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In This Issue:

How will a warm winter affect my landscape?

Whether you believe in global warming or not, West Virginia has been experiencing higher temperatures in both summer and winter. The United States Department of Agriculture hardiness zone map shows that between 1990 and 2015, there has been significant change in temperatures resulting in a shift in hardiness zones.

West Virginia has five hardiness zones: 5a, 5b, 6a, 6b and 7a. In 2012, the state's zone 7a was limited to just a couple narrow bands around Logan and Charleston. The most recent map (see Figure 1 on page 7) shows expansion of zone 7a and shrinking of zones 5a and 5b. It is possible that these zones will become nonexistent.

Changes in dormancy period

Increased temperatures, particularly in winter, have the potential to have troublesome effects on gardens, landscapes and commercially grown crops. Based on physiological responses to day length and other environmental conditions, one could expect issues with the dormancy period necessary for plants to survive and thrive.

Temperate-zone plants are genetically programmed to go dormant during the winter. With the onset of shorter daylight and change in temperature, plants prepare for winter through a series of metabolic processes. Research indicates that in total carbohydrate ratio, there is a decline in starch and increase in sugars in preparation for extremely cold temperatures.

Pre-dormancy

Pre-dormancy begins in response to changes of environmental factors like shorter days and lower temperatures, or cold temperatures while the days are still relatively long.

Looking at the weather data for Morgantown, pre-dormancy started in mid-October with cooler temperatures. There were 18 days with daily maximum temperatures higher than 70 F and with average daily temperatures from the high 50s to low 80s.

By mid-October, average daily temperatures were in the range from low 50s to low/mid 60s moving into the pre-dormancy period. During the pre-dormancy period, the active growth resumes if favorable growth conditions return.

Endo-dormancy

Though still variable, mild temperatures did not push vegetation into restarting the growth. It was a good transition into endo-dormancy or deep dormancy, an innate phenomenon causing buds to remain dormant due to growth-inhibiting physiological processes allowing them to tolerate cold temperatures below zero. Plants in this stage of dormancy will not be provoked into growing by sudden warmups in mid-winter.

November weather was more seasonable with only two days with average daily temperatures above or equal to 50 F.

There were 21 days with temperatures in the optimum range (34 to 45 F) for accumulating necessary chill hours. Temperature fluctuation in December did not present major issues since the plants were still firmly in deep dormancy.

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Autumn olive: An invasive West Virginia brush

Autumn olive *(Elaeagnus umbellata Thunb.)* is a large deciduous shrub capable of forming dense thickets in West Virginia pastures. Native to eastern Asia, it was introduced to North America in the 1800s. Individual plants may reach heights of 20 feet and can easily be distinguished by their leaves, which have a lustrous silvery appearance on their lower surface and are arranged alternately to the stem. Autumn olive displays a vivid white bloom in early spring, and its growth habit may provide refuge for certain wildlife. A bush honeysuckle called Tartarian honeysuckle *(Lonicera tartarica L.)* can often be mistaken for autumn olive; however, its leaves are more oval, oppositely arranged and are not silvery on either surface.

What problems does it cause?

Autumn olive is one of the most common invasive brush species in the state. If left unmanaged, it is capable of significantly affecting pasture productivity. It may reduce the water, nutrients and sunlight available for desirable plant species and may considerably depreciate the productive area of a pasture. Dense thickets of autumn olive can be an eyesore and may serve as a source of undesirable weed seeds to nearby pastures and farms.

How can it be controlled?

While new infestations of younger autumn olive plants may be controlled within a growing season, a persistent approach covering multiple (three to five) years may be required to control well-established stands. A combination of mechanical and chemical methods is recommended when feasible.

Mechanical control

Understanding the physiology of autumn olive is important for appropriately timing a control method. The ultimate goal is to kill the root system, because it can sprout new growth if left viable. The roots expend energy during spring months when the plant works to reestablish its canopy. At this time, the predominant flow of stored sugars (the plant's energy reserves) is in the upward direction into new shoots and leaves.

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Table 1. Herbicides used in pasture for control of autumn olive.

