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UTAH PESTS QUARTERLY

NEWSLETTER

Utah Plant Pest Diagnostic Laboratory

USU Extension

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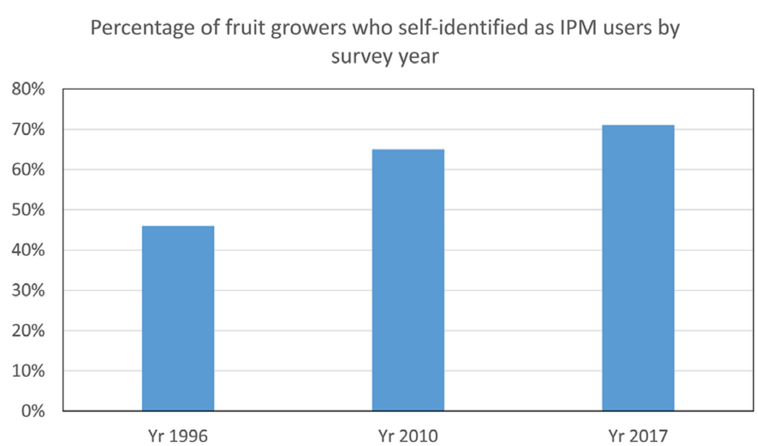
EXTENSION
UtahStateUniversity

20+ Years of Tree Fruit IPM Impacts in Utah

The USU Extension Tree Fruit Integrated Pest Management (IPM) Program has been in existence for over 30 years. Periodic grower surveys provide assessment of IPM use, grower perceptions and needs, and impacts. Our first comprehensive survey in 1996 resulted in a journal article (Alston and Reding 1998). Two additional surveys of the industry were conducted in 2010 and 2017. It is informative to the Utah IPM Program to assess trends and changes in over time.

There has been substantial growth in the proportion of tree fruit growers who self-identify as IPM-users: 46% in 1996, 65% in 2010, and 71% in 2017. In 2017, 48% of growers classified themselves as low-level users of IPM (a set of basic IPM practices including regular pest monitoring, use of thresholds, and pesticide rotation). Medium-level IPM users made up 31% of the growers (low-level plus at least two more practices, such as pheromone traps, mating disruption, nutrient testing, irrigation monitoring, beneficial identification, and plant habitat for beneficial insects), and 21% considered themselves high-level IPM-users (low-level plus at least four additional practices). The most-used IPM practices were visual monitoring (81%), pruning out diseases (77%), identification of beneficial insects and mites (60%), resistant rootstocks and traps for pest monitoring (54%), and avoid disturbing mites in ground cover and habitat plantings to promote beneficial insects and mites (52%). The Utah IPM Program is proud to have helped growers make significant strides forward along the IPM continuum.



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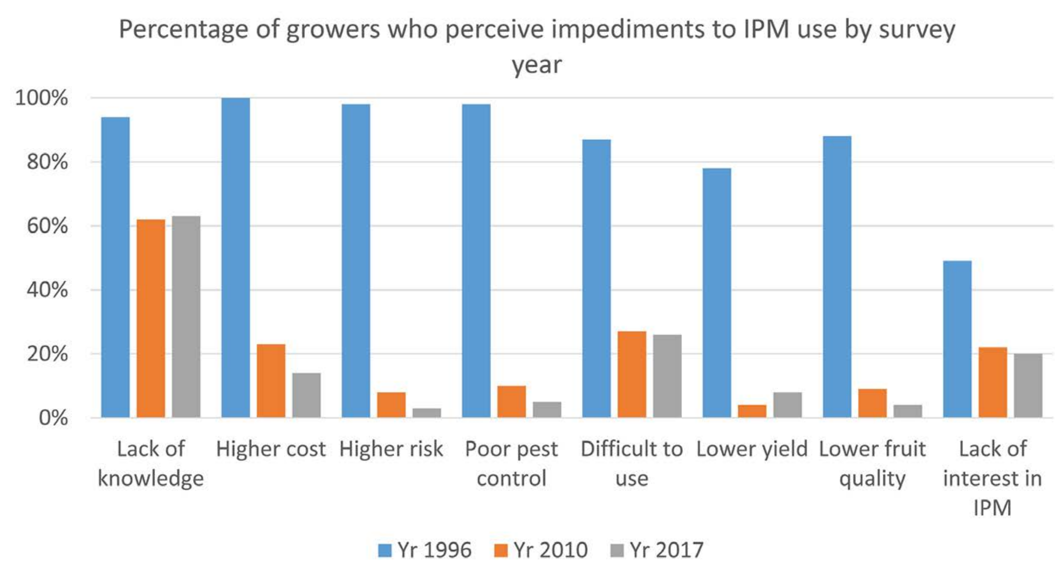
When asked about pesticide use changes in the last five years, the proportion of farms with decreased and unchanged pesticide use was greater in 2017 than 2010 across all fruit crops. In 2010, pesticide use increased on 22-35% of fruit farms; whereas in 2017, use increased on only 7-13% of farms. Utah has not yet experienced severe disruption of IPM programs by invasive fruit pests, such as spotted wing drosophila and brown marmorated stink bug, seen in other fruit production regions. Although both pests occur in the state, IPM programs based on mating disruption and primary reliance on narrow-spectrum insecticides for targeted pests (codling moth, peach twig borer, and cherry fruit fly) are still in practice.

Proportion of Survey Respondents Who Reported a Change in Pesticide Use

	2010 Survey		2017 Survey	
Tree Fruit Crop	Decreased and Unchanged	Increased	Decreased and Unchanged	Increased
Apple	78%	22%	87%	13%
Peach	78	22	89	12
Sweet Cherry	66	34	93	7
Tart Cherry	65	35	91	9

Growers' perceived impediments to using IPM have dramatically decreased since 1996. Especially notable are the tremendous declines in concerns about higher cost, higher risk, poor pest control, lower yield, and lower fruit quality with IPM programs. The greatest impediments remaining are lack of knowledge and training, difficulties in using IPM practices, and a lack of interest in IPM (although this latter impediment was only 20% in 2017). These results provide evidence of effective education and training; however, further improvements can still be made.



