UTAH PESTS News

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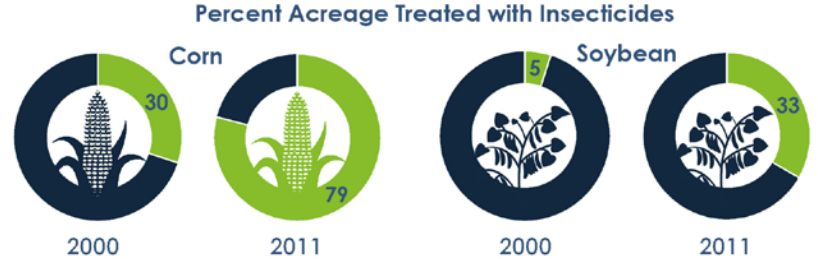
Neonicotinoids: From Innovation to Bad Word



The increased use in corn and soybean is primarily due to neonicotinoid seed treatments.

In recent years, the neonicotinoid class of insecticides, or "neonics", has come under scrutiny, primarily because of concerns with their effects on bees, but also from other environmental issues. The first neonicotinoid (imidacloprid) was released in 1994, at a time when a number of insect pests had developed resistance to several of the major insecticide classes including pyrethroids, organophosphates, and carbamates.

Several characteristics of the neonicotinoids were seen to be favorable, including low mammalian toxicity, high selectivity for arthropods, persistence, and systemic activity. The water solubility allows for movement into plant tissues. While foliar applications can be made, neonics are mainly applied as a seed coating or soil application. These two methods reduced insecticide exposure to the applicator and to beneficial insects. Unfortunately, applicators also saw an opportunity to use neonicotinoids preventively, regardless of the presence of the pest, fitting with a "set it and forget it" mentality. All of these characteristics resulted in increased adoption of neonicotinoids in agricultural and urban settings, making them the most-used insecticides worldwide.

Several newsworthy events have put neonicotinoids in a bad light. A massive bee kill associated with neonic-coated corn seed occurred in Germany, and recently, the largest recorded bumble bee loss occurred in Oregon, from an application for aphid management on blooming linden trees. To be clear, applicator error/misuse was to blame in both of these cases, and it is well known that when bees are foraging, they are generally sensitive to any insecticide application. The connection between neonics and bee death continues to be implicated as a possible factor for bee decline.

Interestingly, the effects of neonicotinoids on honey bees have not matched what would be expected for colony collapse disorder symptoms. This is not to say that neonicotinoids do not harm bees, but it must be taken in context. In several lab experiments, bees that were fed neonicotinoids were negatively affected, but the doses being used were much higher than would be encountered by a bee in a field situation. In field studies, the resulting effects of neonics have been quite variable, with many showing little effect on our non-native honeybees. However, recent field studies have shown some harmful effects of neonicotinoids on native bees.

The lack of consistency in these research trials perpetuates the debate. It is generally accepted by entomologists, however, that bee declines are a result of multiple factors including disease, parasites, nutrition, environmental stresses, and pesticides as a whole (insecticides and fungicides). Erring on the side of extreme caution in some places has restricted the use of neonicotinoids altogether.

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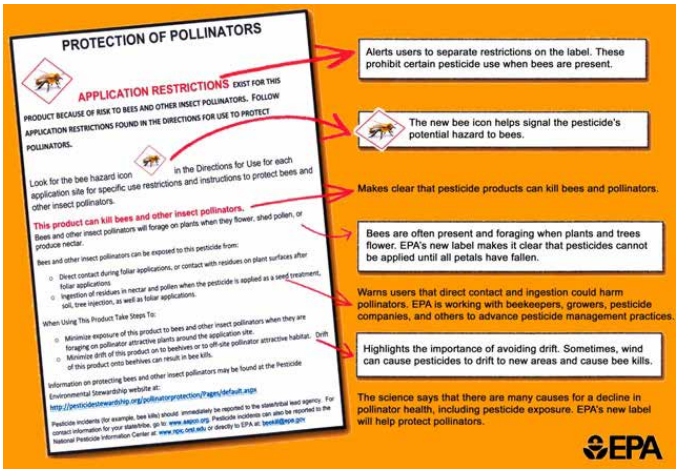
Neonicotinoids, continued from previous page

Insecticide applications can have many unintended consequences. For example, applications of pyrethroids can lead to secondary outbreaks of other pests, like aphids. These applications can kill natural predators that keep those secondary pests in check. Similarly, applications of neonicotinoids in both urban and agricultural settings have resulted in secondary outbreaks of spider mites. Given that neonicotinoids are systemic and interact with the plant, it is thought that neonics may alter plant defense hormones, making them more susceptible to spider mites. At USU, we are investigating the effects of neonicotinoids plus drought stress on spider mite outbreaks. In this on-going research, the mite outbreaks appear to be driven more by drought and less by neonics. In yet another case, Penn State researchers found that although neonics did not harm slugs, the applications resulted in 'toxic slugs' that increased the exposure of predatory ground beetles to neonics and decreased predator abundance.



One of the outcomes from the massive bee kills due to misapplication was the EPA's development of a bee advisory box that is now placed on pesticide labels.