Common Name	*Trade Name*	*Application Method*	*Application Rate (Product)*
Glyphosate	Roundup® (≥4 pounds/gallon), several formulations	Directed foliar, cut stump	Foliar: 2 to 3% solution Cut-stump: 20 to 25% solution
Fluroxypyr + triclopyr	PastureGard® HL	Foliar	1% solution
Picloram + 2,4-D	Tordon® RTU	Cut-stump	Full strength
Picloram + 2,4-D	Grazon® P+D	Foliar	2% solution
Tebuthiuron	Spike® 20P	Directed soil	¾ ounce per 100 square feet
Triclopyr	Remedy® Ultra	Foliar, basal bark, cut-stump	Foliar: 1-2% solution Basal bark, cut-stump: 20% in oil
Triclopyr + 2,4-D	Crossbow®	Foliar, basal bark, cut-stump	Foliar: 2% solution Basal bark, cut-stump: 5% in oil

Autumn olive: An invasive West Virginia brush

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Taking advantage of this timing can make mechanical control methods, such as girdling, prescribed burns, bush-hogging and cutting, more successful. Likewise, a young autumn olive shrub may be grubbed most effectively in the spring, after the plant leafs out fully, by removing the entire root system when the soil is moist. Such well-timed mechanical methods leave the roots compromised and potentially unable to produce new shoots. Any sprouts appearing after mechanical removal should be treated with herbicides to achieve proper kill.

Chemical control

The herbicides effective for autumn olive control are systemic by nature (Table 1). Like with mechanical controls, optimal herbicide effectiveness is achieved when well-timed applications take advantage of the seasonal changes in the plant's physiology. When systemic herbicides are applied later in the season when the flow of sugars is downward toward the roots, better translocation of chemicals to the root system may be facilitated. Choosing the proper herbicide, timing, method and rate of application will determine treatment success. Repeated applications during successive growing seasons may be required in some instances.

Appropriately timed control methods will be most effective in managing autumn olive.

Use a foliar herbicide application to wet the entire canopy without allowing the droplets to drip. Directed applications of herbicides containing the active ingredients glyphosate (Roundup®, etc.), triclopyr (Remedy® Ultra, Crossbow®), fluroxypyr (PastureGard® HL) and picloram (Grazon® P+D) are especially effective for this purpose. Other herbicides, such as 2,4-D and dicamba, provide suppression of autumn olive. Foliar applications of systemic herbicides are especially effective in the months of July through September when there is adequate moisture in the soil. Late spring also is a suitable window for application.

Of the herbicides listed, glyphosate is non-selective and will cause injury to surrounding grasses and other vegetation; therefore, it should be applied as a directed spray to the target plants. If using glyphosate, use a coarse spray with an air-mix nozzle to avoid drift while providing sufficient foliar coverage.

To control larger plants, basal or cut-stump applications are recommended. For basal applications, apply a triclopyr herbicide mixed with high grade mineral oil or No. 2 diesel oil around the bark of a standing plant to a height of 12 to 18 inches above the soil. Follow the instructions on the herbicide label regarding type of sprayer and spray volume required. Basal applications may be carried out year-round, except when snow or rain prevent the spray from being applied all the way to the ground.

Herbicides containing glyphosate or triclopyr also are recommended for cut-stump applications. Using a sponge, brush or sprayer, apply the herbicide solution to the entire cut surface immediately after cutting. In addition, certain ready-to-use formulations may be used to conveniently treat small areas. A liquid formulation containing picloram and 2,4-D (Tordon® RTU) is effective as a cut-stump treatment.

A pelleted formulation containing tebuthiuron (Spike® 20P) may be broadcast directly over soil in the vicinity of autumn olive stems. Care should be taken not to apply this herbicide to areas prone to runoff. Application of this herbicide during early spring, prior to active growth and rainfall, will provide the best results.

Biological control

An effective and sustainable strategy to manage autumn olive is to graze goats and cattle on the affected pasture. Goats prefer brushes such as multiflora rose; however, they also can browse the foliage of autumn olive, especially when they are young. They can defoliate areas infested with brushes that offer limited access to humans.

Livestock tend to trample and forage on brushes when their grazing is confined to a tighter area. Such targeted grazing by goats contained using a solar-powered temporary step-in fence has proven to be effective, particularly to control smaller brushes. Various types of fencing materials, such as poly wire, electric tape and electric netting, are available.