In addition to rising concerns about disruption of IPM programs from invasive pests, a major concern for Utah's tree fruit industry is encroaching urbanization (see graph on next page). The proportion of land adjacent to commercial tree fruit farms with urbanization has increased over time. In 2017, 39% of farms reported that land adjacent to their farm was more than 75% developed with homes and/or businesses present (up from 32% in 2010), and only 39% of farms had less than 25% of land development adjacent to their farm (down from 46% in 2010). If Utah's commercial tree fruit industry is to remain viable into the future, the state and local communities must invest in protecting agricultural lands.

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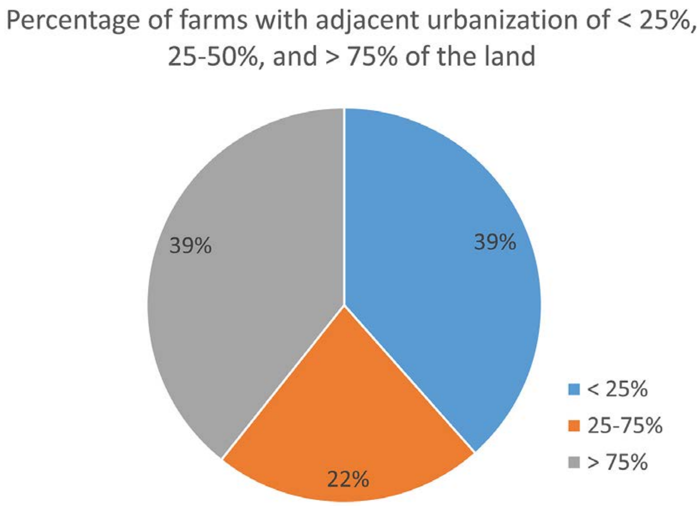

The size of fruit farms is declining, the majority (56%) are only 1-5 acres in size, and only 18% are > 50 acres in size. The percentage of the growers' income that comes from fruit production has also declined: only 25% of fruit growers garner > 75% of their income from the farm; the majority (63%) earn < 25% of their income from the farm.

The Utah IPM Program has made great strides in increasing the use of IPM, decreasing pesticide use, and removing perceived barriers to IPM. As farmer demographics and land use changes over time, Utah has moved to a greater proportion of small-acreage, urban-based farms, and fewer large-scale fruit farms. As Utah's population continues to increase along the Wasatch Front (a narrow corridor of land between the Rocky Mountains and Great Basin), the demand for local and high quality fruit production based on IPM practices will likely continue to increase. Through ongoing assessment, Utah's IPM Program is prepared to adapt to future changing needs.

———Diane Alston, Entomologist,
and Marion Murray, IPM Project leader

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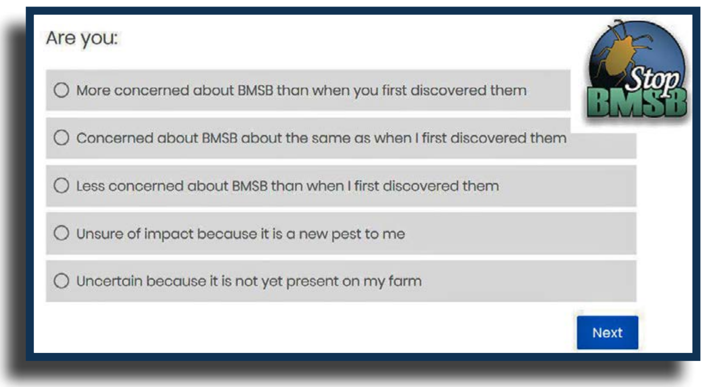
INVASIVE SPECIES SPOTLIGHT

Brown Marmorated Stink Bug Management Survey

A nation-wide survey is currently underway to gather information from farmers and growers on the economic impact of the brown marmorated stink bug (BMSB) on agriculture. The objective of the survey is to better provide you with the help you need in managing this pest. We'd like to find out when BMSB became a problem for you, where you currently get information on how to control them, how much damage you have suffered, your use of and interest in various management practices, and your feelings about biological control methods and their potential for your operation. The results of the survey will be used by Extension programs across the United States to fine tune management advice for the BMSB and help prioritize research and outreach activities.

If you'd like to participate, the survey should take you about 20-25 minutes to complete. Your individual survey responses will be confidential and the data collected will only be reported in summaries. Your participation is voluntary and you can decide not to answer a given question if you choose.



The link to the online survey along with more information about the survey can be found on the StopBMSB.org website.

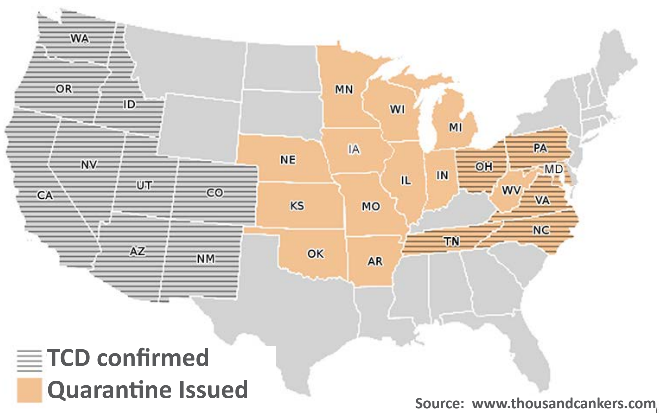
If you have any questions about the Brown Marmorated Stink Bug Management Survey for Commercial Producers, please contact Jayson Harper by e-mail at jkh4@psu.edu or call 814-863-8638.

Resistance to Thousand Cankers Disease

Elisa Lauritzen was recently awarded her M.S. degree in Biology at USU where she studied walnut tree resistance to thousand cankers disease under Dr. Claudia Nischwitz. This fall, she will start work toward her PhD at Penn State University under Dr. Beth Gugino, where she will continue her passion for Extension and plant pathology. We wish her the best of luck!

