2023 Forest Health highlights

ILLINOIS

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FOREST HEALTH ISSUES FOR 2023: AN OVERVIEW

2023 began with a drought lasting well into mid-July for most of Illinois. Mild to moderate drought conditions lasted well into fall. At the time of this writing, most of Illinois has recovered, but areas of western and northwest Illinois are still dry making it a very challenging year for trees. Beginning in mid-July, some areas of the state experienced extremely heavy downpours that led to flooding, but precipitation was spotty and localized.

On the bright side, the drier spring and early summer did help reduce the incidence of foliar diseases like apple scab, cedar apple rust, powdery mildew, anthracnose, needle tip blight of pines, junipers, and arborvitae, and needle cast diseases.

Ongoing statewide issues included herbicide injury to oaks and other hardwood tree species, decline of spruces and pines, and oak decline and rapid mortality of white oaks. Emerald ash borer (EAB) populations continued to progress in areas of central and southern Illinois. Throughout the field season, the Illinois Forest Health team was on the lookout for diseases such as Sudden Oak Death (SOD) and Laurel Wilt (LW) but fortunately, neither one was detected. However, in September, 2023, Illinois joined the spotted lanternfly club with an infestation confirmed in the Chicago area in southern Cook County. Additionally, a statewide survey was initiated to determine the presence of Japanese stiltgrass (JSG) and chafflower (JCF) with a new JCF find in 2023.

Note: The 2023 issue of Illinois Forest Health Highlights (IFHHs) will focus on on-going forest health issues (i.e. herbicide drift damage, oak decline and rapid oak death, extreme weather events), and new and emerging, exotic pests, diseases, and invasive plants including spotted lanternfly (SLF), elm zigzag sawfly, laurel wilt (LW), box tree month (BTM), and survey and monitoring for Japanese stiltgrass and Japanese chafflower affecting Illinois forest resources.

For details on chronic insect pests (i.e. EAB) and diseases (foliar and needle cast diseases, cankers), please refer to previous issues of Illinois Forest Highlights (FHHs).

HERBICIDE DRIFT DAMAGE AND PLANT DISEASES

Herbicide Drift Damage (2, 4, 5)

Signs of herbicide damage to trees continued to be reported statewide in 2023, particularly on state and private lands bordering agricultural fields.

Types of herbicides. In general, herbicides are classified based on the types of weeds they control (grasses, broadleaf plants, woody plants, etc.), when they are applied (i.e. pre- or post-emergence), and their mode of action. Post-emergence broadleaf herbicides selectively kill actively growing broadleaf plants and include growth regulator herbicides containing active ingredients found in 2,4-D, 2,4-DP, MCPA, MCPP, and Dicamba. These products have broad application including homes, farms, and industry. They are prone to drift and volatilization.

Injury symptoms associated with these herbicides include twisted and downward cupping of leaves, and narrow, strap-like leaves on the youngest growth (**Figure 1**). Root uptake of these chemicals is usually more damaging to the plant and on grape the leaves will cup upward (**Figure 2**). These herbicides are fairly soluble and can move through the soil as well as air. As their name implies, grass herbicides kill grassy weeds. They may be applied pre- or post-emergence. Common pre-emergence herbicides include trifluralin and DCPA. Post-emergence herbicides include fenoxaprop, sethoxydim, and fluaziop-P. These products cause yellowing/bleaching of leaves and dieback of actively growing regions. Pre-emergence products are less likely to drift compared to post-emergence herbicides. Non-selective, post-emergence, broad spectrum herbicides are basically designed to kill a wide variety of plants and include paraquat, glufosinate, and glyphosate. A list of tree species sensitive to phenoxy herbicides (i.e. Butoxone, 2,4-D, MCPA, 2,4,5-T, silvex, and Banvel) is presented in **Table 1**.

Figure 1. Suspected herbicide damage to oak leaves. Mature oak leaves displaying severe distortion, cupping, twisting, and strapping due to suspected herbicide damage.

Figure 2. Herbicide damage on grape, most likely due to root intake (upward cupping leaves).

Table 1. Sensitivity of various trees species to broadleaf weed-killers (taken from Hibbs, 1978).

