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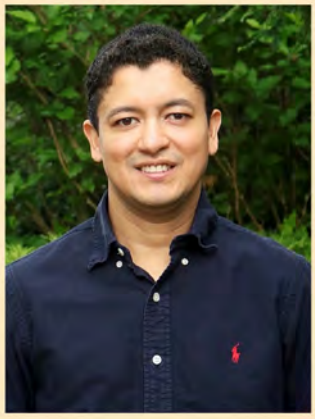
In This Issue:

Introducing WVU Extension's new entomology specialist

Carlos Quesada is the new assistant professor and Extension entomologist at West Virginia University. He completed his master's and doctorate at Purdue University, where he focused on the integration of chemical and biological approaches toward managing scale insects. Before joining WVU, Quesada was a pesticide education specialist at Pennsylvania State University, where he upgraded, developed and presented educational materials about integrated pest management and pesticide safety for extension educators, pesticide applicators and related groups in both the English and Spanish languages.



Carlos Quesada

Quesada's research interest is improving IPM programs to help growers produce high quality crops in ways that are economically and environmentally sustainable. For example, in a recent article, he reported that soft scales showed higher tolerance than armored scales when he treated them with several insecticide active ingredients. His demonstration of the differential effects of pesticides on soft and armored scales help improve the management of these pests by getting pest managers to distinguish between these groups of scales before selecting pesticides.

More scientific questions also intrigue Quesada. For instance, he observed that soft scale insects can excrete insecticides through their honeydew. Excretion of insecticides may increase insecticide tolerance of soft scale insects. In addition, tainted honeydew might have negative consequences for natural enemies and pollinators if it is used as a food source.

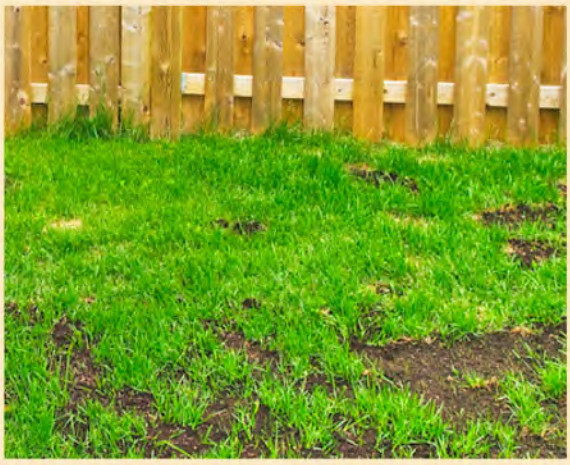
Quesada also is interested in understanding the ecology of crops, because in the absence of biological control in an IPM program, chemical control alone can be insufficient. In his work with scale insects, Quesada found that seasonal abundance of scale insect predators and parasitoids are synchronized with prey phenology. This pattern can help select and time insecticide applications to reduce their negative effects on natural enemies.

If you have entomology-related questions, Quesada can be reached at *carlos.quesada@mail.wvu.edu* or 304-293-8835.

Reseeding and overseeding lawns to manage weeds

Bare spots in lawns provide opportunities for weeds to emerge. Secondary cultural practices, such as reseeding bare spots in a lawn or overseeding a lawn with poor density, are excellent methods to minimize fresh infestations of weeds in an otherwise well-maintained lawn.

Bare spots may occur where grass in particular areas of the turf are killed by biotic or abiotic agents, whereas a thin turf with poor density (ground surface is exposed consistently) could be an indication of improper primary management practices, such as mowing, fertilization or irrigation. Lawns also may be less dense due to the improper choice of turf species, such as Kentucky bluegrass for a shaded lawn or thin fescue for a lawn that receives full sunlight. Other suboptimal conditions, such as excessive thatch, soil compaction or poor drainage, also may cause certain lawns to become thin. If such conditions prevail, other secondary cultural practices, like verticutting (dethatching), aerating or improving drainage by installing a drainage system, may be required prior to overseeding the lawn.



In cool-season grasses, the best time to monitor for bare spots in lawns is the fall, followed by the spring.