Thousand cankers disease (TCD) is a disease that is detrimental to black walnut (*Juglans nigra*). The disease is the result of the symbiotic relationship between the walnut twig beetle (WTB) vector, *Pityophthorus juglandis*, and the pathogenic fungus, *Geosmithia morbida*. The beetles burrow into the walnut bark along the trunk and branches to feed, lay eggs, and overwinter. Thousands of WTB can enter a tree, and at each pin-prick-sized entry point, they introduce the pathogen which colonizes the phloem and generates inky, dark brown to black cankers. Thousands of cankers will then expand and coalesce until nutrient and water flow is restricted, effectively girdling the tree. The disease name was derived from the overwhelming number of cankers that develop as a result of WTB attacks.

Distribution of Thousand Cankers Disease as of Aug. 1, 2017



The Insect and the Disease

The WTB is native to the Southwest and is thought to have co-evolved with the native Arizona walnut (*J. major*), which is not adversely affected by the WTB or *G. morbida*. The range expansion of the WTB, due to human activities and changes in climate, has affected the more susceptible *Juglans* species that exist across the U.S., with the greatest impact on the native black walnut and its hybrids. These trees succumb to the disease in 3 to 5 years, with younger trees often dying in a single growing season.

This exposed canker under walnut bark shows dark staining, where the phloem has been killed by *Geosmithia* around the beetle's tiny gallery.

Symptoms of the disease generally begin with yellowing of the leaves in a portion of the canopy, and then progress to defoliation, branch death, and tree death. Upon close inspection, tiny, round exit holes may be seen on the trunk or limbs, along with dark staining, which is evidence of the cankers.

Thousand cankers disease has been confirmed in 15 states and in parts of Northern Italy. As a result, quarantines of walnut wood products now exist in 18 states and active monitoring of the WTB is underway across the country. Post-harvest treatment of timber and vector management are currently the focus of several studies and include research on semiochemicals as repellents, attractants, and detractants (Chen & Seybold, 2014). Efficacy of insecticides, both contact and systemic, in controlling WTB attacks is unknown.

Investigations in Resistance

Little has been done to understand the relationship between the walnut tree and *G. morbida*. The implementation of naturally resistant trees is being used in the mitigation of several economically important diseases of trees including white pine blister rust, dothistroma, chestnut blight, and Dutch elm disease. The discovery and implementation of resistant trees is an important step in maintaining the black walnut as an intrinsic part of sensitive ecosystems and the economy.

Utah State University's Elisa Lauritzen investigated natural resistance to the disease on black walnuts for her M.S. thesis. A collection of black walnut and black walnut hybrids at USU's Cyril Reed Funk Research Farms in Richmond, UT and Dayton, ID was inoculated with *G. morbida* in early summer 2015, 2016, and 2017.

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Examples of walnut trees resistant to thousand cankers disease in Utah.

The phloem of trees that were inoculated and resistant only turned brown at the area of the inoculation, as shown in top image. Phloem on susceptible trees was easily killed by the *Geosmithia* inoculation (bottom).

The inoculation process consisted of selecting a single branch per test tree and removing two small sections of the bark (8 mm round wounds), approximately 15 cm apart. A control plug of ½-strength potato dextrose agar was placed in the wound closest to the trunk and a plug of *G. morbida* mycelium was placed in the wound furthest from the trunk. The wounds were then wrapped for the duration of the growing season. Inoculated branches were removed from the tree in mid-fall and evaluated for canker development and size. This branch inoculation protocol was repeated on the same trees each year of the project (average of 336 trees).

Lauritzen defined resistance in walnuts as having no canker development for at least two of the three years. Her project ultimately found 15 trees that exhibited this level of resistance. These results indicate that further resistance may exist within the Funk walnut collection and warrants the continued evaluation of these trees for use in future breeding programs for resistance to TCD.

In Utah, many of the large black walnuts have already been killed by this disease, and the concern is still real for the susceptibility of the remaining or newly planted Persian (English) and black walnut trees. If you have questions regarding TCD or WTB, contact your County Extension office, or the Utah Plant Pest Diagnostic Lab through utahpests.usu.edu/uppdl/contact for additional information.

——Elisa Lauritzen, M.S.

References and More Information

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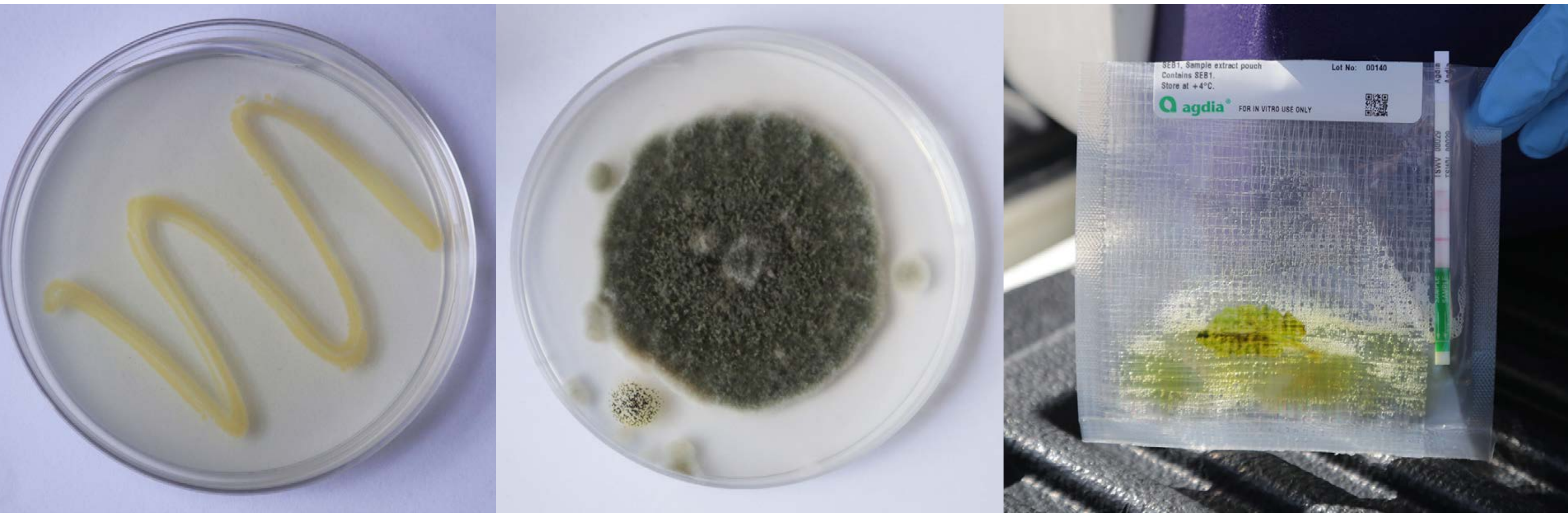
USU Extension Thousand Cankers Disease Fact Sheet.

