



Spring 2018 /  
Vol. XII

# UTAH PESTS QUARTERLY

N E W S L E T T E R

Utah Plant Pest  
Diagnostic Laboratory

USU Extension

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## Is Biochar Worth it for Utah's Vegetable Producers?



Biochar is made by burning biomass at very high temperatures with low oxygen. The final product is high in carbon and is used as a soil amendment.

Biochar has been shown to have long-term benefits for the environment, in terms of sequestering carbon in the soil. But for intensive agricultural production, the short answer to this question is that biochar is not quite ready for wide-scale adoption. Some factors that need to be considered in applying biochar to the soil are initial soil health, the source and production method of the char, and the variable or unknown application rates. In some cases, crop yield may be marginally increased, but this benefit might not outweigh the cost of the biochar itself. Recent studies in the West, including one by USU Extension, have shown mixed results for certain biochar effects vegetable crops.

### What is Biochar?

Biochar is similar to charcoal, but instead, it is produced in a controlled environment. Biomass (the "feedstock") in the form of wood or crop residue, manure, paper mill waste, etc., is burned at a very high temperature (350 – 900°C) under low oxygen, in a process called pyrolysis. The resulting product is of varying particle size, comprising about 50-75% carbon.

### What are the Potential Advantages in Agriculture?

Most biochars have low nitrogen concentrations and thus any inherent fertilizer value is minimal and temporary. The recommendation is that biochar is applied to the soil just once, acting as a conditioner, and that nutrient amendments should also be applied yearly (if needed). Some research studies have found the following benefits of a one-time biochar application on agricultural soils (resulting in improved plant growth and crop yield):

- greater soil nutrient retention due to enhanced cation exchange capacity
- improved efficacy of fertilizers
- higher soil water retention
- increased soil pH
- increased soil aeration
- increased beneficial soil microorganisms
- greater earthworm populations due to improved soil conditions

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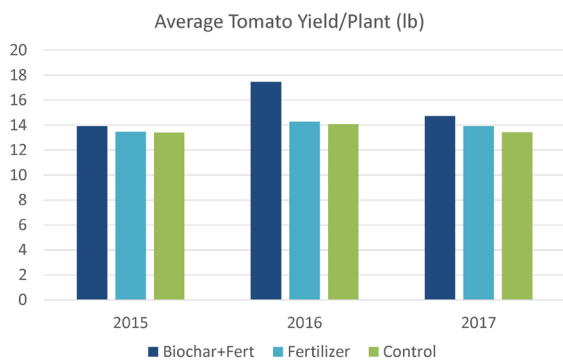
Biochar and fertilizer applied to a vegetable plot in Utah.

### What are the Limitations in Agriculture?

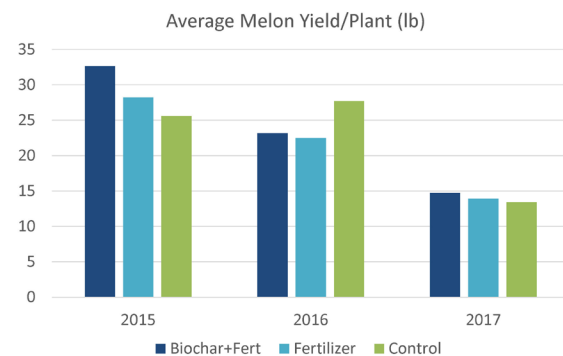
- *Initial soil health:* When biochar research started flourishing, results from tropical systems were very positive, and the excitement in biochar grew. However, those same benefits did not always translate to western U.S. temperate soils and crops. In fact, plants growing in soils that are already healthy may not benefit at all from a biochar application. As one example, a recent study published by the University of California-Davis showed that after three years, there were no long-term benefits in biochar application on a tomato-corn rotational cropping system (Griffen et al. 2016).
- *Source and production method:* Properties of biochar vary with both the feedstock from which it is produced and the method of production. And in turn, these different biochars will behave differently in soils. Although one type of char may show promise, another type may not. Because of this, people are realizing the importance of "classifying" different biochar types based on their properties and potential crop benefits.
- *Application rate:* In soil application, biochar is persistent, and may improve soil condition over time. But specific crop application rates have not been determined. Research studies of biochar in agriculture have used one-time rates ranging from 2 to 22 tons per acre. Higher rates appear to have a diminishing effect. The need for further clarity on optimizing biochar application for increased crop yields is necessary if it is to gain widespread adoption as a soil amendment.
- *Cost:* Today, purchasing commercially-prepared biochar for agriculture is not economically feasible. The cost ranges from \$400 to \$2,000 per ton (and \$100 – 300/cubic yard). Scaling the rate down for backyard gardens results in a slightly more acceptable cost, with bagged products ranging from about \$25 - \$40 per cubic foot (covering 100 - 350 square feet). As an alternative, some commercial growers are investigating on-site production of their own biochar:
  - [Learn to Make Charcoal at restorechar.org](#)
  - [Kiln Design Resources](#)

## USU Extension Biochar Study

Over a period of three years, USU Extension investigated whether biochar as a soil amendment would improve crop yield and root rot-resistance of tomato and melon. For **crop-yield comparisons**, biochar (from beetle-killed pine pyrolyzed at 375°C) was soil-applied in 2015 at a rate of 10 tons/acre at the USU Experimental Research Farm in Kaysville. Each year, we compared tomato and melon fruit yields after a season grown in either biochar+fertilizer, fertilizer, or no amendment. There was no statistical improvement in yield from the biochar + fertilizer application; however, there were trends in the results:



- For the tomatoes in all three years, both average dry weight per plant and yield was highest in the biochar plots, with the greatest increase for both measures in year two.