Neonicotinoids have been effective insecticides, and considering that few safe alternatives exist and that new options will take time to develop, they still have a place in insect management. In 2013, the European Union banned the use of neonicotinoids on crops that attract pollinators. The impacts were modest, but some growers planting rapeseed crops not treated by neonics had higher than normal losses from pests. A recent EPA document, however, showed that neonic-coated soybean seeds did not provide an economic benefit for the crop and suggested that a re-evaluation in other crops may be needed.

Preventive application of neonics is not following an integrated pest management strategy, and unsustainable. Resistance to neonicotinoids has been documented in various species of planthoppers, cotton aphids, whitefly, and Colorado potato beetle. Incorporation of IPM strategies and chemical rotations with other systemics such as diamides, may help relieve some concerns.

The neonicotinoid story is quite complex and unfortunately, there is negative spillover for other insecticide classes. Recently, U.S. Federal court rejected sulfoxaflor, which also targets nicotinic receptor sites and has high acute toxicity toward bees (as many insecticides do). It is important to be mindful of this complexity, not to simplify the effects, and use these innovations wisely by getting back to basics in IPM.

-Ricardo Ramirez, PhD, Extension Entomologist

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Cover Crops – Seriously!

Dr. Dan Drost is the Extension Vegetable Specialist for Utah State University. His research and outreach help vegetable growers become more sustainable, and focuses on water use, nutrition, sustainable systems, and alternative crops. Dan is also world-renowned for his research on asparagus production (www.aspireus.com). Read more about Dan's work and accomplishments here.

Buckwheat (in late July) is a short-season cover crop with a fibrous root system that aerates the soil.

Cover crops come in a variety of flavors and provide a range of benefits. So how do you decide on which cover crop (CC) to grow (the flavor) and if they are right (the benefits) for your farm. A lot of work has gone into evaluating CC's, but ultimately, their impact depends on each farm's unique needs. In general, they provide many benefits:

- Increase soil fertility
- Reduce weed and pest pressures
- Prevent soil erosion
- Conserve soil moisture
- Improve soil health

Ideally the CC should solve a recurring farm problem, be acclimatized to the area, fit the farm's production timetables, provide specific positive benefits, and not create new problems. Before picking a cover crop flavor, you should identify what the farm needs and which goals you are trying to accomplish by growing the cover crop.

FARM NEED: Good soil is the foundation to growing healthy productive crops. While you can't do much about the soil texture (proportions of sand, silt and clay) on your farm, there are ways to improve nutrient availability and soil structure, manage pest problems, reduce soil losses, increase water holding capacity, and change farm productivity. Over time, soils may lose their structure, become deficient in specific nutrients, and become more difficult to manage, thus negatively impacting productivity. One solution to maintaining a productive soil is to integrate cover crops into the rotation. Cover crops help build soil organic matter; thus improving nutrient availability and water holding capacity, preventing erosion, and changing soil structural properties. Some CC's are better at one or more of these improvements.

ADAPTATION: Fitting the right CC to local conditions and specific farm needs ensures that you get the most benefit. If you need more soil nitrogen, you should grow one of the legume CC's like vetch, peas, clover, or alfalfa. If your farm soil is dense or compacted, a deep rooting CC like alfalfa, sweet clover, or sorghum can help break up the soil and create root channels. If weeds are an issue, CC's with a dense canopy like wheat, barley, millet, or buckwheat can smother out weeds. When adapting a CC to your farm, you need to consider "when is the best time to grow the CC"? This is a scheduling issue since you generally don't grow the CC and cash crop at the same time.

SCHEDULING: After thinking about which problems you are trying to solve and which CC to plant, you now need to look at the timing of the CC relative to other farm activities. Is the CC of choice winter hardy? If so, how early or late in the fall can it be planted? Fall is a good time to plant many CC's. However, if planted early you may need water to get them established and keep them growing. If you plant too late, you may not get them established, the CC may not over-winter very well, or it may not grow enough to help stabilize or protect the soil from erosion. For some CC's, spring or summer may be a better time to grow them. This

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Cover Crops, continued from previous page

Hairy vetch, shown here in early May, is a winter-hardy, annual legume. It is said to be more efficient at nitrogen fixation than peas.

creates its own scheduling problem if the land is occupied by other crops. Fast growing CC's like buckwheat or millet (both like hot weather) can be planted in mid-summer after an early cash crop to help control weeds, re-cycle residual soil nutrients, or add more organic matter back into the soil. Sometimes finding the right niche in which to use a CC is difficult.

BENEFITS: Here are just a few of the benefits of growing some of the more common CC used in Utah. Winter grains (grasses) like wheat, barley, or rye are great for stabilizing the soil, trapping free phosphorus and potassium, choking out weeds, and growing quickly. If you want really good summer grass CC's, grow millet or sorghum-sudangrass. Sorghum-sudangrass is a great CC and should be more widely used in Utah. Very few growers use the brassica CC's (mustards, radish, rape). All of these help loosen dense soils, suppress diseases, nematodes and weeds, and they grow rapidly. Finally, legumes that grow in the winter (vetches, some clovers, alfalfa) or summer (some clovers, beans, peas) are great nitrogen producers, help loosen soils, and are good weed control agents.