Once brush is under control, create and maintain a dense canopy of forage and employ rotational grazing. This will help the forage out-compete new autumn olive seedlings and prevent the shrub's reestablishment.

Venting is key for your high tunnel IPM program

Anyone who has walked into a high tunnel or greenhouse in the summer can attest to the importance of venting the structure to reduce the temperature inside. In addition to helping with temperature reduction, ventilation also is critical to maximize crop production and controlling plant diseases through moisture level reduction.

High humidity levels favor disease development for many pathogens, such as leaf mold, gray mold and late blight. Therefore, it is important to reduce moisture in the high tunnel to lower the potential for plant pathogens to develop, as well as to maximize plant production and lower production costs. Additional information on moisture management can be found in a past issue of the "IPM Chronicle" (Volume 4, Issue 1) in an article titled Moisture Management is Key in Disease Management.

Ventilation systems

Roll-up sides

The most common ventilation system used in high tunnels is roll-up sides that allow passive ventilation. This type of ventilation works best for structures that are on sites with sufficient airflow. A wind speed of only 2 to 3 miles per hour is all that is needed to force cooler outside air into the windward side of the high tunnel. As the cooler air travels across the high tunnel, it will create a vacuum on the opposite side to pull the hotter air out.

If there are a number of trees, buildings or other significant wind breaks nearby, airflow may be hindered (Figure 2); thus, it is important to consider manufacturer and service provider recommendations when siting a high tunnel to ensure ventilation is maximized.

Figure 2. Buildings, trees and other objects can reduce ventilation in a high tunnel. (Photo credit: B.E. Liedl)

If the plants within the structure form a dense canopy, this also can hinder airflow within the high tunnel. The limited airflow may cause warmer air, and thus humidity, to collect in the plant canopy and peak of the structure (Figure 3). To avoid this situation, plant and prune your crop to allow for adequate airflow.

Figure 3. High plant density can hinder airflow across the high tunnel. (Photo credit: B.E. Liedl)

Gable vent

Another ventilation option is to install a gable vent near the peak of the high tunnel's end wall (Figure 4). This acts as the first stage of ventilation before rolling up the sides. In warm summer months, the vent will allow hot air trapped near the peak to be vented, as well as vent out excess humidity during the winter growing season. Even if a vent wasn't included when the high tunnel was first built, it is easy to retrofit a structure with one or two.

Considering venting options before putting up a high tunnel is ideal, but existing high tunnels can be retrofitted to improve ventilation to increase crop yields and produce higher profit.

Figure 4. Gable vent in a high tunnel end wall. (Photo credit B.E. Liedl)

Effect of healthy seeds and transplants on plant health

The Food and Agriculture Organization of the United Nations proclaimed 2020 as International Year of Plant Health, noting that healthy plants are the foundation for all life, ecosystem functions and food security. Plant health also is vital to the sustainable development of agriculture to feed the growing global population. Sustaining plant health through pest protection is a key factor in eliminating hunger and rural poverty, addressing issues of global concern, decreasing the effects of climate change and boosting economic development.

Figure 5. Crown rot and fruit rot symptoms that manifested from subtle black leaf spot symptoms on strawberry transplants. (Photo credit: a – MM Rahman; b – invasive.org; c – MM Rahman)

A new plant starts its life cycle from a seed or transplant, regardless of whether it has an annual or perennial life span. Like other organisms, the plant's early life stages are susceptible to numerous environmental and biological stresses.

Healthy seeds

One of the best ways to reduce the chances for early-season plant problems, especially diseases, is to use healthy seeds. Rainy and humid conditions during the growing season and seed ripening stages favor the development of many fungal, bacterial and viral problems that can be carried on infected seeds; therefore, it is unwise to save seeds from a disease-prone area. Producers should purchase seeds or transplants from reputable companies that sell high quality, disease-free seed and transplants. These seeds often originate from dry regions where diseases are less common.

Treating saved seeds

If you choose to save seeds, treat the seeds with bleach, hot water or fungicides to get rid of the diseases from seeds. Bleach removes disease-causing organisms from the surface of seeds, while hot water kills both external and internal pathogens. The hot water treatment is especially helpful for eliminating many disease-causing organisms on and within small seeds. Detailed instruction for hot water seed treatment can be found at *http://ag.umass.edu/news/hot-water-treatment-of-seeds*.