Diagnosing Plant Diseases at the UPPDL



The Utah Plant Pest Diagnostic Lab uses a variety of techniques to identify a pathogen. Culturing is done by placing part of the diseased plant on nutrient agar (left and middle), while diagnostic kits are available for other pathogens (right).

What happens after you mail a plant sample with symptoms of a suspected disease to the Utah Plant Pest Diagnostic lab (UPPDL)? First, we check the sample in and notify relevant diagnostic team members. We then begin the diagnostic analysis with a visual inspection to narrow down possible causes. The photos and information about the plant and symptom development you provide help with this step. Finally, we determine the cause.

Bacterial Diseases

Identification of bacterial diseases depends on the plant species and symptoms. In some cases, bacteria will readily come out of cut tissue and we are able to use microscopy to see the bacteria streaming from the tissue and identify the species ($10 per sample). In other cases, for example, fire blight or bacterial soft rots, we have to culture the bacteria onto nutrient agar, and then run a DNA-based test for identification. This process takes between two days and two weeks, depending on the testing involved. Charges for bacterial identification per sample are $15 for culturing and $30 for molecular identification.

Fungal Diseases

Identification of fungal diseases also depends on the plant species and symptoms. Turf diseases are assessed by microscope alone ($10 per sample). The reason we do not culture turf pathogens is because they are very slow-growing on nutrient agar. It can take several weeks for them to even start growing. In the meantime, mold and other fungi also colonizing the roots will overrun the actual pathogen on the artificial medium. Turf pathogens frequently have structures (spores, resting structures, etc.) that develop in the roots or on the foliage that we can see under the microscope and use for identification. We are usually able to make a turf diagnosis within a few days of sample arrival.

For fungal pathogens on other plants, we look for fungal structures on the plant tissue. This works well for powdery mildews, for example. Some fungi, including powdery mildews and downy mildew, cannot be cultured on artificial growth media. If we suspect downy mildew but do not see fungal structures, we incubate the plant in a moist chamber for a day or two to encourage fungal growth.

Fungi that readily grow on artificial media, such as *Alternaria* sp., *Fusarium* sp. or *Verticillium dahliae*, take about a week before identifiable structures like spores are produced in culture. Other *Verticillium* species that cause wilt in trees can sometimes take up to three months to start growing in culture, and in some cases, will not grow at all. Fungi from decaying wood can only be identified if they produce fruiting structures such as conks ("shelf" fungi) on the bark. Otherwise, we can only narrow it down to a generic identification of a wood decay pathogen.

Fungi can usually be identified by the morphological structures and do not requires DNA identification. Charges for fungal identification per sample is $15 for culturing and $30 if molecular identification is needed.

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Virus Identification

There are several methods used to identify viral diseases. For some viruses like Tomato spotted wilt virus and Tobacco mosaic virus, there is an antibody-based test called an ImmunoStrip. The ImmunoStrips are expensive, but will tell us if the sample is positive in just 30 minutes. These usually work well in highly symptomatic plants. For other viruses, we can use ELISA testing. It is also an antibody-based test but takes six to eight hours to complete. We can test for several viruses with this method including Potyvirus such as Watermelon mosaic virus. We try to keep the virus test kits (which expire in one year) in stock for the common plant viruses in Utah. If a virus is rare, we have the option to send the sample to a commercial lab if the client is willing to pay the cost, which is $100-200 per sample. Testing for viruses that can be done in our lab is $30 per sample. A third way to test for viruses such as curtoviruses that cause curly top is polymerase chain reaction and DNA sequencing.

———Claudia Nischwitz, Plant Pathologist

INVASIVE SPECIES UPDATES

Utah Imposes Firewood Quarantine

USU Extension and collaborators installed a highway billboard in Davis County, encouraging passers-by to 'Buy it where you burn it,' a campaign that targets campers and other outdoor adventurers to use local wood to avoid moving tree-killing pests.

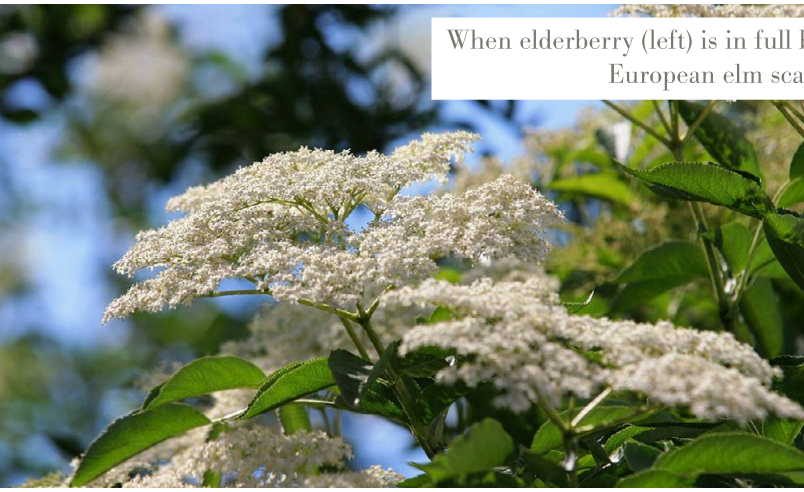
Invasive species are a growing threat to our nation's agricultural systems and natural resources. Some of the most common ways invasive species spread to new areas is in or on outdoor gear, personal and recreational vehicles, passenger baggage, and wood products, including firewood, pallets, and wood chips. For example, invasive pests, such as emerald ash borer (*Agrilus planipennis*), gypsy moth (*Lymantria dispar*), Asian longhorned beetle (*Anoplophora glabripennis*), spotted lanternfly (*Lycorma delicatula*), and velvet longhorned beetle (*Trichoferus campestris*) have been known to hitchhike to new locations on firewood. These pests can travel to new areas on their own, but usually only short distances. The movement of firewood allows these insects to be transported hundreds of miles; therefore, hastening their spread and destruction.