POTENTIAL PROBLEMS: Generally the benefits of a CC outweigh the problems. The grain crops may not breakdown well if they are too mature before incorporating into the soil and can tie-up soil nitrogen. We've seen some CC's (buckwheat, millet, rye) become weedy if allowed to set seed. Sometimes the CC grows so much biomass that they are hard to incorporate, may interfere with planting of the desired crop, or may suppress early crop growth until they start to decompose. Finally, all CC's need water to get established and grow. If water resources are in short supply or unavailable, this can limit the performance of the CC or the CC may dry out the soil and rob the desired crop of needed spring moisture.

So in conclusion, assess your farm's needs, identify the best time and place for the CC, decide when and which CC to plant, and try to build your cash crop's rotation with cover crops in-mind. By doing these things, your farm will gain more than it will cost by not using adapted cover crops. For more details on CC's, you can download or purchase "Managing Cover Crops Profitably" from the USDA Sustainable Agriculture Research and Education program.

Growing Cover Crops for Pest Management

Cover crops (CCs) have been used to suppress pests since the beginnings of agriculture. CCs can be an effective tool to reduce weeds, insects, plant diseases and nematodes. They can reduce the need for pesticides, lower crop production costs, and improve the diversity and resilience of soils. Some of the greatest challenges to implementing CCs are to determine which ones are best adapted for your area, and optimal planting and removal schedules (e.g., killing or suppression with herbicides, mowing, or tillage) (see previous article). Another major consideration in selecting an ideal CC and crop rotation system is how to best use them to reduce farm and garden pests.

WEEDS. Of all the pest groups, CCs can have the largest impact on suppressing weeds. CCs reduce weeds through

Polyculture of crimson clover, cereal rye and hairy vetch used as a green manure cover crop for sweet corn.

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Cover Crops for Pest Management, continued from previous page

physical and chemical means. Physical mechanisms include shading, smothering, and out-competing weeds for water and nutrients. Allelopathy is a process by which an organism releases one or more biochemicals that influences another species. In the case of some CCs, they can reduce the growth of weeds through allelochemicals. Cereal rye, buckwheat, and sorghum-sudangrass can suppress weeds with both physical and biochemical mechanisms. Cereal rye is a common cool-season CC; sow it in late summer or early fall following harvest of the cash crop to compete with weeds in the winter and early spring. Buckwheat and sorghum-sudangrass are common warm-season CCs; sow in the spring, summer or fall during gaps between cash crops or inter-seed with the cash crop to suppress weeds. Vegetable seedlings can be planted into CCs killed with an herbicide; the dead mulch suppresses weeds and other pests. Living CCs are commonly used in perennial crops such as fruit, nut, and vine orchards. During the lifespan of the perennial crop, CCs can significantly reduce the weed seed bank and provide long-term weed suppression.

INSECTS. CCs are used to conserve and enhance beneficial organisms, such as predators, parasitoids, and pathogens of insects and spider mites. CCs attract beneficial organisms to their protected habitats, moisture, and food (insect prey, nectar, pollen, and insect honeydew). Conservation-, strip-, or no-tillage of CCs maintains residues on the surface to extend the time when critical resources are available to beneficial insects and mites. When crops are attacked by herbivores they release chemical cues that attract predators and parasitoids. Nearby CCs can serve as a reservoir of beneficial insects and mites. Crimson clover, alyssum, sweet william, and flowering herbs are attractive to beneficial insects. Pollinators will also benefit from resources provided by many of the same CCs. Some CCs can also serve as trap crops to attract pest insects away from the cash crop, such as 'Pacific Gold' mustard or pac choi for flea beetles, and yellow crookneck or straightneck squash for squash bugs. It is important to avoid pushing pest insects into crops by removing or mowing CCs at the wrong time. Mowing alternate rows in orchards is a good way to maintain resources for natural enemies and avoid pushing spider mites into fruit trees.

DISEASES. CCs can support populations of beneficial microbes, such as epiphytic bacteria that adhere to plant surfaces and form biofilms. These bacteria can out-compete plant pathogenic bacteria as they try to invade plant tissues. CCs improve soil organic matter; thus increasing beneficial microbes. Verticillium wilt of solanaceous crops

Alternate rows of sunn hemp (*Crotalaria juncea*) were cut and tilled into the soil to suppress plant parasitic nematodes before planting cucumber seedlings between rows. Remaining rows of sunn hemp continue to be cut once a month and managed as a living mulch to suppress weeds.

A rye-vetch cover crop was mowed down to suppress weed competition during broccoli seedling establishment.

can be suppressed following incorporation of sudangrass green manure. Cereal rye and wheat, clovers, vetches, and buckwheat have been shown to reduce soil-borne diseases and nematodes.