Sensitive	Intermediate/Unknown	Tolerant
Apple	Cherry	Catalpa
Ash	Cottonwood	Linden
Amur Cork Tree	Honey Locust	
Birch	Mulberry	
Boxelder	Oaks	
Elm	Silver Maple	
Hackberry		
Hickory		
Horse Chestnut		
Maple (Sugar, Red and Amur)		
Redbud		
Sycamore		
Walnut		

Herbicide drift. Like with all pesticides, herbicide drift can be a problem. Factors affecting drift potential include formulation, application method, air temperature, wind, and soil factors. For example, 2,4-D (low volatile ester formulations) can vaporize and be carried by the wind while 2,4-D (amine formulations) are less likely to vaporize. Granular formulations rarely move or volatilize. It is well known that the smaller the droplet size the higher the drift potential. To avoid drift issues, it is recommended to produce larger droplet sizes along with lower pressures or use sprayers with larger orifice nozzles. Weather factors such as air temperature, wind, and relative humidity (RH) may also contribute to herbicide drift. Some herbicides may vaporize at temperatures greater than 85^{o}F during or immediately after application. Herbicides in a vapor state can move large distances and can cause plant damage considerable distances from the point of application. Producing larger droplets and applying them closer to the target plants can minimize wind drift. Soil factors also play a role in herbicide drift. The amount of uptake by a soil-applied herbicide depends on the type of herbicide, location of plant roots in the soil, soil type, and soil moisture. Some herbicides are mobile and move rapidly in sandy and/or porous soils while others may persist in the soil.

Diagnosing herbicide drift damage. **Be careful not to jump to premature conclusions when attempting to diagnose for herbicide or other chemical injury.** Correct tree diagnostics is all about “patterns, patterns, patterns”. For example, are several different tree species impacted, or just one species? Is only one part of the tree impacted, or is damage more widespread? Other maladies may mimic herbicide damage including low temperature injury, foliar diseases (i.e. anthracnose), insect feeding (i.e. plant bugs, leafhoppers), and air pollutants. Some tree species may show damage while others will not.

A question to ask is, is only the new growth affected or is the entire canopy impacted? If it is a one-time event, then later new growth should look normal. In some cases, leaf tissue analysis may be required to determine which chemical is involved in plant damage. Has there been any disturbance to the soil around or near the tree(s) (i.e. addition of fill, construction activity, soil compaction, etc.), are there girdled roots present, and has there been a drought or flooding? Remember, most of the problems we see with trees usually start below ground.

Managing chemical drift damage. Unfortunately, for rural forested areas and woodlots, there is really no practical treatment other than to reduce stress factors in areas where tree symptoms are being observed. Trees growing in urban areas and home landscapes should be protected from predisposing stress factors such as construction injury, soil compaction, changes in drainage, competition from turf, and drought. Focus on tree health and vitality by mulching, watering during dry spells, and fertilizing where appropriate if nutrient deficiencies are present. Remember, older mature and over-mature trees do not react well to changes in their immediate growing environment. In most cases, healthy trees will recover from chemical damage the following season, but chronic exposure to herbicides along with the aforementioned pre-disposing factors may be enough to cause the tree to begin to decline, ultimately resulting in death. If you have to apply an herbicide for any reason, avoid herbicide drift by not spraying when cross winds exceed 10 mph, using lower pressures, and using spray nozzles that produce large-sized droplets.

Illinois Herbicide Damage Survey Results. We still have a lot to learn about spray drift and all of the related factors contributing to herbicides moving off-target. In 2018, we initiated a statewide survey to obtain a better idea of how extensive the problem is and to better understand the causes contributing to leaf tatters and/or herbicide drift and the relationship between chronic chemical drift exposure and its effect on long-term tree health. Leaf tissue samples were taken in 2023, focusing on oak species. Results are pending. **A summary of herbicide leaf tissue sampling for 2018-2022 is presented in Figure 3.**