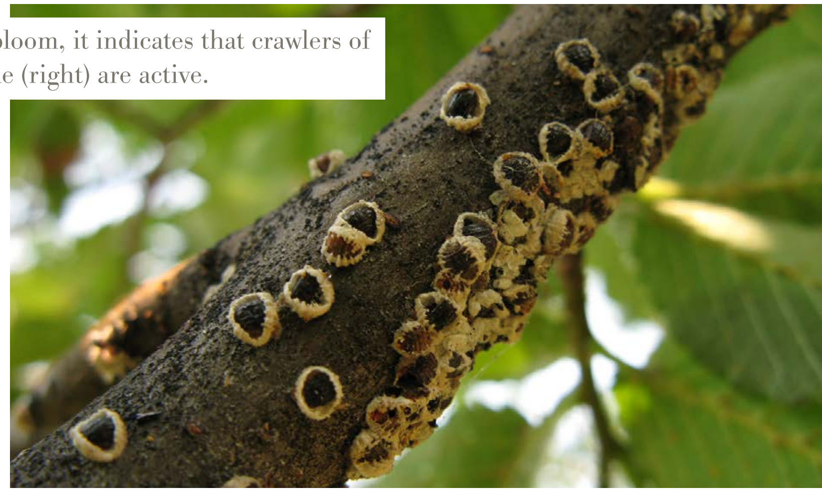
To help prevent the spread of forest pests, Utah State Department of Agriculture and Food enacted a firewood quarantine earlier this year. The Utah Firewood Quarantine restricts the movement of firewood from quarantined areas of the U.S. and Canada into the state without appropriate heat treatment and labeling. Firewood that has been heat-treated to 160°F at the core and maintained for 75 minutes, and is packaged with a USDA APHIS or state of origin compliance sticker may be moved across state lines. Note that some firewood bundles are labeled as kiln-dried and pest-free, but kiln-drying firewood is not considered to be as effective at killing pests as heat-treating firewood (see the article 'Kiln-Dried vs Heat-Treated Firewood' on the Don't Move Firewood website for more information).

The easiest way to comply with the quarantine is to buy local firewood. Do not transport firewood outside county boundaries to prevent inadvertently transporting tree-killing pests to non-infested areas. Call ahead to your camping destination for assistance in tracking down a local firewood dealer. Wood that looks healthy may still be harboring tiny insect eggs or fungal spores. Anyone who has moved firewood in Utah from a regulated area is urged to burn it immediately and safely. Further, learn about the invasive species that are in or near your area (visit Utah's CAPS website and Don't Move Firewood's Gallery of Pests to know which species to watch out for), and be aware of the signs and symptoms of those species. Contact the Utah Plant Pest Diagnostic Lab if you suspect a new invasive pest. Finally, tell your family and friends about the dangers associated with moving firewood and other wood products.

———Lori Spears, USU CAPS Coordinator

Indicator Plants for Pest Activity - Another IPM Tool





When elderberry (left) is in full bloom, it indicates that crawlers of European elm scale (right) are active.

When catalpa (left) is in full bloom, it indicates that crawlers of San Jose scale (right) are active.

For those in the green industry who manage pests, the best decision-making tool for applying a pesticide is regular pest monitoring. The downside is that making observations for each pest on each managed property can be time-consuming and difficult. With learning and practice, some pest activity can be predicted simply by observing the phenology of indicator trees and shrubs.

What is Phenology?

Phenology is the study of the synchronization of developmental stages of organisms (such as plants and insects) with the weather. Starting in spring, the timing of these events largely depends on daily maximum and minimum temperatures. Plant phenological events, such as bud break or bloom, are easy to see, and are correlated with accumulated heat. Insect activity, such as hatching of eggs, are also associated with accumulated heat, but are more difficult to observe. Because both events correspond to accumulated heat, the plant's event can be used to predict the insect's event, and thus determine when the pest may be most susceptible to effective management tactics.

Plants that are used for phenological observations are called indicator plants. Some indicator plants such as lilac are commonly planted and easy to spot, whereas others could be incorporated into the client's landscape or even on a piece of land at your business or elsewhere.

Good indicator plants should be common to a wide geographical area, hardy, easy to recognize, and easy to grow. They should have short, well-defined bloom periods, with blooms and fruits that are recognizable from a distance.

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Examples of Indicator Plant Stages, and their Corresponding Pests

Plant	Stage	Pest Activity to Treat
Horsechestnut (*Aesculus hippocastanum*)	bloom	pine needle scale – newly hatched crawlers
Norway maple (*Acer platanoides*)	late bloom / leafing out	honeylocust pod gall midge – adults laying eggs
Serviceberry (*Amelanchier spp.*)	bloom	fall cankerworm – hatch and larval activity
Catalpa (*C. speciosa*) or Japanese tree lilac (*Syringa reticulata*)	full to late bloom	San Jose scale – crawlers are active
Flowering quince (*Chaenomeles speciosa*)	beginning bloom	ash plant bug – vulnerable to insecticide sprays
Beautybush (*Kolkwitzia amabilis*)	blooming	flatheaded apple-tree borer – adults laying eggs on bark
Wild cherry (*Prunus serotina*)	bloom	oystershell scale – crawlers active
Elderberry (*Sambucus canadensis*)	blooming	European elm scale – crawlers active
Common lilac	late bloom	European pine sawfly – larvae hatching
Common lilac	late to post-bloom	lilac/ash borer – adults start laying eggs

As mentioned on the prior page, plant and insect activity can be predicted based on a measure of accumulated heat. This measurement is called growing degree days, and for landscape pests, is calculated starting on March 1, using daily maximum and minimum temperatures. Most insect activity occurs above 50°F, so growing degree days only accumulate above this temperature.