- For the melons, both the average dry weight per plant and yield was highest in the biochar plot in the first year, but the increase in yield did not continue. In year 2, dry weight was again highest again in the biochar plots, with yield second highest. By year 3, yield was lowest in the biochar plots, and dry weight was highest in the control plots, followed by the biochar plots.

The **root rot-resistance comparison** was conducted in a greenhouse where we grew tomato and melon transplants

in potting soil that was either amended or not amended with the same type of biochar (2% rate by volume). After approximately 6 weeks of growth, half the potted plants were each inoculated with 20 rice grains coated in mycelium of a mix of *Phytophthora capsici*, *P. nicotianae*, *P. cactorum*, and *P. megasperma*. Plants were then grown with normal irrigation and fertilization for an additional 8 weeks. Plants were then rated for disease, weighed, and roots were tested for *Phytophthora* with Agdia test kits. Disease was found on the inoculated plants in both soil types, and no disease was found on un-inoculated plants. This trial was repeated three times. We had hoped to see less incidence of disease on plants growing in the biochar soils, but instead, we found that:

- For both the melons and tomatoes that were inoculated with *Phytophthora*, there were no differences in the number of diseased plants, symptoms (based on individual plant ratings), or average dry plant weight, between the plants growing in biochar and non-biochar media.

Biochar is still a hot topic, as the number of biochar-related scholarly publications have increased nearly five-fold over the last five years. Indications suggest that biochar could play a role in improving sustainable agriculture. But the challenges of cost, variability in biochar types and application rates, and how this technique can work with other soil health practices such as no-till, cover cropping, manuring, and mulching, still need to be addressed. Certainly, improved recommendations for agriculture and landscape industries and residential sites are coming, but a few years down the road.

Land reclamation is an area of potential use for biochar that may be more productive than use in commercial agriculture. Research scientist Chris Peltz and USU Forestry Extension Associate Darren McAvoy are interested in using biochar as a tool for land reclamation in the Uinta Basin. Learn more about this [here](#).

—— Marion Murray, IPM Project Leader

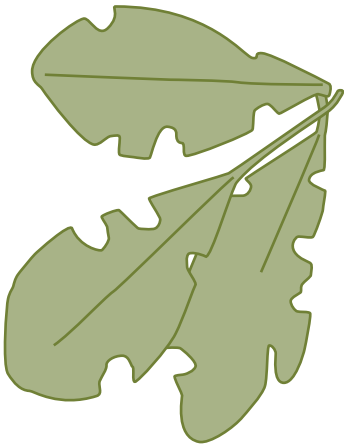
—— Cami Cannon, Vegetable IPM Associate

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The USU Extension biochar study was funded by a WSARE Producer & Professional grant.

# The Mystery of the Notched Leaves



By mid-summer, some ornamental and crop plants in Utah have foliage with oddly notched margins. But what causes this damage? The culprit is rarely noticed, but inside homes, the insect turns up quite frequently during the summer and fall months. The insect, or rather a group of related insects, is called a root weevil, and this group causes more damage than feeding on leaf edges.

Root weevils are small beetles. In Utah, they are most commonly in the genus *Otiorhynchus*. Interestingly, none of the 17 species found in North America are native, with introductions occurring from various regions of Europe, northern Africa, and northern Asia. The beetles range in length from about 1/4 to 1/3 inch. Coloration is variable, but the most-common Utah species are black with gold flecks or solid brown to black. As a member of the weevil family, these pests have a snout, but it is shortened and rectangular compared to other weevils that have long, skinny mouthparts. Members of *Otiorhynchus* have fused outer wings and do not fly. When they are startled, they will often drop to the ground to escape. During the day, root weevils hide around the base of plants in mulch or soil.



Adult black vine weevil.



Left: Lilac root weevil adult.

Right: Rough strawberry root weevil adult.

The most common species causing plant damage in Utah are the black vine weevil (*O. sulcatus*), lilac root weevil (*O. meridionalis*), strawberry weevil (*O. ovatus*), and the rough strawberry root weevil (*O. rugosostriatus*). These weevils feed on many plants (over 100 species).

One of the most frequently affected plants is lilac. Many lilacs in Utah exhibit the classic marginal leaf notching created during nocturnal feeding by the adults. A few other common host plants include strawberry, raspberry, privet, peony, spruce, rose, and peach. Leaf notching, however, is not the only issue caused by root weevils.



Left: Black vine weevil larva. All root weevil larvae look similar to this larva. Right: Strawberry root weevil adult.