Reseeding and overseeding

In cool-season grasses, such as Kentucky bluegrass, fescue and ryegrass, which make up a majority of the lawns in West Virginia, the ideal time to monitor for bare spots present in lawns and reseed such areas with fresh turf seed are the fall (mid-September to mid-October), followed by spring (late March to mid-April). This also is a good time to overseed lawns suffering from a poor density.

Typically, these times of the year are when winter annual weeds and summer annual weeds, respectively, begin to germinate. If annual weeds, such as hairy bittercress, chickweed, henbit or deadnettle, are present at this time, it may be a good idea to mechanically remove weedy patches and then reseed. Perennial weeds, such as nimblewill, ground ivy, violet, clover, etc., may have to be managed by spot applications of a systemic herbicide, such as glyphosate, applied three weeks prior to seeding in the fall. Once the bare spots are disturbed by gently using a rake or light tiller, they can be reseeded using an appropriate seed or blend that would thrive under the prevailing light conditions. Overseeding also may be carried out at the same time of the year as reseeding, if necessary.

Preparation

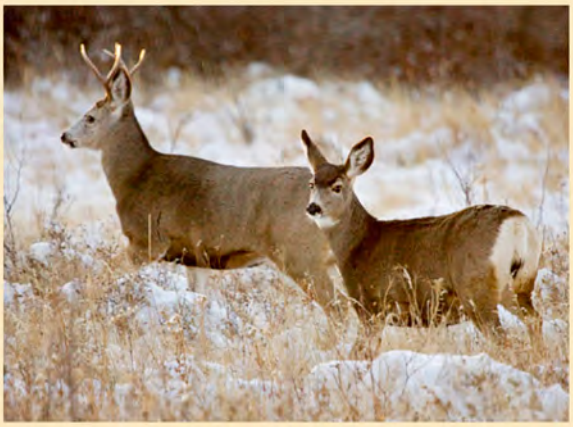
Best results are achieved when reseeding or overseeding are carried out after a slight disturbance of the turf surface, such as aeration (followed by top-dressing) or verticut mowing. A verticut mower is a piece of equipment with blades that revolve vertically in the soil surface, which can remove thatch upon careful adjustment of the blade height from the soil surface. A rotary or drop spreader may be used to uniformly distribute the turf seed to the lawn surface. Overseeding typically requires one-third to one-half of the seeding rate per unit area compared to new seeding.

After reseeding, apply mulch to conserve soil moisture until the seeds germinate and establish; however, mulching is not essential for overseeding. Application of a preemergent herbicide, such as mesotrine (Tenacity), labelled for cool-season grasses soon after seeding would hinder the germination of weed seeds after reseeding or overseeding. A fertilizer also can be applied to ensure proper nourishment of emerging grass seedlings.

Manage deer damage through the fall hunting season

When landowners want to manage white-tailed deer damage on their property, they often focus on an applied tool or method that reduces damage. An often overlooked component of deer damage management is harvest management. Hunting can help reduce deer damage by reducing deer numbers in areas where deer can safely and legally be hunted.

State wildlife agencies routinely manage deer populations by regulating deer harvest. They establish hunting seasons and bag limits to keep deer populations in balance with the habitat. While state wildlife agencies provide hunting opportunities through hunting seasons, they must rely on hunters to harvest the deer and on landowners to allow hunters access to property for hunting. This means that landowners have the opportunity to design their own deer management programs to suit their property's needs and management objectives.



State wildlife agencies manage deer populations by regulating deer harvest using hunting seasons and bag limits.

Designing a deer management program

The first step is to determine one's management objectives. Objectives vary greatly, but they can be as simple as "I want to reduce the amount of deer damage to my pumpkin patch" or "I want to see more deer in my backyard."

The second step is to determine how many deer currently inhabit a property. Obtaining an accurate count is a difficult and expensive task. However, taking simple steps, such as counting deer in fields, using game cameras to count deer, or recording the number of deer seen during hunting or farming activities, can provide rough estimates of deer numbers. These estimates allow landowners to track deer populations over time.