NEMATODES. The primary goal in use of CCs to suppress plant parasitic nematodes is to enhance the diversity of the native soil nematode community. A balanced and diverse nematode community will prevent the build-up of plant-parasitic nematodes because of the numerous feeding behaviors of nematodes, including plants, fungi, bacteria, other nematodes, insects, and other organisms. CCs that have shown the best results in suppressing plant-parasitic nematodes include mustards, radish, sunn hemp, showy crotalaria, sorghum-sudangrass hybrids, marigold (*Tagetes patula*), hairy indigo, and velvetbean. These CCs release root exudates that are suppressive to nematodes and/or release

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Cover Crops for Pest Management, continued from previous page

biochemicals from green manure when incorporated into the soil.

To use CCs successfully, one must invest in gaining knowledge and experience; however, the benefits CCs can bring to improved crop growth and pest management are well worth the investment. There are many online resources. Select those that are most relevant to your growing climate and conditions. Some good resources for pest suppression with CCs in Utah include the following (click on orange links): "Managing Pests with Cover Crops" by Phatak and Diaz-Perez, "Using Cover Crops for Pest Management on Small Farms" by Pollock, and "Nectar Cover Cropping for Sustainable Pest Management" by Irvin and Bistline.

-Diane Alston, Entomologist

ENTOMOLOGY NEWS AND INFORMATION

Pitch Moth Update

In the spring 2015 issue of Utah Pest's News, in the article "A Pitch and a Strike," we discussed the increasing occurrence of pitch masses on pine trees, particularly Austrian pine, in Utah. At the time, we were uncertain of the moth species causing the damage, and are close to identifying it.

Douglas-fir pitch moth, left, and sequoia pitch moth, right.

With assistance from the University of Utah, we hung pheromone traps to collect moths emerging from Austrian pine on the U's campus. The traps were hung in early June and within a few days, they were full of male clearwing moths.

The moths were collected from the traps and processed to remove the genitalia, which are used in determining species. The moths were determined to be one of two species, either sequoia pitch moth (*Synanthedon sequoiae*) or Douglas-fir pitch moth (*S. novaroensis*). Some refer to these as the *Synanthedon sequoia-novaroensis* complex. The only way to definitively distinguish these two moths is through molecular genetic analysis, which is our next step. Both species can attack pine and Douglas-fir trees, and have a similar life cycle.

Adult flight begins in May and can continue through September. Upon emergence, adults mate and the female lays individual eggs around bark wounds or crevices. (After mating, the moths die within a few days.) The eggs take about two weeks to hatch and the larvae then bore into the bark.

The larvae continue to bore through the bark into the outer cambium, causing the tree to exude copious amounts of resin. The larval feeding area (galleries) can be small and contained, or extend five to six inches in any direction. The larvae spend two years in the tree, and as they mature, they leave the bark and start feeding in the pitch mass. Larvae pupate in a chamber within the pitch mass and emerge, leaving the pupal skin extruding from the mass.

There are not many control options for sequoia pitch moth, and under normal circumstances, small to moderate numbers of moths will not injure a tree. Please review the spring 2015 edition of Utah Pests News for control recommendations. If you find pitch masses on other pine species, Douglas-fir, or spruces, we would like to identify the moth species involved. Please contact Ryan Davis if you wish to submit a sample: ryan.davis@usu.edu.

-Ryan Davis, Arthropod Diagnostician

Russet Mites on Tomatoes

Russet mites are microscopic eriophyid mites that can occur by the thousands. The injury they cause mimics a plant disease.

In the last few weeks of summer 2015, several tomato samples were sent to the Utah Plant Pest Diagnostic Lab. The complaint was that plants started to dry up and die from the bottom up. Often the stems had a rusty color and had lost their hairs. In severe cases, green fruit attached to the vines developed small cracks. The first thoughts for symptoms like these are a disease or fertilizer or chemical burn. But the final diagnosis was a tiny eriophyid mite – the tomato russet mite.

The tomato russet mite cannot be seen with the naked eye. Minimum magnification required to see the mites is about 16x. The mites are cream-colored and worm-like, with four front legs. The mites prefer to feed on tomato plants, but will also damage potato and eggplant. They reproduce rapidly on these hosts. Depending on temperature, the life cycle—from egg to adult—can be completed in less than a week. Optimum temperatures are between 70 to 90°F with 30% or less humidity. Secondary russet mite hosts include pepper, petunia, bindweed, nightshade, and jimson weed, but these plants are not as severely damaged.

Russet mites can be introduced into a field or greenhouse on infected transplants. Once there, they can reside on weeds for long periods of time until a suitable host is planted again. Spread across a field can occur by wind and on clothes as workers brush by infected plants. In northern Utah, mites typically cannot survive through winter, and must be re-introduced each season.

Mite feeding on the skin of tomatoes causes russeting of the fruit.

For the type of tomato symptoms described above, it is important to get a quick diagnosis to prevent yield losses. Russet mites can be controlled organically by sulfur or conventionally by a miticide (such as abamectin), as soon as the symptoms first appear. Sulfur should be applied when temperatures are below 90°F to avoid damage to the plants. Severely infected plants should be removed immediately.

-Claudia Nischwitz, Plant Pathologist

Cool-Season Turfgrass Varieties for Utah

In the summer 2015 edition of Utah Pests News, we recommended a few cool-season turfgrass cultivars for Utah. As requested, here is an expanded list of turfgrass cultivars that could be used. Many new cultivars are being continually investigated, and data for them can be found on the National Turfgrass Evaluation Program website.