The immature stage – a legless white larva with a brown head capsule – will feed on host roots, causing plant decline and sometimes, plant death. Larval root feeding is most severe prior to pupation in late May and June. Adults are also capable of feeding on buds and young shoots. The other issue with root weevils is that they can be a nuisance indoors, found crawling around, or dead, in homes and structures starting in mid-summer through fall. Indoors, they will not damage stored food products or harm people.

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Kent Loeffler, Cornell University, Bugwood

Peggy Creb, USDA Agricultural Research Service, Bugwood

Whitney Cranshaw, Colorado State University, Bugwood



Whitney Cranshaw, Colorado State University, Bugwood

Root weevil damage.

Root weevils have one generation per year. While some adults may overwinter, most root weevils overwinter as larvae in the soil around host plants. When soil temperatures warm in the spring, larval feeding resumes until they pupate in late May or early June. Adults emerge around mid-June and begin feeding on foliage. By late June and early July, females lay eggs in the soil around host plants, which will hatch into the larvae that eventually overwinter.

Management of root weevils can target the larval, pupal, or adult stage. Plants with marginal leaf notching the previous year will likely have damage the following year. If damage is expected, larvae can be targeted in April or May with a systemic insecticide (imidacloprid) applied within the plant-root zone as a soil drench (check label for restrictions on blooming plants). For a biological approach, target weevil larvae and pupae with beneficial nematodes (*Heterorhabditis* spp. or *Steinernema* spp.) in the spring when soil temperatures are at least 60°F, or in late June and early July when eggs begin to hatch. Nematodes should be applied early morning or evening to avoid high temperatures. Keep in mind that nematode efficacy may vary depending on the species used, the weevil species and developmental stage, soil moisture and temperature, handling, storage, and other factors. When applying either nematodes or systemics, ensure that the soil is moist – but not over-irrigated – prior to application and for at least 2 weeks post-application.

Adult weevils can also be targeted. To monitor for adults, begin looking for leaf notching in June. Adults can be found on the plant at night using a flashlight or during the day by searching the base of the plant in the vicinity of the stem. Pyrethroids applied to the foliage where adults feed and/or to the stem near the ground where weevils travel and hide during the day can effectively control adults. Always read the pesticide label and avoid foliar applications during bloom which can harm pollinators. On woody host plants, banding stems with Tanglefoot or a similar product, can keep adults from crawling into the canopy to feed. For this to work, plants must be pruned so no branches are touching the ground or other plants or objects which are not banded. Do not apply Tanglefoot directly to the bark or foliage; instead, apply it to a banding material (e.g. duct tape) wrapped around the stem. Plants should be banded prior to adult emergence in June (for northern Utah). Bands will need to be maintained as they become full, dirty or lose stickiness, and can be removed in the fall.

Indoors, adult weevils can be vacuumed or physically removed with other methods. Pesticides are not recommended for management of nuisance weevils within a structure. Exclusion and alteration of habitat around a structure, such as planting non-host plants and reducing moisture, can reduce weevil populations. Appropriately labeled pyrethroid insecticides can be applied to the foundation and ground in problem areas to reduce adult entry.

——— Ryan Davis, Arthropod Diagnostician

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## New Codling Moth Biofix-Setting Model



A delta trap baited with a codlemone lure is the traditional method for setting codling moth biofix (first trap catch).

The USU Extension IPM Program has been testing a new method to set biofix (first trap catch) for codling moth, the primary insect pest of apple and pear in Utah. The method was developed by Dr. Vince Jones, Washington State University (Jones et al. 2013), and has been used in the Washington State apple industry for several years. In Jones' method, biofix is set using a site-specific formula calculated from orchard latitude and elevation (for locations higher than 400 m [1,312 ft]).

The traditional method for setting codling moth biofix is with a pheromone trap to capture the first emerging male moths of the season. Some of the problems with setting biofix with a trap include 1) cool spring temperatures can interfere with moth flight (the lower threshold for consistent

moth flight is about 55°F), 2) deploying an adequate number of traps and placing them in locations with adequate codling moth populations (widespread use of mating disruption in commercial orchards has decreased codling moth populations in some locations), and 3) checking traps frequently enough, every 1-2 days, to establish an accurate biofix.

In 2016 and 2017, we tested the formula-based biofix predictions in 16 locations in northern and southern Utah. Our goal was no more than a five-day difference in the predicted biofix vs. trap-based biofix. In each orchard, we hung and checked pheromone traps, and conducted intensive sampling to determine first egg hatch and larval entry into fruit for 1st and 2nd codling moth generations.

In 2016, we found that the formula predicted biofix within 1-3 days of the traps for all northern sites. Additionally, formula vs. trap predictions for start and end of egg hatch for 1st and 2nd generations, and 2nd and 3rd flights, only varied by 0-2 days. Variances were greater for southern sites, 5-11 days for biofix, but only 0-3 days for egg hatch and 2nd and 3rd flights. Traps in some southern sites were checked infrequently during biofix-setting, and may have contributed to the greater discrepancy.