Fungicide seed treatments will protect the seeds from soil organisms and seedling disease during the early stages of seedling development, particularly when planted in conditions that are favorable for disease development. Fungicide-treated seeds should be handled with caution and planted promptly.

Healthy transplants

Transplants produced in greenhouses or nurseries also can be infected with diseases or infested by small insects, such as mites, aphids or white flies, if proper sanitation practices are not carried out. Sanitation methods include sterilizing reusable flats and pots and additional necessary clean-up measures. For example, transplants sitting on seedling trays or pots with improper drainage can be infected with phytophthora.

Perennial tree transplants may take these infections to the landscapes where they are planted, showing symptoms after a few years resulting in fatal plant health consequences. In other cases, due to a period of latency, infected plants only show symptoms at certain stages of maturity or when environmental conditions are conducive for disease development. For example, if exposed to anthracnose-causing fungi during

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Figure 6. Leaf distortion on a pepper plant due to broad mite injury initially on the transplants. (Photo credit: presnet.org)

Figure 7. A brown callus layer on a pepper fruit due to broad mite injury that initially came with the transplants. (Photo credit: MM Rahman)

Keeping wildlife out of your garden

Growing a garden can be a rewarding project; however, when intrusive wildlife appear, gardening can become challenging. Fencing is the most efficient and cost-effective method to exclude unwanted wildlife from small gardens. The seriousness of the problem and the amount of money willing to be spent will directly affect the choice of fence design and materials.

White-tailed deer control

White-tailed deer are the most commonly reported cause of garden damage. In areas where deer populations or deer damage are low, a single-wire electric fence, 30 inches off the ground, can deter deer from your garden. To make the single-strand electric fence more effective, smear peanut butter on 3-by-4-inch flags of foil and attach these to the fence at regular intervals of 3 to 4 feet along the fence. The peanut butter will attract deer to the fence, the deer will touch the flags with their nose or mouth, and the shock will provide adverse conditioning. Replacing the foil flags and peanut butter with strips of cloth soaked with an odor-based deer repellent is another alternative.

In areas where deer populations and deer damage is high, a sturdier fence may be necessary. The most effective deer fence is an 8-foot tall fence constructed with heavy gauge galvanized woven or welded wire. This type of fence is effective and long-lived; however, it is expensive and not aesthetically pleasing. Another option for effective fencing is a 7- to 8-foot tall plastic deer fence. It is similar to the woven wire style but made of sturdy plastic netting instead. This style of fencing is less expensive and can be taken down seasonally.

Smaller mammal control

Small- and medium-sized mammals, such as rabbits, woodchucks (also known as groundhogs), voles and moles, also can cause significant damage to gardens. To exclude medium-sized mammals, use a fence of heavy poultry wire or 2-inch mesh woven wire. The fence should extend at least 3 feet above ground and be buried about 10 to 12 inches below ground to prevent burrowing beneath.

Bending the top 12 to 15 inches of wire outward at a 45-degree angle will help prevent climbing animals from climbing over the wire fence. Adding a single-wire electric fence 4 to 5 inches above ground and about the same distance outside the mesh fence also will help.

A fence built to the above specifications but using a smaller diameter mesh will provide protection against smaller mammals, like rabbits, voles and moles. Consider using woven wire or poultry wire with a mesh opening no larger than 1 inch for rabbits. Voles and moles will require rolls of sheet metal or hardware cloth with a mesh size of ¼ inch or smaller. Adding the single-wire electric fence (with peanut butter or repellent) above the lower mesh fence will effectively exclude both deer and smaller mammals, saving the garden from destruction.

Healthy seeds and transplants *– continued from page 5 –*

propagation, strawberry transplants can get foliar infection but will not show severe symptoms until field set or fruit ripening (Figure 5). Pepper seedlings grown inside the greenhouse oftentimes can be infested with broad or cyclamen mites without showing any obvious injury; however, when transplanted in the field or inside a high tunnel, they can show serious leaf distortion (Figure 6). Eventually, a brown callus layer will form on the fruit (Figure 7) to make it unmarketable.