The third step is for landowners to determine a target number for their deer population. When you understand your own tolerance for deer and combine that with an approximate number of deer already on an area of land, you are able to develop a deer population goal for the property. If the goal is to increase the deer numbers, no harvest will be needed. If decreased numbers are the population goal, then harvest is warranted.

If you determine that you need to harvest deer, the fourth step is to ask "How many deer should I harvest to reach my deer population goal?" The answer to this question, based on your objectives and how many deer are found on your property, may be difficult to determine. If your objective is to reduce damage by reducing deer numbers, then you should focus on observing the damage and continue to harvest deer until you see a reduction in damage. This may require a few years of observation and harvest, but with time and attention, you can reach your goals.

Considerations during harvesting

Be aware that the sex of deer harvested is more important than the number. Increasing the harvest of does (females) will reduce the deer population. This is because the average doe will have one or two fawns per year. Therefore, if there are 10 adult does on the property and none are harvested, the deer population could grow to 30 deer (10 does + 20 fawns). If only four of the 10 does were harvested, the population would grow to only 18 deer (6 does + 12 fawns). While this doesn't take into account any additional mortality, it demonstrates the potential for the deer population on the property to explode.

Reducing the numbers of bucks (males) will not have the same impact on the potential number of fawns produced, since one buck is all that is needed

– continued on page 9 –

Verticillium wilt of maple trees

Verticillium wilt of maple is primarily caused by the fungal pathogen *Verticillium dahliae* and to a lower extent by *V. albo-atrum*. These fungi attack more than 400 plants, shrubs and trees, causing a vascular disease that can result in plant death. Maples (*Acer* spp.) are probably the best-known shade trees that are susceptible to verticillium.

These two fungal species are primarily soilborne pathogens that invade the xylem of host trees resulting in leaf drying, curling, defoliation, wilting, dieback and eventually tree death.

The varieties of maple trees most susceptible to verticillium wilt include Norway maple (*Acer platanoides*), Japanese maple (*Acer palmatum*), red maple *Acer rubrum*) and silver maple (*Acer saccharinum*), which grow in the United States Department of Agriculture plant hardiness zones 3 to 9.

Figure 1. A verticillium wilt-affected maple tree showing premature leaf drying up and barren branches that dropped all the leaves. (Photo credit: MM Rahman)

Symptoms

Maple wilt can show both acute and chronic symptoms from verticillium infection. During the acute symptom expression, maple trees will have leaves that curl, scorch at leaf margins followed by drying up, appear abnormally yellow or red, and fall off within a very short period of time.

Young trees generally succumb to maple wilt within a year. However, most maple verticillium infections show chronic symptoms that appear in isolated branches on only one side of the plant (Figure 1).

Once the infection extends to the vascular tissues, the disease migrates mostly upward – not as much radially from the stem. If only one branch exhibits symptoms, it is easy to miss the diagnosis in the first year; however, major infection and symptom expression on a whole tree also can be mistaken as premature fall leaf drop.

In general, older trees may continue to display more chronic symptoms, such as reduced twig growth, sparse crowns, stunted leaves and dieback, for several years before complete death.

Because many other plant abnormalities, such as drought stress or early spring frost, can affect maple leaves with similar symptoms (including premature leaf drop), it is important to diagnose verticillium wilt based on the presence or absence of vascular streaking after cutting the base of an affected stem.

In cross sections of the stem, vascular discoloration will appear in rings or arcs (Figure 2). However, vascular discoloration is more likely to be found in larger branches and trunks.

Disease Cycle

The verticillium fungus that causes maple wilt can live in the soil for years undetected. The fungus first attacks the tree through the roots, which spreads the infection through the maple's vast vascular system. Most frequently, verticillium spores invade the root system at the site of an earlier wound, although stressed trees are susceptible to direct infection.

– continued on page 5 –

Maple verticillium wilt – continued from page 4 –

Direct infection through root hairs also may occur, but these infections rarely make it to the vascular system.

As the infection spreads, vascular tissues (especially the xylem) are colonized and plugged by fungal growth preventing transport of water and nutrients to tree branches and leaves. Infected dried up and dead leaves fall on the ground bringing the fungus back to the soil in a wider area.