Spring conditions in 2017 were more variable. Early spring was warm, then temperatures cooled during apple bloom and first codling moth flight. These variable temperatures led to greater differences between the formula and trap predictions: 21-22 days for biofix in northern Utah, and 6 days in southern Utah. However, differences in predictions of peak egg hatch and subsequent flights only differed by 1-7 days.



Codling moth eggs were found on fruit and nearby leaves. Eggs in the “red-ring” stage indicate imminent hatch (left). Larvae usually entered fruit near their egg (middle; clear, hatched egg is within the black pen circle).

A newly hatched larva is chewing an entry hole into an apple (right).

Degree-days for codling moth biofix from the Jones et al. formula (2013) for some key fruit production areas in Utah, and codling moth biofix dates based on the formula in 2016 and 2017.

City (County)	Degree-Days	Date in 2016	Date in 2017
Perry (Box Elder)	184	Apr 21	Apr 30
Kaysville (Davis)	194	Apr 21	Apr 16
Provo (Utah)	205	Apr 19	Apr 16
West Mtn./Genola (Utah)	209	Apr 20	Apr 13
Cedar City (Iron)	251	May 10	Apr 27
New Harmony (Washington)	263	May 6	Apr 22

Although we didn't always meet our goal of no greater than five days' difference between the formula and trap-based biofix models, prediction of the critical development events – egg hatch and moth flight later in the season – met, or nearly met, our goal in most cases. Errors in degree-days associated with biofix-setting are only a small percentage of the total degree-day accumulations for key phenological events such as flight and egg hatch (Jones et al. 2013). Therefore, modest discrepancies in biofix degree-days will have minimal impact on accurately predicting egg hatch and moth flight later in the season.

Going forward, the USU Extension IPM Program will include the codling moth formula-based biofix as a "Pest" selection in the [Utah TRAPs](#) (Temperature Resource and Alerts for Pests) web tool. For the next several years, the IPM Program will continue to collect trap-based biofix dates for codling moth and include this as an option on TRAPs, as well. The user will be able to select their biofix-setting preference: fixed biofix (formula) or trap biofix (first trap catch).

This research was supported by a Utah Specialty Crop Block Grant administered by the Utah Department of Agriculture and Food, USU Extension, and the Utah Agricultural Experiment Station.

— Diane Alston, Extension Entomologist  
 — Marion Murray, IPM Project Leader  
 — Rick Heflebower, Washington Co.  
 Extension Horticulture Agent

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# Invasive Pest Spotlight: White Satin Moth



White satin moth adult.

The white satin moth (*Leucoma salicis*) is a strikingly beautiful insect. It is related to the infamous gypsy moth (*Lymantria dispar*) and other important defoliators of forest trees known as tussock moths. White satin moth larvae feed on poplar and willow, and occasionally on other hardwood trees, such as aspen, cottonwood, and more rarely, oak and crabapple. They consume entire leaves, except for major veins, and will eventually cause branches to die as well as whole trees, if left untreated. Feeding injury is most visible after mid-June. Larvae can also cause nuisance issues as they leave behind excrement while they crawl on trees and other outdoor surfaces.

This moth is native to Eurasia, and was first introduced to North America in the early 1920s. Populations can now be found throughout most of the northern half of the U.S., including the Pacific Northwest and Great Basin states. In Utah, it has been detected in Wasatch County. Populations are usually low, especially in urban areas, but the pest caused heavy defoliation in parts of Lake Tahoe-Nevada State Park in 2017.

Adults have a black body that is about  $\frac{3}{4}$  inch-long and covered with white hairs, silver-white wings with a satiny sheen, a wingspan from  $1\frac{1}{2}$ -2 inches, and black and white rings on the legs. Adult females are larger than males and have thread-like antennae; males have feather-like antennae. Green eggs are laid in clusters, but covered with a white, foamy secretion. Larvae have dark-colored bodies, with pale yellow blotches down their backs, a whitish line down each side, and red-brown, hairy warts on the back and sides. They can reach  $1\frac{3}{4}$  inches in length when mature. Pupae are dark-colored, hairy, and about  $\frac{1}{2}$  to  $\frac{1}{4}$  inch in length. Any suspect life stages can be sent to the [Utah Plant Pest Diagnostic Lab](#) at Utah State University for confirmation.



White satin moth larva.

White satin moths overwinter as larvae on tree trunks or branches, and resurface in the spring to continue feeding and developing until late June or early July. Around this time, mature larvae spin loosely woven silk cocoons in rolled leaves, on branches, in bark crevices, or on other outdoor surfaces before pupating. Adults emerge from pupation during July and August, and fly at night, swarming like snowflakes around host trees. Females then lay eggs on leaves and branches. Eggs hatch about two weeks later and the new larvae feed on foliage for about a month before finding a suitable overwintering site. There is just one generation per year.

In general, healthy trees can better withstand pests like white satin moth. Keep trees healthy and vigorous by fertilizing them in the spring, and watering them during prolonged dry periods and again in the fall before frost sets in. If you suspect white satin moth eggs or larvae on



White satin moth eggs.