Plants as Indicators

A great resource to get started in predicting pest activity based on indicator plants was developed by Donald A. Orton of the Illinois Department of Agriculture, as described in his book, *Coincide: The Orton System of Pest Management.* This system pairs phenology and growing degree days. Researchers have been determining degree-day values associated with life stages of many species of pests and stages of development of various indicator plants. This book describes the indicator plant stages for 64 insect pests and 38 plant diseases. Most are applicable to the eastern half of the U.S., but many occur in the Intermountain West, as well. Other resources for types of indicator plants are provided below.

——— Marion Murray, IPM Project Leader

Other Resources:

OMAF Publication 841, Guide to Nursery and Landscape Plant Production and IPM.

University of Maryland Pest Predictive Calendar.

Using Degree-Days and Plant Phenology to Predict Pest Activity (Dan Herms).

Using Degree Days to Time Treatments for Insect Pests.

Utah TRAPs: Select your location, and in the right-side box, select "Landscape Plants" under the "Pest" drop-down.

Turf Billbug Management - Timing It Right

Turfgrass is affected by several insects, but of specific concern in the Intermountain West are billbugs. Research at USU has found that three billbug species occur in the region including bluegrass, hunting, and the Rocky Mountain billbug, with the two former species being most abundant. Larval damage of turf resembles spots of drought-stress, yet we find that drought-stressed turf also appears to be attractive to billbug populations.

The primary management of billbugs consists of preventive applications of systemic neonicotinoid or anthranilic diamide insecticides targeting larval stages early in the spring. Curative or contact insecticides also exist that target the overwintering adults in the spring or established larvae in summer. One of the challenges turf managers face is determining effective timing of insecticides, partly because billbugs are mostly hidden (eggs in stems and larvae below-ground) for the majority of their life cycle and only diagnosed when turf damage is apparent.

In a recent article in the *Journal of Economic Entomology*, Dr. Madeleine Dupuy, former USU biology graduate student, tracked the life stages of billbugs to develop a degree-day model to predict billbug activity. Using local maximum and minimum temperatures, a degree-day equation for Utah and Idaho billbug activity was created

The billbug species complex in Utah can be distinguished by a few characteristics, with the adult bluegrass billbug being the smallest with even dimples throughout its thorax, hunting billbug having a "Y" within "( )" pattern on the thorax, and the Rocky Mountain billbug being the largest (10 mm) with deer hoof-like prints on the hardened forewings.

Billbug larvae initially feed within turf stems but then transition to feeding on the roots in soil. Using the tug test can reveal smaller larvae tucked within a stem or larger larvae within the soil.

to calculate degree-days (heat units) that correspond to adult activity. Dr. Dupuy's model calculates temperature readings from weather stations beginning January 13 when temperatures reach above 37.4°F. The model is available on the Utah TRAPs website for those close to one of the supported weather stations in Utah. (Those outside of Utah but in the region can also use the average method of degree-day calculation with January 13 and 37.4°F.) Using this model, practitioners can take the guesswork out of timing management by knowing when billbug populations are active.

Dr. Dupuy followed this work by determining whether recommendations used in the eastern U.S. can be adapted in the Intermountain West. In the eastern U.S., insecticide treatments are timed when 30% and 50% of adult billbug populations are present for preventive and curative applications, respectively. Using the newly adapted degree-day model, a turf manager can predict 30% and 50% of adult billbug activity, but it was not clear whether these management timings would be successful in our region.

Dr. Dupuy tested the model by conducting insecticide spray trials using these management recommendations and evaluated spray application timings by a pesticide applicator. Her trials and that of a turf manager colleague show that these recommendations (treatments around 30% and 50% adult billbug activity which corresponds to an

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accumulation of 986 and 1433 degree-days, respectively) can be adopted in the Intermountain West for billbug management.

Pairing the degree-day model with monitoring tools, like a pitfall trap for adults and use of the tug test for damaging larval stages in soil, can assist with confidently knowing when to manage billbugs. The Utah TRAPs site also provides easy access to the model and provides icons highlighting when 30% and 50% of billbug adult activity are predicted to occur. It is clear that a challenge is fitting treatments for all clientele within the window of susceptible billbug timing. Recognizing that efficacy may decrease as applications deviate from these timings is important. Fine-tuning this model will require feedback from turf managers across the region and we welcome involvement from any turf professionals looking to provide data and input on their success in billbug suppression.

———Ricardo Ramirez, Entomologist

References:

Dupuy, M. and R.A. Ramirez. 2016. Biology and management of billbugs in turfgrass. Journal of Integrated Pest Management 7:6; 1-10

Dupuy, M., J. Powell, and R.A. Ramirez. 2017. Developing a degree-day model to predict billbug seasonal activity in Utah and Idaho turfgrass. Journal of Economic Entomology

Murray, M.S. 2008. Using degree-days to time treatments for insect pests. Utah State University Extension Publication IPM-05-08

Skeletonizers in the Closet

In late June and early July, the UPPDL received numerous email inquiries that included images of skeletonized river birch leaves from many northern Utah locations. Since we had no physical pest specimens, our initial research revealed three leaf beetle species as possible culprits, including the alder flea beetle (*Altica ambiens*, syn. *Macrohaltica ambiens*), alder leaf beetle (*Agelastica alni*) and the birch leaf beetle (*Pyrrhalta hundsonia*).