Cool spring temperatures encourage activity of the pathogens that cause verticillium wilt, but symptoms typically don't show until late in the growing season.

Figure 2. Cross section of a maple twig showing vascular discoloration (Photo credit: http://www.sicktree.com/idotis/jpg/vrtwilt.jpg)

Microsclerotia (resting structures) of *V. dahliae* in the soil are stimulated to germinate by secretions from nearby growing roots. Hyphae from germinating microsclerotia grow toward the roots, penetrate the root surface and grow inter- and intra-cellularly through the root cortex to reach the xylem vessels.

Once inside the vessels, the fungus starts to produce conidia that are spread throughout the infected tree with the flow of xylem fluid. At vessel ends or against protruding parts of vessel elements, conidia are trapped and may germinate.

The new hyphae penetrate adjacent vessel elements, produce conidia and the process continues – finally leading to systemic colonization of upper parts of infected plants.

Management

Fungicides are not effective for controlling or eliminating verticillium or maple wilt. Pruning and burning or disposing of dead or affected branches help limit the infection; however, it will not eliminate the disease, because the fungus has spread through the roots and vascular system. Applying a balanced fertilizer with ammonium sulfate as the nitrogen source at the early stage may reduce disease severity. In addition, extra watering, especially during a dry spell, can help to decrease the wilt problem.

While none of these methods will cure maple wilt, they may help extend the longevity of a tree.

Prevention

Because there is no cure for maple wilt, prevention is the best management strategy.

First, never plant maples in an area where previous plants or trees have died from the disease. Another preventive approach is to plant resistant trees and cultivars whenever possible.

Once planted, keep trees healthy, because healthy trees are better able to resist the disease.

To keep trees healthy, consider putting the following cultural and chemical controls in place:

Cultural control

- Prune and burn affected limbs, preferably before leaves fall and before new inoculum is incorporated into the ground. Remember to clean pruning equipment after use.
- Do not track soil from infected areas into clean areas. Clean boots, equipment and tools before leaving an infected area.
- Apply nitrogenous fertilizer to a minimum – only enough to produce normal, non-succulent growth.
- If the tree dies and/or is removed, replace it with a non-susceptible host, such as conifer, birch, dogwood or sycamore.
- Avoid planting maple in fields with a history of verticillium wilt. Avoid fields previously planted with potatoes or tomatoes.
- Conducting a soil test for verticillium propagules prior to planting may help determine the suitability of a planting site.

Chemical control

- Fumigating the site before planting may keep the tree healthy during the early stages when they are most susceptible to infection.

Oak shothole leafminer

Oak shothole leafminer (*Japanagromyza viridula*, syn. *Agromyza viridula*) is an insect that belongs to the order Diptera and is native to United States. Typically, oak shothole leafminer damage goes unnoticed. However, in the summers of 2019 and 2020, the insect caused significant damage to oak trees in several states including West Virginia, Ohio, Maryland and Delaware.

Figure 3. Distinct damage caused by oak shothole leafminer. (Photo credit: Carlos Quesada)

In West Virginia, damage by oak shothole leafminer has captured the attention of landowners, the government and West Virginia University, because oak is considered one of the most important tree species in the state.

It has been estimated that oaks comprise about 33% of all merchantable tree trunk volume growing in West Virginia.

Also, oak is a common ornamental tree used for municipalities and homeowners in urban landscape.

Pest biology

Oak shothole leafminers undergo a complete metamorphosis with four distinct life stages: egg, larval, pupal and adult.

Larvae of oak shothole leafminer can be observed in the second week of June. Larvae tunnel through the leaf tissue leaving telltale trails known as blotch mines.

Because they are small, oak shothole leafminer's blotch mines do not cause significant injury to oak compared to other leaf miner insect species.

Once larvae are about to pupate, they drop to lower foliage or the ground. Some pupae develop into adults within days, whereas, others overwinter to emerge the following spring.

Damage description

The main plant injury is caused by the adult. Adult females create leaf holes that are characteristic of this fly species (Figure 3). Females have been observed damaging leaves in June and July (Figure 4).