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your trees, you can use a high-pressure water sprayer to knock them loose or apply “sticky bands” to the trunk to help trap the larvae as they crawl up the tree to feed. Natural enemies generally keep this pest in check, and infestations are usually short-lived, so chemical insecticides are generally not needed; however, a microbial insecticide containing *Bacillus thuringiensis* var. *kurstaki* (Btk) is an environmentally safe control measure. Btk is a naturally-occurring, soil-inhabiting bacterium that makes proteins that are toxic to larvae, but the larvae must ingest it for it to be effective. Control is best achieved when targeting early instar larvae feeding on newly emerging leaves in the spring.

——— Lori Spears, USU CAPS Coordinator

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## ENTOMOLOGY NEWS AND INFORMATION, continued

### Spider Mites Like it Hot with Neonics



Spider mites use a stylet to pierce and suck out leaf cell contents giving a speckled look and causing eventual leaf desiccation. With mites being tiny, webbing along the midrib on the underside of leaves is a good indicator of spider mites.

The most well-known factor leading to spider mite outbreaks is plant exposure to drought conditions. Water-deprived plants undergo changes in plant chemistry such as increased nutrient availability and altered biosynthesis of plant defense chemicals that favor mites. Optimal irrigation can reduce plant stress and aid in reduced mite feeding and damage. Overhead irrigation and rain events also physically wash mites from plants and increase humidity, helping to decrease populations.

During hot, dry field seasons, dust buildup on foliage from dirt roads benefits mites and hinders mite predators, adding to the issues associated with drought conditions. Insecticides are also implicated in spider mite outbreaks. Some of the classic mechanisms for why we see outbreaks after insecticide applications include a reduction in predators that keep mites in check, and where the overuse of some insecticides has resulted in resistant spider mite populations. The less obvious mechanisms that have been

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Dr. Ruckert manipulated corn irrigation treatments with drip irrigation to create distinctly different water-stress levels, & used a cage to exclude mite predators & establish a known number of mites on experimental plants.

observed include instances where insecticide applications stimulate spider mite egg production, and cases where insecticides alter plant hormones related to plant defense and result in increased susceptibility of plants to mites. Plant water-stress and pesticide use on crops can often occur simultaneously in our region, but they have only been evaluated independently on spider mite populations.

In a recent 2018 paper in the journal *PLoS ONE*, Dr. Alice Ruckert, former USU biology graduate student, investigated the combined effects of water-stress and neonicotinoid seed treatments in field corn on Banks grass mite populations. Corn is a major agronomic crop in Utah and in our semi-arid environment, spider mites can easily flare up. The Banks grass mite is one of the primary species affecting corn. The damage is commonly seen as stippling starting at the lower leaves and with progressively heavy infestations leading to completely desiccated leaves and reduced corn yields. To combat destructive insect pests capable of wiping out a newly emerging and growing corn crop, corn seed is often treated with neonicotinoid insecticides. The systemic activity of neonicotinoids provides protection to the growing plants from insects, but not mites. Neonicotinoids have come under scrutiny for their non-target effects on beneficials, and their role in spider mite outbreaks. Dr. Ruckert conducted a series of field and greenhouse experiments where she manipulated irrigation levels to expose corn plants to varied water-stress conditions and compared

spider mite populations on corn with and without neonicotinoid seed treatments.

Her main findings were that the combination of plant water-stress and clothianidin, a specific neonicotinoid active ingredient, consistently increased Banks grass mite populations. Thiamethoxam, another neonicotinoid active ingredient tested, however, did not show the same effect. Rather, the combined effect of plant water-stress and thiamethoxam on mite outbreaks only occurred when corn plants were mature, from tasseling until the soft dough phase. Ruckert suggested a reason for this is that thiamethoxam metabolizes into clothianidin during corn development, accumulating in late development stages where it interacts with water-stress to promote mite outbreaks. Given the differences between these neonicotinoid active ingredients, it is clear that not all neonicotinoids should be considered equal, and recognize that there are nuances in their specific interactions. We have seen these nuances for beneficials too, in other research where pollinators are able to detoxify some neonicotinoid active ingredients better than others.

Dr. Ruckert's work also showed that when water-stress and neonicotinoid use occurred simultaneously, Banks grass mites increased, while other research has shown that mite species like the two-spotted spider mite, will increase with neonicotinoid use alone. With neonicotinoid seed treatments being the standard for field corn, combined with Utah's semi-arid conditions, we expect to see spider mite outbreaks. Similar to previous research, Dr. Ruckert found that both factors alter plant physiological responses and the microhabitat influencing mites. By understanding interactions between water-stress and neonicotinoid use, this may allow pest managers and farmers to predict and anticipate mite outbreaks and establish proactive pest management strategies.

—— Ricardo Ramirez, Entomologist

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# Five Vegetable Insect Pests of Utah & When to Watch for Them

Although only about 1% of insects are harmful, their damage can cause great frustration throughout the growing season. Knowing when to look for persistent pests can help alleviate stress by informing decisions on when to take action or when to stand down.