The birch leaf beetle was ruled out due to its more northern distribution and a life cycle that did not match what was being observed in Utah (Lindquist and Davis, 1971). The alder leaf beetle was a very close match and has been recorded feeding on various species from the Betulaceae family (birch, alder, hazel, hornbeam) and *Tilia* (linden, basswood), *Salix* (willow), and *Populus* (poplars) spp. The alder flea beetle was also a close match, but we could not find records of it feeding on any host other than alder.

Eventually, we were able to acquire larval specimens for DNA analysis. Unfortunately, this testing only narrowed down the identification to genus - *Altica*. Therefore, we can only assume that the pest is alder flea beetle. For confirmation, we will acquire a known alder flea beetle specimen, and compare its DNA to our own collected specimens.

The alder flea beetle is a small, metallic green to dark blue beetle (~ 1/5 inch). Mature larvae are slightly longer than adults (up to ¼ inch), have shiny black heads and

Reports of leaf beetle feeding have been rampant in spring-summer 2018. The alder flea beetle larvae skeletonize foliage with their voracious appetite.

thorax, and are predominantly black to dark brown on the back and yellowish on the underside.

Adult beetles will chew holes in foliage while the larvae feed gregariously on top of the leaves, leaving only the veins behind (skeletonizing). Adults and larvae tend to start feeding at the bottom of the tree canopy first, and work their way higher up the tree.

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Adult alder flea beetles chew holes in foliage.

There is only one generation of alder flea beetle per year. Adults overwinter in debris and other secluded places around host trees and emerge in spring to feed. Adults will mate and females lay clusters of yellow eggs on leaves. The larvae will feed together on top of leaves, and begin to pupate in July and August in Utah (depending on season and location). Adults will emerge in July and August and continue to feed on foliage until they go into hiding for winter.

Damage from the alder flea beetle looks severe, but it should be considered an aesthetic issue. As with other skeletonizing and defoliating insects, trees can recover from damage. Repeated loss of leaf area can cause tree stress and decline, however this occurrence is rare with alder flea beetle, especially on birch. Affected trees should be kept healthy via proper watering and maintenance.

Adult alder leaf beetle resting soon after emergence from overwintering.

If an insecticide application is desired to reduce aesthetic damage or to manage outbreaks, it should be appropriately timed. Monitor for adult beetle activity in spring after leaves have expanded to determine if there is a large population. A foliar application can be directed at the larvae later in the season, and options include pyrethroids, spinosad, or azadirachtin. Alternatively, a systemic insecticide (i.e., imidacloprid) can be applied to the soil around the base of the tree right after budbreak (and if adult activity is observed). This allows the product time (~ 4 weeks) to move into the foliar sap, killing larvae (and adults) as they feed. (Note that river birches and alder are wind-pollinated, and therefore a systemic insecticide will not harm pollinating insects.)

Alder flea beetles are part of a larger group of beetles called the leaf beetles (Chrysomelidae). There are many common leaf beetle pests in Utah including the elm leaf beetle (*Xanthogaleruca luteola*), cottonwood leaf beetle (*Chrysomela scripta*), sumac flea beetle (*Blepharida rhois*), western corn rootworm (*Diabrotica virgifera*), cereal leaf beetle (*Oulema melanopus*), western black flea beetle (*Phyllotreta pusilla*), and the list goes on. If you suspect that a leaf beetle is causing plant damage, submit a picture or sample to the UPPDL and we'll help you figure out what it is and how to manage it.

——— Ryan Davis, Arthropod Diagnostician

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IPM In The News

Dogs to the Rescue for Avocado Trees

Dogs can detect odor concentrations at minute rates of 1 to 2 parts per trillion. They are commonly used in law enforcement to locate missing persons, explosives, drugs, weapons, and ammunition. Recently, their skills have been put to use in detecting Invasives, including spotted knapweed, brown tree snakes, and the emerald ash borer. Florida International University scientists put canine detection to the test to see if dogs can identify the lethal laurel wilt disease, which has the potential to severely disrupt the avocado industry. The disease has already resulted in the death of 300 million laurel trees in the United States alone. Once external symptoms are evident, the pathogen likely has already spread to adjacent trees via root grafting, so early detection and tree removal is key for the avocado industry. The Florida study, published in *HortTechnology*, found that out of 229 dog trials, only 12 yielded false alerts. The authors provided proof that dogs can be a powerful management tool if the disease is caught in its earliest stages. They say that "man's best friend may help save an industry."

Insect Deterrent from Tobacco Plants

Scientists from the Technical University of Munich developed a biodegradable agent that works to repel insects. The agent is derived from cembratrienol (CBTol), produced in tobacco leaves. They first isolated the sections of the tobacco plant genome responsible for the formation of the CBTol molecules. They then built these into the genome of coli bacteria, grew bacterial colonies in wheat bran, and then separated the active ingredients from the nutrient solution using centrifugal separation chromatography. Initial investigations indicate that the CBTol spray is non-toxic to insects, yet still protects against pests such as aphids. They also found that its antibacterial effect on gram-positive bacteria disinfects against *Staphylococcus aureus* (MRSA pathogen), *Streptococcus pneumoniae* (pneumonia pathogen), and *Listeria monocytogenes* (listeriosis pathogen).

Will Pests Outrun Us?

The list of weeds, insects, and plant pathogens developing resistant to pesticides is growing, threatening our ability to manage these pests. In fact, certain weed species have evolved resistance to every class of herbicide in use, and more than 550 arthropods have resistance to at least one pesticide. This has resulted in a pesticide treadmill that exacts an annual toll of some $10 billion. In a *Science* review paper, North Carolina State University scientists recommend that policymakers should provide resources for studies that would test the efficacy of a particular pesticide resistance strategy in one large area -- thousands of acres or more -- and how weeds and crop yields compare to similarly large control areas that don't utilize that particular strategy. They suggest that farmers could receive incentives to participate in these studies.