Because the mouth parts of females cannot penetrate leaf tissue, they use their ovipositors to cause enough damage for fluids leaking from the leaf to be lapped up.

Figure 4. Adult stage of oak shothole leafminer. (Photo credit: https://bugguide.net/node/view/1221114net)

The area injured by this action soon turns brown and dries out, eventually forming a small disk. These disks of necrotic tissue often remain conspicuously attached to the expanding hole formed in the leaf.

Oak shothole leafminers' impact

Oak shothole leafminer damage can reduce photosynthesis to the point that it stops the season's growth for oak seedlings.

In addition, the tattering and inhibition of leaf development results in the tree having a poor appearance.

In August 2020, WVU Extension Service specialists estimated that about 95% of the leaves of oak trees at Snake Hill Wildlife Management area in Morgantown showed distinct damage caused by oak shothole leafminer.

This damage reduced percent leaf area by 17%, 35% and 49% in chestnut oak, white oak and northern red oak, respectively. If damage persists in future years, it is possible that oak trees may suffer more severe injuries.

Lowering soil pH to help acid-loving plants thrive

While most plants thrive with a pH level between 6 and 7, there are certain plants (blueberries, azaleas, rhododendrons, magnolia, Japanese Pieris, hydrangeas, daffodils, nasturtium, gardenia, etc.) that grow best under acidic conditions, which require soil amendments to lower the pH levels of 5.5 or below. The soil pH directly influences the availability, mobility and the plant's uptake of the inorganic nutrients because of the pH's impact on soil microorganisms, mineralization of organic substances, decomposition of soil minerals, etc.

Figure 5. Severe chlorosis due to iron deficiency in blueberry and oak. (Photo credits: M. Danilovich)

Determining the need for soil acidification

Monitoring the plants' growth and overall appearance will provide an insight into the state of their nutrition. If the pH is outside of the acceptable range for optimal performance, symptoms will indicate whether there is a lack of or a surplus of certain elements.

In acid-loving plants grown in soil with too high of a pH level, leaves will develop symptoms of chlorosis or distinct yellowing of the leaves between the veins and narrow green bands along the veins (Figure 5). To prevent this from happening, soil pH must be kept within the optimum range ensuring adequate nutrient supply in the soil.

It is important to know that not all soils are created equal. The first step to determining the need for soil acidification is to identify the pH of the given soil. It is easier to lower the pH of sandy soils than to lower the pH of loamy soils that have more organic matter. It is more difficult to acidify soils with high organic matter, soils with free lime content and clay soils with high cation exchange capacity, which all have higher buffering capacity or capacity to neutralize the free hydrogen ions that govern the soil acidity (Table 1).

Table 1. Amount of sulfur required to lower the soil pH for growing blueberries in lbs./100 sq. ft.

	Target pH of Soil					
	4.5			5.0		
Present pH	*Sand*	*Silt*	*Clay*	*Sand*	*Silt*	*Clay*
	lbs./100 sq. ft.			lbs./100 sq. ft.		
4.5	0	0	0	—	—	—
5.0	0.4	1.2	1.4	0	0	0
5.5	0.8	2.4	2.6	0.4	1.2	1.4
6.0	1.2	3.5	3.7	0.8	2.4	2.6
6.5	1.5	4.6	4.8	1.2	3.5	3.7
7.0	1.9	5.8	6.0	1.5	4.6	4.8
7.5	2.3	6.9	7.1	1.9	5.8	6.0

Source: Adapted from *The Mid-Atlantic Berry Guide for Commercial Growers 2013-2014* (recalculated by M. Danilovich to show the amount of sulfur needed to lower present pH to desired values in lbs./100 sq.ft.)

Lowering pH with sulfur

Blueberry growers and gardeners with acid-loving plants are inquiring about ways to lower the pH. The least expensive material that would lower soil pH is sulfur; however, it is not the fastest.

Sulfur lowers pH with the help of bacteria that converts the sulfur into sulfuric acid to lower the pH level. When dealing with living organisms, the soil temperature

– *continued on page 9* –

Preparing for the next growing season as this season winds down

As the production season starts to wind down, it is important to start preparing for the next season. This is particularly important when working to manage pests in high tunnels and greenhouses.