It may be difficult to find all of the varieties tested by NTEP and that are recommended in the table below because new cultivars are constantly being tested and introduced. You may need to select a few that will work in your particular situation (sunny, shady, irrigation, no irrigation, etc.) and try to locate one, or a mixture of them.

The information in the table below was taken from a USU Extension fact sheet written by Kelly Kopp and Paul Johnson. Please read their full fact sheet, Turfgrass Cultivars for Utah, before selecting a turfgrass cultivar, as it contains important information on selecting grasses.

-Ryan Davis, Arthropod Diagnostician

Fine-leaf Fescue	Kentucky Bluegrass	Tall Fescue	Perennial Ryegrass
Marco Polo	Midnight	Coronado Gold	Amazing GS
Bighorn	Midnight II	Blade Runner	Calypso II
Little Bighorn	Everest	Inferno	Caddieshack II
Audobon	Bluestone	Matador GT	Paragon GLR
Inverness	Impact	Cayenne	Uno
Florentine	Perfection	Silverstar	
Garnet	Baron		
Dawson	EverGlade		
Aruba	Award		
Tiffany	Bedazzled		
Windward	Total Eclipse		
JS			

Centers for Disease Control Acquits the Hobo Spider

For many years, the Centers for Disease Control's (CDC) venomous spiders website contained three spiders: widow spiders (black widow), brown spiders (brown recluse) and the hobo spider.

Recently, the CDC removed the hobo spider from its website in response to the mounting evidence that hobo spiders do NOT cause necrotic bites. For Utahns, that leaves the western black widow spider as the primary spider of concern in the state. Utah does not have brown recluse spiders.

While people want to blame the hobo spider for mysterious bites and skin lesions, it is important that doctors make the proper diagnosis for patients with sudden and unknown skin lesions. With over 40 causes of necrotic skin ulcers, a misdiagnosis of hobo spider as the cause may prevent discovery of a more serious medical issue. Lesions caused by bacterial infection, disease, or a medical condition are far more serious than hobo spider bites.

You can learn more about hobo spiders by clicking this link, which includes a brief summary of evidence for, and against, hobo spiders causing necrotic lesions, and draw your own conclusions.

-Ryan Davis, Arthropod Diagnostician

Ghosts of Holiday Pests

'Tis the season for holiday festivities, good cheer, and joyous feasts. As you prepare for the holiday season, however, be on the watch for invasive pests. They may be hitchhiking or latching onto your belongings as you travel to and from visits with your loved ones, or are used in holiday plant decorations.

English holly (***left***) is a botanical Grinch (invasive species) masking as a holly alternative. BMSB adults (***right***) are shield-shaped, 5/8-inch long, and mottled brown. They have a smooth edge along their pronotum ("shoulders"), rounded shoulder tips, and alternating dark and light bands on their antennae and along their abdominal edges.

As you pull boxes of holiday decorations and heirlooms from storage, make sure to check them for brown marmorated stink bug (BMSB). BMSB is native to Asia and feeds on more than 300 plant species, including fruits, vegetables, some field crops, and even landscape ornamentals. They are strong fliers and excellent hitchhikers, allowing them to spread rapidly to new areas. BMSBs will soon begin their trek from their field hosts to residential settings to seek out warm shelter to overwinter as adults, including attics and garages. Keep in mind that several native stink bugs closely resemble BMSB (check out the Invasive Insect Look-Alike fact sheet for more information).

BMSB was first detected in the U.S. in Pennsylvania in 2001 and began causing crop damage by 2009. They are now found in 42 states, ranging from occasional detections, to minor nuisance problems, to severe agricultural and nuisance problems (www.stopbmsb.org). In Utah, BMSBs have been found in urban settings in Utah, Salt Lake, Davis, and Weber counties, either in homes or on ornamental hosts including catalpa, honeysuckle, Siberian peashrub, Amur maple, and butterfly bush. However, given that BMSB reports and detections are increasing each year in Utah, it may only be a matter of time before they are found causing damage to agricultural crops. Please report all suspected BMSBs to Lori Spears (lori.spears@usu.edu). Find out more information about BMSB and other invasive insects at Utah's Cooperative Agricultural Pest Survey (CAPS) website.

This season, also be on the lookout for invasive plant species that are commonly used in holiday displays and avoid decorating with them. For example, invasive plants such as Oriental bittersweet (*Celastrus orbiculatus*), multiflora rose (*Rosa multiflora*), and English holly (*Ilex aquifolium*) have attractive qualities, but are known to invade and disrupt native habitats, and are difficult to control. These plants are also used by BMSB and may help facilitate their establishment and spread (see stopbmsb.org for a list of known BMSB hosts).

Lastly, movement of Christmas trees and other holiday greenery is federally regulated in some areas of the country to prevent the spread of invasive forest pests. Federal and state agencies work with tree farms and other establishments in quarantine areas to make them aware of movement restrictions. Most live Christmas trees sold in Utah are brought in from other states. To help minimize the chance of spreading invasive forest pests, you can either:

- cut your own Christmas tree (with an appropriate permit) from a forest close to your home (preferably within the same county), or
- buy a pre-cut Christmas tree and/or other fresh holiday greenery from a reputable local source.