## 1. Aphids

Aphids are common in Utah vegetable crops, but are not harmful unless they may be vectoring a virus or are present in high numbers. They have a wide host range and can transmit viruses to several vegetable crops including

tomato, pepper, potato, pea, bean, and cucurbits.

Watch for adults in late May and June. Adults and nymphs are often found in clusters on leaves or stems, but may be found singly. Watch for rapidly increasing populations and feeding damage in the late spring through early fall.



## 2. Flea beetles

Flea beetles are an annual problem in the early spring and can cause cosmetic damage and/or stunt or kill small plants. Flea beetles are especially harmful during cool springs when plants cannot outgrow damage. Tuber flea

beetle larvae can cause severe tunneling in potato tubers and summer management is necessary to prevent tuber damage. Crops susceptible to flea beetle damage include eggplant, pepper, brassicas, and potatoes.

Watch for flea beetle adults and monitor seedlings for feeding damage from early April to mid-June. Keep an eye on crops near field borders with cruciferous weeds.



## 3. Spider mites

Spider mites are common during hot and dry weather conditions and can kill plants if left unmanaged. Vegetable hosts susceptible to damage include beans, peas, cucurbits, tomato, eggplant, pepper, and potato.

Check the undersides of leaves for moving specks of “dirt” (twospotted spider mites can look like dirt without a hand lens). Start with older leaves and leaves closest to the ground. Watch for stippling especially during hot, dry conditions. Webbing indicates the presence of heavy populations.



## 4. Squash bugs

Squash bugs are annual pests in cucurbits (especially pumpkin and squash), every year and can be very difficult to control when populations are allowed to build.

Monitor in the spring for squash bug adults under plant debris, perennial plants, or near buildings. Look daily for eggs under leaves starting in late spring and early summer until harvest. Watch for plant wilt (associated with heavy squash bug feeding) throughout the season and keep in mind that adults and nymphs like to congregate on lower parts of the plant.

## 5. Tomato russet mites



Tomato russet mites are found mostly on tomato plants, causing damage during hot, dry conditions. Severe infestations can result in plant death. Other solanaceous plants such as eggplant, pepper, and potato are also susceptible.

The presence of tomato russet mites often goes unnoticed, due to their microscopic size, until injury is evident. Watch for injury symptoms especially during hot, dry conditions. Infested leaves will dry, wither, and drop. Look for bronzing on lower leaves and stems. Use a microscope to check damaged leaves and surrounding healthy leaves for mites.

For more information on insect pests of Utah vegetables, see the [Vegetable Production and Pest Management Guide](#) and the new [Vegetable Pests of Utah: Disease and Arthropod Pest Identification Guide](#).

———— Cami Cannon, Vegetable IPM Associate

# Worker Protection Standard Training Requirements for Growers



Reprinted with permission by [Jeremy Jubenville](#), Extension Educator at [Michigan State University Extension](#). Access the [original article here](#).

The Environmental Protection Agency (EPA) [Worker Protection Standard \(WPS\)](#) is designed to reduce the risk of pesticide accidents with workers in agriculture. Some of the requirements set forth in the 2015 revision of the WPS were selected for delayed implementation to give agricultural producers time to ready themselves for compliance. The latest set of regulations from this revision went into effect January 2, 2018.

The following information is a summary of essential training requirements and exemptions specified in the WPS, along with some EPA-approved sources for training materials.

## Pesticide Safety Training for Workers and Handlers

- Employers must ensure **workers** and **handlers** receive pesticide safety training annually.
- **Workers** need to be trained before entering a pesticide-treated area. (A treated area is one in which an REI from a pesticide application has been in effect within the last 30 days.) This often means workers will need to be trained their first day on the job.
- **Handlers** need to be trained before engaging in any handler activity.
- Pesticide safety training must be delivered in a manner employees can understand.
  - Trainers *must be present for the duration of the training session*.
- Employers are required to keep training records for at least two years.
- Training may be presented orally from written

materials or slides, or using a prepared video.

- Use EPA-approved presentation materials with a designated EPA approval number.
- Employers must inform **workers** and **handlers** on where to find the following safety-related materials at the worksite:
  - EPA [WPS Safety Poster](#)
  - Hazard communication information (what pesticide was applied, REI, etc.)
  - Safety data sheets
  - Decontamination supplies (water, soap, single-use towels)

## Where to Find Training Materials

- EPA has materials available for download: [Safety Information Related to the Worker Protection Standard](#).
- [Pesticide Education Resource Collaborative](#) has free training materials available for download.
  - Training videos can be played directly from the website or downloaded and copied to a DVD.
  - Videos are available in English and Spanish, both with closed-caption options.
  - Several different options of video quality/resolution are available.
- Printed Pesticide Education Resource Collaborative training and compliance material is available for ordering at the [National Pesticide Safety Education Center](#) website.
- Iowa State University Extension and Outreach offers a self-paced, online [Train-the-Trainer](#) course.

**Note:** Training on the expanded content needs to happen within six months (180 days) after EPA announces the availability of training materials. The most current videos on the [Pesticide Education Resource Collaborative](#) site are EPA-approved and will be sufficient to satisfy this requirement.