Recurring pests

Reviewing your production year, did you have any recurring pests this season? If the pests were recurring, did your management techniques work or not? For example, after having problems with fungus gnats in greenhouse tomato production, beneficial nematodes were applied to the media. After applying the nematodes, there have not been any problems during the growing season; therefore, the application of the beneficial nematodes will be continued next season.

New pests

When reviewing your growing season, were there any new pests you encountered? If so, consider not only what you will need to control it, but also how it came into your operation? If you buy transplants, do not bring them into your production area until you are confident that the transplants did not bring any pests with them. Purchased plugs or transplants should be held in a quarantine area for several days to a week away from your production location. Treating those transplants in a small area will reduce the risk of bringing them into your high tunnel or greenhouse.

Figure 6. Quarantining transplants prior to introduction into the production area. (Photo credit: B.E. Liedl)

Figure 7. Remove plant material and clean inside your high tunnel to prepare for next season. (Photo credit: B.E. Liedl)

Control options

When the control measures used are not working, you will need to consider other options. Are there other available control methods? Are there resistant varieties available? Is rotating the problem crops to another location or another year an option to break the pest cycle? For instance, aphids can be a problem when growing peppers and can come from a neighboring site. As a result, consider releasing beneficial insects as soon as the pepper seeds are planted. Be sure to monitor the plants several times a week to catch the problem before it explodes and continue monitoring weekly the rest of the season.

Also, consider cleaning out your high tunnel or greenhouse before the next season. This can be as easy as removing plants or debris that are infected as well as cleaning and disinfecting tools and equipment. However, this does not mean the pest is eliminated, as some pests can stay until the next crop is introduced, so it is important to understand the life cycle of the pests to be able to break the pest cycle.

Taking the time now to assess what pest management techniques worked and did not work this season will help you get off to a good start next season.

Manage deer damage

– *continued from page 3* –

to potentially breed all the does on the hypothetical property. Using the same doe example previously mentioned, if there had been five bucks on the property and four of them are harvested (but no does), you could still end up with double the number of deer ((5 bucks + 10 does – 4 bucks harvested) = (1 buck + 10 does + 20 fawns) = 31 deer!)).

To decrease deer numbers, a landowner should focus on the number of does harvested and continue to harvest does (within the legal limits) until observed damage is reduced. This will take multiple years, possibly multiple hunters and even the cooperation of neighboring landowners.

The key to a successful deer damage management program is an integrated approach that combines harvesting does during the hunting season, possibly harvesting deer during the growing season using crop depredation permits (if the deer density and damage is very high) and using nonlethal techniques, such as habitat alteration, fencing, repellents and guard animals, the rest of the year.

Lowering soil pH to help acid-loving plants thrive

– *continued from page 7* –

must be 55 F or above for the organisms to be active. Another important consideration is that the soil should not be saturated or flooded. Under such conditions, anaerobic bacteria will convert sulfur into hydrogen sulfide, which is phytotoxic and will kill the roots.

The best timing for sulfur applications is in spring, when the soil temperature is suitable for the bacterial activity. It may take several months or more than a year to sufficiently lower the pH level by using sulfur. For best results, sulfur must be incorporated into the soil. If applied at the surface, it will take significantly longer to alter the pH.

Table 2. Lbs. of fertilizer needed to equal 1 lb. of sulfur

Fertilizer Material	*Lbs. needed to equal 1 lb. of sulfur*
Sulfur	1
Aluminum sulfate	6.94
Iron sulfate	8.96
Ammonium nitrate	5.19
Ammonium sulfate	2.83
Urea	3.71
Di-ammonium-phosphate	4.45

Lowering pH with fertilizers

Fertilizers that are often recommended for lowering soil pH is ammonium sulfate and iron sulfate, or ferros sulfate. They react much faster than sulfur; however, application of these fertilizers requires a significantly higher rate to achieve the same acidifying effect.

To substitute the amount of sulfur in Table 2 with any of the fertilizers in Table 3, multiply the pounds of fertilizer needed to equal 1 pound of sulfur.

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