Virus Inhibits Plant Defenses

In nature, a significant percentage of caterpillars are parasitized by wasps. In addition, tens of thousands of wasp species harbor a type of virus called polydnaviruses (PDV) in the female ovaries. The PDV suppresses the immune system of the caterpillar host for the benefit of the larval wasp's survival. Now researchers at Penn State University report in the *Proceedings of the National Academy of Sciences* that the PDV in wasps also suppress the defense mechanisms of the plants on which the caterpillars feed, which ensures that the caterpillars will continue to be available as a food source for the wasps. The research team placed parasitized and non-parasitized caterpillars onto tomato plants. After allowing the caterpillars to feed on the plants for 10 hours, they used molecular and biochemical techniques to show that parasitized caterpillars induced significantly lower enzyme activity and defense-gene expression among the tomato plants than the non-parasitized caterpillars. The reason for this was the reduced formation of glucose oxidase in the saliva of caterpillars, which normally elicits plant defenses. The Penn State team plans to examine whether other parasitic wasps and viruses that can parasitize a much broader range of caterpillar species also can suppress plant defenses in a similar capacity.

Neonicotinoid Insecticides and Non-Target Insects

Neonicotinoids are versatile insecticides and are the most widely-used insecticide class in the world. The downside is that they may be contributing to population declines of pollinators and other insects. A team of researchers from the University of Missouri College of Agriculture, Food, and Natural Resources is looking at the role neonicotinoids play in the performance of non-target insects. They conducted a meta-analysis of nearly 2,000 published papers, looking at five measures -- abundance, behavior, condition, reproductive success and survival, and published their findings in the journal *Ecological Applications*. They found that in spite of some of the papers having mixed conclusions, when taken across all studies, their analyses showed similar

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negative effects to the performance measures being evaluated. The broad consensus was that neonicotinoid insecticides were showing a strong negative trend not just on pollinators, but on detritivores and predator insects. The researchers report that this is the beginning stage of a large-scale experimental project they will conduct in the field to evaluate the impact of using these insecticides on public lands.

Combating Pesticide Resistance by Targeting Insect Gut Microbes

A new review paper published in the *Annals of the Entomological Society of America* by Apex Bait Technologies Inc. of California, reports on the connection between microbes that live inside an insect and the insect's ability to evolve resistance to pesticides. The authors' objective is to identify patterns and find ways to combat pesticide resistance. They reviewed several dozen studies, where some studies showed that the insects' gut microbial community was not responsible for pesticide resistance, while others showed that certain microbes do play a large role conferring resistance by breaking down or binding to the pesticide toxin and rendering it ineffective. The review paper has spurred the Apex research group to pursue a study on German cockroaches to figure out how exposure to insecticides might alter microbial growth.

Removing Pesticide Residues inside Honey Bees

Over time, minute amounts of pesticides from pollen accumulate in a honey bee's body, reducing the lifespan of each bee in a colony. Researchers at Washington State University are testing a new material they have developed that, when ingested, can potentially remove pesticide residue inside bees. The product is a micro-powder substance that can be incorporated into a sugar solution fed to bee colonies. The researchers have found that the substance does not harm bees, and it does not absorb amino acids or anything a honey bee eats other than pesticides. They estimate that each micro-particle could attract and absorb about 300 nanograms of pesticide residue, and they will test this theory in the coming months. As a comparison, a grain of salt weighs 58,500 nanograms, and 15 nanograms of a certain pesticide may kill a bee. They hope to have the product on the market in the next two years.

New Insights into Pierce's Disease

Pierce's disease of grapes, caused by the bacterium *Xylella fastidiosa*, kills grapevines in three to five years, and has so far cost California producers more than $100 million in losses. The disease is vectored by the invasive glassy-winged sharpshooter, and it has become more of an issue in recent years. In a new study, published in *Frontiers in Plant Science*, researchers at the University of California, Davis have identified a set of molecular markers that influence the onset of Pierce's disease in grapevines. More than 200 plant species harbor the bacterium but are asymptomatic, and having identified the molecular markers, researchers can use them for early detection, to develop resistant grapevine varieties, or to understand why the other plants do not develop disease.

New Publications, Videos, Books, and Websites

- Results of research from Michigan State University and their collaborators in managing spotted wing drosophila have been combined in the publication, Management Recommendations for Spotted Wing Drosophila in Organic Berry Crops. The guide provides a list of recommendations that organic or conventional growers should consider, including monitoring techniques, preventive strategies, and cultural and chemical management options.

- Michigan State University is offering a new online course called Pollinator Champions. The course provides research-based information about pollinators, pollinator decline, and conservation efforts.

- The IR-4 Project at Rutgers University recently launched the Plant Search page on their Protecting Bees website. Users can search for pollinator-attractive plants by zip code, bloom period, sun/light requirements, and/or pollinator attractiveness. The results provide descriptions and pictures, the option to compare pollinator information, and can be downloaded as a printable list.

- Researchers from Columbia University, the University of Wisconsin – Madison, and the Centers for Disease Control have created the Tick App as a citizen science project. The app allows users to report daily tick diaries and provides reminders to check for ticks.

Featured Picture of the Quarter

This giant ichneumon wasp (*Megarhyssa atrata*) appears quite imposing, but is actually a beneficial insect. The long "tail" is not a stinger, but the female's ovipositor (egg-laying structure). She is an ectoparasitoid, and larva feeds on the body of another insect larva. The adult wasps do not need to feed, but this one is getting a drink from a spittle bug.

The name is "giant" for a reason. The female, plus her ovipositor, can be as long as 5 inches. Why so long? The giant ichneumon specializes in parasitizing the wood-boring pigeon tremex, a horntail wasp that feeds inside decaying portions of trees, logs, and stumps. The female ichneumon uses scent or sound cues to find tremex larvae inside the tree. She'll spend an hour "drilling" her ovipositor through the bark and wood to lay a single egg on the tremex larva or in the larva's burrow. The hatched ichneumon larva then finds and consumes the tremex larva. The following spring, the ichneumon pupates within the tremex's burrow, and then emerges as an adult between June and September.

——— Photo by Marion Murray, IPM Project Leader

Grape leaf clipart, courtesy FCIT

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