For additional holiday tips, including tips for preventing invasive species, check out the following websites:

Don't Move Firewood – *Holiday Greenery page*
USDA APHIS – *Holiday Greenery page*
Utah-Grown Christmas Trees

-Lori Spears, Utah CAPS Co-Coordinator

Why Did My Tomatoes Ripen so Late?

Every year, we have inquiries on tomatoes not maturing, especially this year. There are several reasons that could cause tomatoes to ripen late, including the variety, temperature, irrigation, fertilization, and insects and diseases.

One of the ways tomatoes are classified is maturity class. The maturity class is displayed on seed packets as "days to maturity" (from transplant time). Early maturing tomatoes ripen in about 55-68 days, mid-season tomatoes ripen in 69-80 days, and late varieties take more than 80 days to mature. Make sure to pay attention to maturity class as you choose the variety of tomatoes to plant.

Temperature also plays a big role in tomato ripening. When air temperatures rise above 85°F, the plant stops making the components required for the fruits to mature. Soil temperature is also important; the roots require soil temperatures below 80°F for optimal growth. So as temperatures rise, one of the first responses is for shallow-rooted tomato plants to develop a deeper, more robust root system, further diverting and delaying precious fruit-ripening energy. The hot June and cooler July that northern Utah had this year really slowed growth and ripening. The delayed plant growth can lead to later fruit set and maturity.

Tomato ripening is also sensitive to water. Plants require deep and infrequent (1 to 2 inches per week) waterings. Drip irrigation is preferred since it allows the moisture to permeate deeply into the soil. Watering plants frequently for short periods of time can promote shallow roots systems. Towards the end of the season, after fruits reach mature size, a small decrease in water is beneficial in that it can trigger fruit ripening.

Fertilization amount and timing can also play a role in fruit maturity. Heavy or late fertilization of tomato plants encourages excessive foliage growth and delays fruit maturity (plants put energy into leaves rather than fruits). To properly fertilize tomatoes, side dress with nitrogen (34-0-0) using 1-2 tablespoons per plant at 4 and 8 weeks after transplanting. Place the fertilizer 6 inches to the side of the plant and irrigate it into the soil. Do not fertilize again.

The use of mulches can conserve soil moisture and reduce weed growth. The use of black plastic ground mulch is recommended and may also raise soil temperatures in spring to promote an earlier harvest. Mulches can also help moderate fluctuations in soil temperatures so that plant growth and development can proceed with fewer problems. Hotcaps, plastic tunnels, fabric covers, and other devices protect seedlings and transplants from cool air temperatures. These row covers

enhance growth and ripening. Plants grown under row covers require ventilation when air temperatures exceed 80°F. Tomato flowers are sensitive to high temperatures during flower development and early fruit growth. Row covers can also be used near the end of the growing season to protect fruits from frost damage allowing them to stay on the vines longer.

Insects and diseases may also cause delays in fruit maturity. Insects such as flea beetles, hornworms, and fruitworms can defoliate tomato plants, delaying plant growth and fruit maturity. Aphids slow maturity as they feed on the undersides of leaves, causing them to become crinkled and curled. Aphids can also transmit virus diseases which can cause stunting and chlorotic areas on leaves. Bacterial and fungal diseases can also cause lesions and delayed plant growth.

Don't get discouraged if you've done all you can to ensure you have healthy tomato plants, yet still have a delay in fruit ripening; every growing season is variable and hard to predict. Mature green or slightly colored tomatoes can still be harvested at the end of the season and used later as they ripen. Optimal storage temperature for tomatoes is 55°F.

So to summarize, here are some things you can try:

- Choose early or mid-season maturing varieties.
- Be patient! Your plants just might need more time with the cooler weather to produce mature fruits.
- Try changing your watering practices, such as watering for a longer period of time and less frequently.
- Use mulch and row covers.
- Keep plants free from insects and diseases.
- At the end of the season, harvest all mature fruits that are green or colored slightly. Store at 55°F and use as they ripen.

-Bonnie Bunn, Vegetable IPM Associate

Fall is for Mushroom Hunting and Spore Prints

Some people see mushrooms and think, "gross, remove it," while others say "yum, eat it" or "pretty, photograph it." Technically speaking, a mushroom is the fruiting structure of the body of certain fungal species. Akin to apple fruits, mushrooms are simply containers where reproductive spores are formed and then released (like the seeds in apples). We rarely see the main body of the fungus (think: tree), as it is made up of microscopic structures called hyphae that grow within the material that the fungus is consuming (a live plant, wood, detritus, fruit, bread, etc.). Given the right temperature and moisture, the fungus produces fruiting structures, and in the case of some species, those are mushrooms. Mushrooms are unique to each fungus: some are colorful and architectural, some are edible, some are poisonous, and some make beautiful spore prints.