## Trainers

- To be a **trainer**, you must have accomplished **one of the following**:
- Be a licensed/certified restricted-use pesticide (RUP) applicator.

continued on next page

- Have completed an EPA-approved Train-the-Trainer course.
- Be designated by state, tribe or EPA as a qualified trainer.

### Notes on Train-the-Trainer courses

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The [Pesticide Education Resource Collaborative](#) website has a free, downloadable curriculum for delivering a [Train-the-Trainer](#) course. As a bonus, Train-the-Trainer instructors that deliver an entire course are considered to have finished the Train-the-Trainer course and are thus qualified to be a trainer of workers and handlers for WPS pesticide safety training.

### Respirator training

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Respirator training must occur annually for any employee that is required to use a respirator, including owners, immediate family and certified crop advisors. Specific training materials are not required. However, the handler employer must ensure that each handler can demonstrate knowledge of the following, according to [OSHA's Respiratory Protection](#) informational booklet:

- Why a respirator is required and the reasons for selecting a specific type of respirator.
- The capabilities and limitations of the selected respirator.
- How to inspect, put on and remove, and check the seals of the respirator.
- How to use, maintain and store the respirator properly.
- What can happen if the respirator does not fit properly or is not being used and maintained correctly.
- How to use the respirator effectively in emergency situations, including when the respirator malfunctions.
- How to recognize medical signs and symptoms that may limit or prevent the effective use of the respirator.

### Exemptions from WPS Training Obligations

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[Chapter 6](#) of the Pesticide Educational Resources Collaborative "[How to Comply](#)" manual provides a comprehensive discussion of owner, family, and certified crop advisor exemptions. Although owners are exempt, from a safety standpoint, it is in their best interest to obtain a similar level of WPS knowledge and training as the employees.

- Agricultural business **owners and their immediate family** are **exempt** from many WPS training requirements, including:
  - Pesticide safety training for workers and handlers.
  - Providing information on where to find the EPA WPS Safety Poster, hazard communication information, safety data sheets and decontamination supplies (water, soap, single-use towels).
  - Training for equipment used in pesticide handling activities.
  - According to the "[How to Comply](#)" manual, an immediate family includes: spouse, parents, step-parents, foster parents, father-in-law, mother-in-law, children, step-children, foster children, sons-in-law, daughters-in-law, grandparents, grandchildren, brothers, sisters, brothers-in-law, sisters-in-law, aunts, uncles, nieces, nephews and first cousins.
- **Certified restricted-use pesticide (RUP) applicators** are exempt from WPS worker and handler training requirements.
- **Certified crop advisors** are also exempt from WPS pesticide safety training. However, non-certified crop advisors are required to receive the appropriate annual training as workers or handlers from their employer. Within the scope of the WPS, a certified crop advisor is someone who has been certified by the [National Alliance of Independent Crop Consultants](#) or another program that has been approved by EPA, tribal, or state authorities. Self-employed crop advisors are obligated to provide themselves with appropriate WPS training.

### Conclusion

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Sorting through the [Code of Federal Regulations](#) can seem like a tall task for any one person. Subject matter is usually woven throughout the document, intertwined with related concepts, and often requires a bit of untangling to obtain a clear overview of any given topic. While the contents of this article are intended to be an inclusive guide to the WPS training requirements for agriculture, they *should not* be considered a substitute for the advice from a professional consultant or agricultural labor attorney. In addition, as with any subject related to regulatory compliance, please consult official sources for interpretation and final rulings.

— Jeremy Jubenville, Extension Educator  
Michigan State University Extension

## IPM In The News

### Crop Edge Plantings are Important

Due to their homogenous nature, wheat fields do not typically sustain high populations of natural enemies. A recent study published in the *Journal of Applied Ecology* showed that wheat fields with a diverse landscape around the field harbored enough beneficial insects to manage aphid outbreaks. The Bavaria, Germany study compared aphid predation in 18 winter wheat fields with either low-diversity or high-diversity surroundings. They found the biggest impact of edge diversity occurred when border plantings were at least 500 meters wide. Insect predators were more important than birds in aphid management, and fields surrounded by sunflower, rapeseed, or beet sustained the maximum number of natural enemies of aphids.

### On-Farm Pathogen Test

Testing for soil pathogens in diagnostic labs is expensive, and it may take days to weeks to get results. In addition, separating genetic material of soil pathogens from the myriad of other soil microorganisms is often difficult. Effective, on-site testing is the tool of the future, and one "homemade" option is available now. Washington State University plant pathologists have developed a step-by-step instruction and materials checklist to construct a testing device. In developing the protocol, the team overcame the lab-testing difficulties in isolating pathogen DNA from soil by instead using magnets to capture DNA. The system was tested on potato fields in eastern Washington, but the authors report that it will work on soil anywhere in the world. The results were published in the *Journal of Visualized Experiments*, and includes a video showing how to assemble the testing device. Access the article and [demonstration video here](#).

