts in spring of 2021.

We solicited volunteers from each county in Utah, and 33 people signed up—not knowing entirely what they were in for—from nine counties. Virtual conferencing allowed us to provide an online orientation session for participants from St. George to Logan. We provided five additional online trainings on advanced pest scouting and identification throughout the summer.

At the start of the season, each scout was mailed a packet of resources needed for their adventures, including a hand lens and a set of four identification books.

Once per week, they spent time in their garden of choice scoping out pests, and then recorded their findings on a shared spreadsheet and uploaded images. Some of the more common organisms reported were cutworms, clover mites, stink bugs, red fire bug, aphids, spider mites, lady beetles, preying mantids, and leafcutter bee. The images were used by Extension for educational outreach, and the scouts increased their knowledge of plant pests and accumulated volunteer hours.

The infographic below shows the results of this program from just one season, and the next page includes some of the great images submitted. We plan to continue the program into the future, and use the latest technology available to interact via a variety of channels with people in all corners of the state.

— Mair Murray, IPM Specialist and Nick Volesky, Vegetable IPM Associate

Images by Master Gardener IPM Scouts, starting top right:

squash bugs, S. Hunt, Washington Cty; orange underwing, A. Willoughby, Weber Cty; leafcutter bee, G. Babcock, Carbon Cty; Colorado potato beetles, D. Nalder, Davis Cty; Mormon cricket, G. Babcock, Sanpete Cty; ten-lined June beetle, B. Villalba, Cache Cty; head of yellow jacket, B. Hales, Salt Lake Cty; American dog tick, M. Mimms, Salt Lake Cty; weevils on roses, B. Villalba, Cache Cty

IPM In The News

Effect of Pest Feeding Order on Pea Plants

Researchers at Washington State University conducted one of the few studies that looks at the interaction of several plant antagonists, in this case, two pests and a virus. They exposed pea plants to pea leaf weevils, pea aphids, and Pea enation mosaic virus in differing orders. The study, published in *Molecular Ecology*, found that plants first exposed to weevils had enhanced anti-pathogen defenses which helped them become more resilient to virus infections. Plants that were exposed to aphid feeding first had a reduced anti-pathogen defense response, and plants that were virus-infected had stronger anti-herbivore responses. To further complicate these interactions, they discovered that the induced anti-pathogen responses from the weevil feeding decreased the nutrition of the plant overall. These complex relationships are critical to understanding plant responses and deciphering appropriate pest management practices.

Models Predict that Plant Diseases Will Increase in the Future

A study conducted by University of Exeter and published in *Nature Climate Change* estimates how 80 plant pathogens may affect crops due to climate change. Previous research has shown that crops in higher latitudes will have increased crop yields, but this latest study reveals that the gains will likely be tempered by the increased burden of crop protection due to tropical diseases shifting away from the equator. The authors' models looked at projected yields of 12 major crops and suggest that the U.S., Europe, and China are likely to see major changes in plant diseases due to new conditions brought on with the changing climate.

Plants get Wearable Device

Like humans, plants can now wear devices that monitor their health. Researchers at North Carolina State University report in the journal, *Matter*, the creation of a prototype plant patch that records volatile organic compounds (VOCs) emitted by the plants. Plants emit different VOCs under different circumstances, so targeting specific combinations can alert users to specific plant problems such as physical damage, drought stress, or pest attacks, possibly before symptoms are visible. The authors are currently working to develop a next-generation patch that is solar-powered, capable of wireless data transfer, and along with VOCs, records temperature, humidity, and other environmental variables.

Cutting Herbicide Use in No-till Operations

Penn State researchers conducted a nine-year study that showed it is possible for no-till producers to decrease their herbicide use by practicing integrated weed management. Using methods such as banded herbicide, seeding small grain, and tilling every six years, they found that although the weed biomass was greater in areas where herbicide was not used, the overall yield was not affected. Although herbicides have historically been used in no-till production, the researchers concluded that if diverse integrated weed management principals and methods are implemented, herbicide reduction is a viable goal.

Novel Biofungicide to Prevent Fungal Infection

Engineers and plant pathologists at UC Riverside describe in *Biotechnology and Bioengineering* a novel biofungicide using engineered yeast containing a plant DNA code that blocks fungi from breaking down cell walls. The authors mapped the DNA code in green beans that tells the plant to produce a protein that inhibits the infection process of fungal pathogens. The code was then inserted in common baker's yeast and the yeast successfully produced enough of the targeted protein to repel all tested pathogens. The authors suggest that using this technique as a sprayable biofungicide would inhibit the fungal infection process. They caution, however, that because plants also form beneficial relationships with other fungi, future research needs to ensure the spray only repels harmful fungi.

Clothing Prevents Mosquito Bites

Researchers at North Carolina State University have created bite-proof, form-fitting clothing to be used as an insecticide-free option against mosquito bites. To do this, they developed a computational model to describe the biting behaviors of *Aedes aegypti*, a mosquito that carries many modern human diseases. Variables such as the mechanics of mosquito biting and the dimensions of the head, antennae, and mouth, were used in the model to produce a textile with certain thickness and pore size that would prevent bites. The authors report in *Insects* that they are confident this model can be used to produce bite-proof clothing to be used for both military and everyday purposes.

Bread Dough Lures Slugs and Snails

A team of researchers from California, Oregon, Hawaii, and Montana have shown that simple bread dough (flour, water, and yeast) is highly attractive to

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Featured Picture of the Quarter

Investigations into diseases of vegetables in Utah has revealed several different viruses. Shown here is alfalfa mosaic virus in potato. It is spread by various aphids species that pick up the disease from nearby alfalfa and then feed on the potato plant. These aphids usually do not travel more than a mile.

Infected plants have bright yellow mottling on foliage and are stunted. Potato tubers may crack and develop dry, brown patches in the interior.

—— Image by Claudia Nischwitz, Plant Pathologist

IPM in the News, continued

six invasive pest slugs and snails. The study, published in *Insects*, found that bread dough was significantly more attractive than a widely-used toxic bait and water alone. The authors suggest that a pre-mixed dry formulation of flour and yeast, where water simply needs to be added to activate the bait, would likely have an indefinite shelf life and be readily shippable. The bread dough could be used in escape-proof traps or in traps with a molluscicide.

Cabbage White Butterfly's Evolving Tastes

The imported cabbageworm is the larva of the cabbage white caterpillar (*Pieris rapae*), and one of the most destructive pests of cole crops. Over millennia, it has changed its behaviors to go toe-to-toe with the evolving self-defense mechanisms of its hosts. To model the path of this co-evolution, scientists at Washington University in St. Louis used previously published time-calibrated phylogenies for this butterfly plus 65 additional Pieridae genera and 33 families of plant hosts. The authors published in *Ecology Letters* that the butterflies tend to "clump" to specific plant groups and can regain hosts they haven't used for millions of years. This indicates an evolutionary mechanism that increases their chance of survival. The results of this study provide evidence that the structure we observe in butterfly-plant networks today has been stable over millions of years.

Clipart courtesy of FCIT

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