The best time to forage for mushrooms is in early fall, after rains. Before collecting, it is important to become knowledgeable about native mushrooms so that poisonous ones are avoided. Although there are thousands of mushroom poisonings in the U.S. per year, the number of edible mushroom species far outweighs the number of poisonous ones. With preparedness, mushroom hunting can be a fun and safe activity. Here are some tips to help in identifying mushrooms:

- Take two collecting baskets when foraging. Put known edible mushrooms in one, and unknown mushrooms in the other for later identification. You won't get sick by simply touching a toxic mushroom.
- Identification characters include the mushroom size, shape, and color, the stem, a spore print, the habitat, and the structure of the stem base, which could be below ground. Write this information down as you collect.
- Use a regional field guide. An excellent option is: **All That the Rain Promises and More: A Hip Pocket Guide to Western Mushrooms,** by David Arora.
- Join the Mushroom Society of Utah (utahmushrooms.com). Established more than 20 years ago, their mission is to promote scientific and educational activities related to fungi, while supporting the protection of natural areas.
- Be extremely careful if you are a pet owner and want to take your dog on a foraging trip. Dogs lead the list as victims of mushroom poisonings.

When searching for mushrooms, it is also important to respect the land and practice selective and sustainable harvesting. When gathering mushrooms, leave the soil, woody debris, vegetation, and the fungal body of the mushroom undisturbed. Do not disturb the ground with rakes or leaf blowers. Harvest mushrooms by cutting, twisting/plucking, or with the use of tools no greater than one inch blade width. Clean up all trash and litter.

As far as where to go, many of the best edibles are found in Utah's mountainous spruce/pine forests. For the most part, a permit is not required for personal collection on state and federal lands, but be sure to learn the regulations. A few prized delicacies and dangers are shown below, but there are dozens more species that are edible or have amazing photographic beauty.

CHANTERELLE (*Cantharellus cibarius*)

Chanterelle's rich gold color make them easy to spot. They are funnel-shaped, with a smooth cap, and have gills that extend to the stem. They grow in small clusters in mountainous coniferous forests, or among grasses and mosses. They have a unique peppery, peachy flavor.

SHAGGY MANE (*Coprinus comatus*)

This edible mushroom is easy to identify. It grows either singly or in clusters and has a bullet-shaped, slightly shaggy cap and a smooth stem. They can be found in grass, wood chips, among rocks, or in hard-packed soil. Their flavor is pleasant yet mild. The only drawback with these mushrooms is that they don't last long. Once they start turning inky-black (within a few hours of picking), they are not good to eat.

PUFFBALL (many species)

The word "puffball" may bring to mind your cherished (chunky) pet, or it may bring up childhood memories of stomping on dried, round structures on the

Turf Overseeding, continued from previous page

ground to stir up a cloud of brown dust (spores). You may be surprised to know that when puffballs are young, they are a great delicacy. Newly emerged puffballs are pure white, round, and without a stem. The interior flesh is the consistency of cream cheese and had an intense, earthy flavor. They can be found in decomposing soils, meadows, or on wood.

AMANITA (many species)

One of the most well-known poisonous mushrooms are Amanitas. There are many species, each with varying degrees of toxicity. The highly toxic *Amanita phalloides* (with a bright red cap) can cause death within 6 to 18 days after ingestion. In Utah, we most commonly see *Amanita muscaria*, which is more of a narcotic. Amanitas have 6-inch-wide caps, often sticky to the touch, in shades of yellow, brown, red, or cream-green. The cap has white gills and grows on a stalk about 5 inches tall with a white cup at its base.

-Marion Murray, IPM Project Leader

How to Make a Spore Print

Individual mushroom spores are microscopic, but the color of a collection of spores is a useful identifying feature. The resulting print can also make a lovely art piece.






1. Remove the mushroom stem and place the cap on top of a white (or black) sheet of paper (or on glass), and cover to prevent air currents. Leave overnight.

2. Carefully lift the cap straight up. The resulting spore print will reflect the pattern of the mushroom's gills or pores, since the spores fall directly downward.

3. If glass was used, lay it over white or black paper to view the spores.

4. If the spore print is for mushroom identification, determine the spore color and use books and keys to identify.

5. For an art piece, preserve it with two to three coats of spray fixative. One low-toxic option is hair spray. Spray the print carefully, as it may blow the spores away.

6. Keep in mind that getting good prints will take trial and error. Some mushrooms may be too mature or others may not be ready to release spores.

In the National News

SOIL BACTERIAL MIXTURE PROTECTS PLANTS

Many soil micro-organisms, including certain bacterial species, form symbiotic relationships with plant roots, improving the plant's supply of water and nutrients. Recently, scientists at the Max Planck Institute for Chemical Ecology have found that soil bacteria play a greater role. In a research field site in Utah, where *Nicotiana attenuata* had been planted into the same soil for over 15 years, 50% plants were dying from a sudden wilt disease in the latter years. In that same field, the wild individuals of this western U.S. native tobacco plant were unaffected. Researchers decided to isolate the bacteria on the roots of the healthy plants. They then inoculated test plants with the bacteria and found that those given a mix of three or more species were significantly healthier as compared to the fungicide treatment or inoculation with just one or two bacterial strains. The results of the study emphasize the importance of crop rotation to prevent the buildup of soil borne diseases.