### Importance of Soil Moisture for Urban Trees

A recent study out of North Carolina State University found that insufficient water not only causes tree stress, but allows other problems to have an outsized effect on trees growing in urban environments. Over a two-year period, entomologists collected data on 40 urban-grown willow oaks, including temperature, water-stress level, and the density of scale insects, a common pest in the area. They also conducted laboratory experiments where willow oak saplings were grown in various temperature, water, and scale density regimes. The researchers found that trees that had adequate water showed increased growth under high air temperatures and were not adversely affected by scale insect infestations. On the other hand, trees under water stress alone had limited growth, and those that were water-stressed combined with increased heat and/or scale insects, showed a multiplier effect, where growth was curtailed far more than water stress or scale insects alone.

### Virus Distribution in Agriculture

Knowledge of the diversity and distribution of plant viruses is lacking, especially at the agroecosystem level. In addition, the majority of plant viruses that remain to be identified are found in areas with little human activity. A study conducted by a team of international scientists in France and South Africa used an approach called spatial metagenomics to directly link sequences of viruses to their host and to a geographical position. They found that in cultivated areas, viral infections are significantly more frequent than in natural areas. They also found that the natural areas, which are still largely unexplored in terms

of the biodiversity of microorganisms, contained a large number of viruses. These areas adjacent to agricultural land could enable scientists to better understand and quantify risk factors in the emergence of new plant diseases. The results were published in *The ISME Journal*.



### Positive Effects of Bt Corn Before and After Introduction

Bt corn is a genetically-engineered crop that since 1996, makes up over 80% of U.S. field corn plantings. University of Maryland entomologists looked at trapping, damage, and management data of the European corn borer on other crops from 1976-2016 to quantify "side-effects" of Bt corn. This study, published in the *Proceedings of the National Academy of Sciences* provides the first documentation that Bt corn has significantly decreased adult moth activity, recommended spraying regimens, and overall crop damage in vegetables such as sweet corn, peppers, and green beans. In some cases, the researchers reported a 90 percent decline of the European corn borer population in the mid-Atlantic area. The authors' next steps are to quantify the economic benefits from decreased spraying and crop damage, as well as consideration of the environmental benefits.

continued on next page



### Benefits of Birds and Bats Worldwide

Birds and other vertebrates can help to protect crops from certain pests, and many farmers are taking advantage of their services. A research review, led by Michigan State University biologists, showcases some of the best global examples that have helped reduce pesticide use, environmental impact, and in some cases, increase yields. Some of the review's highlights, published in the journal *Agriculture, Ecosystems and Environment*, include the following. In Michigan, kestrels in sweet cherry orchards significantly reduced the abundance of birds that eat fruit. In Indonesia, cacao plantations have documented increased yields of 290 pounds per acre—equaling nearly \$300 per acre—from having birds and bats in their fields. In Jamaica, birds eating a nuisance coffee pest saved an estimated \$18 to \$126 per acre annually. In New Zealand, grape growers helped reestablish a declining native falcon that in turn, helped to reduce grape pests. The next stage of the MSU team's research will be to identify the best practices for using vertebrate controls and to measure the impacts and costs of specific improvements.

## New Publications, Videos, Books, and Websites

- A website developed by the [Western Bedbug Work Group](#) contains documents, presentations, videos, and other materials about bed bugs and bed bug management for the western U.S.
- [Soils and Sites for Organic Orchards and Vineyards](#), a publication developed by ATTRA, helps in developing sustainable and profitable fruit tree, bush, or vine production. It includes cover crop and mulching options, fertilization, and the role of mycorrhizae in maintaining healthy fruit plants.
- [Chemical Ecology of Insects: Applications and Associations with Plants and Microbes](#) is a new book that covers recent research on insects and chemical communications and presents the current status about challenges faced in the management of pests in agriculture and human health.
- The video, [Soil Aggregate Stability: Visual Indicators of Soil Health](#), shows the dramatic differences in aggregate stability that result from different soil management practices of the exact same soil type, and explains why aggregate stability is important as an indicator of soil health.
- SARE has developed a new [Organic Production](#) resource page on their website, assisting organic producers to manage pests, fertility, and tillage in compliance with stringent organic standards.

## Featured Picture of the Quarter



The hot, dry, and dusty conditions of summer 2017 caused localized outbreaks of spider mites in various vegetable crops. Spider mite outbreaks can also occur after insecticide sprays have been applied that kill their natural enemies and/or stimulate spider mite reproduction.

The images to the left were taken in early September at community gardens in Utah. The top image shows a twospotted spider mite infestation on bean. The surrounding plants were also infested with spider mites and a video of the swarming population can be seen [here](#). The bottom image shows twospotted spider mite damage to a tomato plant. The infestation was so severe that every part of the plant (including the fruit) was covered in stippled feeding damage and the overall plant health was declining.



Feeding damage from spider mites results in:

- stippled or flecked leaves
- discoloration (gray or bronze) & scorched leaves
- leaf loss (which can significantly impact yield and lead to sunburning of squash, melons, and watermelons)
- potential plant death

— Photos by Cami Cannon,  
Vegetable IPM Associate

Kestrel and Corn clipart courtesy FCIT.

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