Precaution with transplants

Take the following precautionary measures with transplants to ensure healthy plants:

- Buy only from reputable companies that follow stringent sanitation and pest management protocol.
- Use a stereo microscope or high magnification hand lens to make sure transplants do not have any tiny insects underneath the leaves or at the base of the stems.
- Put suspected transplant samples inside a plastic bag under mist for 72 hours. If there is any latent infection, symptoms should be visible after seven days.
- Treat seedlings after proper diagnosis. This is convenient due to the requirement of spraying in small areas and the relatively low tolerance of seedlings and transplants.
- Use an integrated approach that includes the above-mentioned steps, along with selecting a proper site, providing balanced nutrition, regularly scouting for any maladies at the plant's early stage and taking any necessary remedial measures.

How will a warm winter affect my landscape?

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Ecto-dormancy

To get out of endo-dormancy, plants require accumulation of a certain number of chill hours. The Midwestern Regional Climate Center has a useful tool that can be used to calculate the accumulation of chill hours. This year by the first week of January, the Morgantown area had accumulated 900 to 1,000 chill hours. The same values are accumulated in the Northern Panhandle, Eastern Panhandle, Hampshire County, parts of Hardy, Mineral, Monroe and Greenbrier counties, as well as in the counties at the southwest, northwest and northern edges of the state.

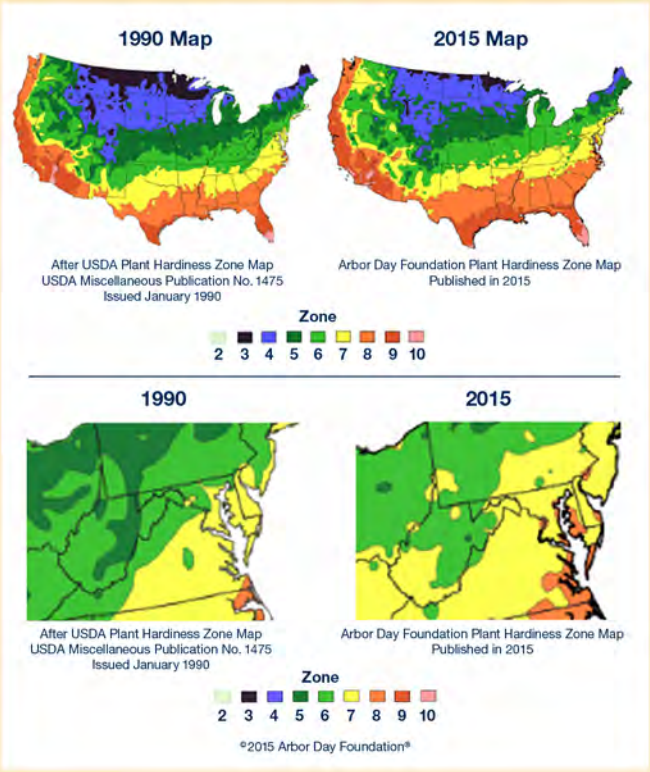

Figure 1: Changes in USDA hardiness zones for the period from 1990 to 2015. (Image credit: Arbor Day Foundation)

The central part of the state is about 200 chill hours behind. This means that ecto-dormancy is nearing. Historically, ecto-dormancy occurs in late winter when the chill accumulation requirements are satisfied. Active plant growth will resume when favorable weather conditions are evident. Flowering trees and shrubs can be forced into opening the buds and blooming by placing branches in water and keeping them at room temperature.

Potential for freeze injury and increased pests

If warm winter weather continues, plants will begin to open up the bud scales and start to open the buds. More water will start to flow through the plants making them extremely susceptible to freeze injury.

Generally, warm winters indicate an early spring, an early display of flowers and high probability for late spring frost injury. Flowering trees and shrubs will start vegetation much earlier than normal. Fruit trees will be particularly vulnerable if the mild temperature trend continues. Early bloom and fruit set can fall victim to a sudden temperature drop in the spring.

Mild winter temperatures also enable the survival of many insects and pathogens that would not survive cold winters. If the warmer temperatures continue, one can expect very heavy insect and disease pressure.

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