STINK BUG SOLUTIONS FOR CORN GROWERS

Entomologists at the University of Delaware have been investigating the biology of brown marmorated stink bug on sweet corn, in particular, the economic threshold and optimal time to treat. They placed mesh bags over developing ears of corn and added stink bugs to the bags in different densities for 7 days. They found that stink bugs are capable of causing substantial economic losses at levels as low as one bug per ear of corn, and that the greatest potential for yield loss happened when infestations occurred during the milk stage of ear development. The study, published in *Journal of Economic Entomology*, will next determine the most effective time periods to apply pesticides.

CATERPILLAR MANIPULATES PLANT DEFENSES

There are many signals that pass between insect pests and plants and their mechanisms are slowly being discovered. Chemical ecologists at Penn State investigated the chemical compounds in the frass of fall armyworm to determine if any of them signal the plant to either enhance or turn off defenses. They found that the frass "tricks" the plant into sensing that it is being attacked by a fungal pathogen. Because plants cannot defend against pathogens and insects simultaneously, the frass essentially turns on the pathogen defense, and turns off the herbivory defense. The research, recently published in *Journal of Chemical Ecology*, may lead to the isolation of specific components of insect frass that can be incorporated into an organic compound to be sprayed on crops.

BATS' VALUE IN PEST MANAGEMENT

Bats are voracious predators of insects, including many crop pest species. Their ecological and economic impact in corn was recently published in *Proceedings of the National Academy of Sciences* by scientists from Southern Illinois University Carbondale. They compared the effects of bats on open versus "exclosed" corn fields, with all other factors—pests and other predators, including birds—remaining equal. The corn in the exclosures had 60% more corn earworm larvae than the corn exposed to bats. Based on this difference, the authors estimate that bats provide a service to corn farmers worth about $1 billion globally.

IRRADIATION FOR EXPORT PRODUCTS

Over the last 20 years, USDA Agricultural Research Service scientist Peter Follet has developed and expanded the use of post-harvest ionizing radiation to remove insects from export crops, in particular, those grown in Hawaii. Recently, his team has developed protocols for western flower thrips, European grapevine moth, and spotted wing drosophila. They are also working to design a compact irradiator cabinet for use by small packing houses. Irradiation, which replaces the harmful fumigation practices of the past, has been found by the EPA to have no adverse effects on human health.

NEW HOPE TO PREVENT PIERCE'S DISEASE

Pierce's disease is a deadly bacterial wilt disease of grapes. It is spread by the glassy-winged sharpshooter that is difficult to control with insecticides. Plant pathologists at Texas A&M have identified a mix of four bacteriophages (viruses that attack bacteria) that will attack the pathogen. They found that the mixture, when sprayed on the plants, worked both to prevent infection of the grapevines and to stop the disease when infection had begun. This biocontrol technique is currently being field-tested in Texas.

MITES CAN REVEAL WATER QUALITY

Nearly every freshwater aquatic ecosystem contains varying levels of water mites and insects. The poorly understood water mites are predators of aquatic invertebrates, and many researchers believe they could be excellent indicators of water quality. The problem is that no protocols currently exist for water mite sampling or testing. Scientists are just now starting to describe these unknown mite species so that testing methods can be developed in the future. Measuring water quality by the population of water mites and other insects will not only be more cost effective, but also provide a more complete picture of the water body's overall health than a chemical testing.

continued on next page

Featured Picture of the Quarter

Alfalfa mosaic virus can attack tomato or pepper plants grown near alfalfa. It is rare to see this disease on tomatoes in Utah. The virus is transmitted by aphids, and can cause symptoms on foliage and the fruit. The tomato fruit becomes bumpy with purple-brown necrotic spots that go deep into the flesh. On leaves, the tiny necrotic (dead) spots could be mistaken for other diseases.

-Image by Claudia Nischwitz, Plant Pathologist

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GLYPHOSATE UNDER FIRE

The California EPA's Office of Environmental Health Hazard Assessment has recently announced a notice that it intends to list glyphosate (a phosphanoglycine herbicide) and three other chemicals as cancer-causing, and is seeking public comment. The action falls under Proposition 65, a measure that requires the state to publish a list of chemicals known to cause cancer, birth defects, or other reproductive harm. The intent to list glyphosate is based on a scientific review panel's sufficient evidence of carcinogenicity in experimental animals, including studies from the World Health Organization. Glyphosate, an ingredient in RoundUp and other generics, is the most widely used herbicide in the world. Adding it to the list would mean that businesses will be required to provide a "clear and reasonable" health warning on glyphosate products.

USING ANTS IN IPM

Ants can be found on every continent except Antarctica, making them the world's most successful terrestrial organism. Many species feed on other insects, and their social behavior allows for excellent pest control. In a recently published review of more than 70 studies of ant-pest interactions, Aarhus University's Dr. Joachim Offenberg concluded that on many tropical crops, ants can be more effective than chemicals for controlling pests. In one example, using ants on cashews resulted in 49% higher yields and 71% higher profits. Offenberg believes that someday, ants could also be used on a wide variety of temperate and tropical crops and forest plants.

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