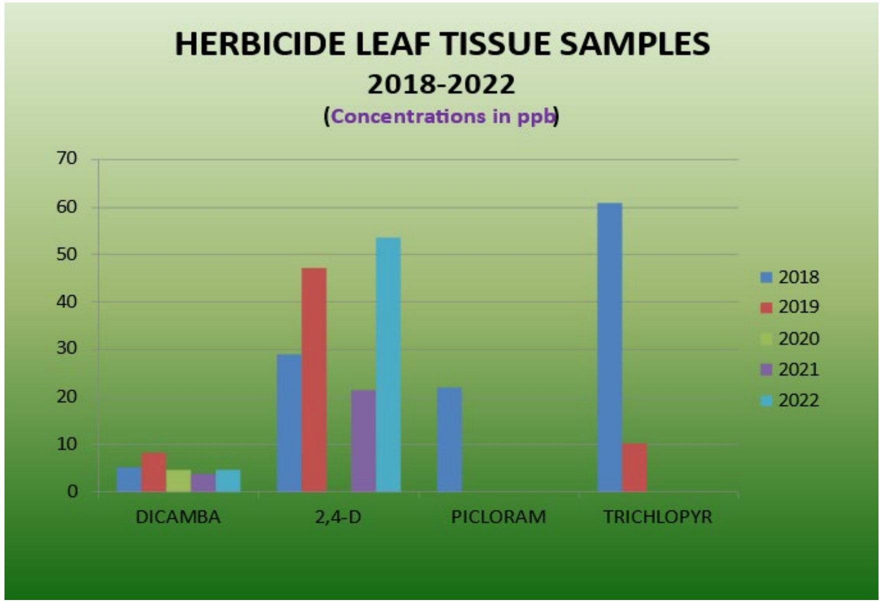

Figure 3. Summary of herbicide leaf tissue sample test results (ppb) for 2018-202.

SUDDEN OAK DEATH (SOD (1,12,14)

SOD is a disease of oaks caused by the pathogen *Phytophthora ramorum*, a water mold that also impacts over 100 other plant species throughout the world. The disease was originally detected in California in the 1990s and has since killed millions of oaks on the West Coast. The pathogen can spread through infected nursery stock and surface water. In 2020, it was detected in plants distributed to retail locations throughout Illinois. To determine whether the pathogen had the potential to spread from these locations to neighboring natural areas and parks, in the spring and fall of 2022, surface waters around these locations were sampled and analyzed for the presence of *P. ramorum*. **To date, test results have been all negative and the pathogen has not been detected. Testing will continue in 2024.**

LAUREL WILT AND THE REDBAY AMBROSIA BEETLE (10, 13, 15)

Another serious disease that we are monitoring for is Laurel Wilt. It is a fungal wilt disease caused by the pathogen *Raffaelea lauricola* which is spread primarily by the tiny redbay ambrosia beetle (*Xyleborus glabratus*) and several other beetle species. The disease has killed hundreds of millions of redbay (*Persea borbonia*) and swamp bay (*P. palustris*) trees, two important understory species, in the southeastern United States. The fungus also affects other members of the laurel family (Lauraceae) including sassafras (*Sassafras albidum*), spicebush (*Lindera benzoin*), and commercially grown avocado (*P. americana*) trees. Like other wilt diseases, the fungus induces a reaction in the tree that restricts the flow of water, causing leaves and branches to wilt and turn brown, and eventually killing the entire tree **(Figure 4)**. The redbay ambrosia beetle is very small (about 2 mm long) and is rarely seen **(Figure 5)**, although signs including small exit holes, sawdust "noodles", or fine sawdust can indicate their presence. ***For noodle images refer to https://www.forestryimages.org/search/action.cfm?q=ambrosia+beetle+noodle.*** Although redbay trees do not grow in Illinois, sassafras and spicebush are an important part of ecosystems in the southern part of the state and are susceptible to the wilt. The pathogen was recently detected in western Kentucky, so the disease and the beetle vector have been monitored for since 2020 in southern and central Illinois. **To date, no symptomatic trees or redbay ambrosia beetles have been detected in Illinois.** In 2024, we will continue to monitor for this destructive fungus and its insect vector.

Figure 4. Signs of laurel wilt in sassafras: brown wilted leaves (L) and dark streaks under the bark (R). Photo courtesy of University of Kentucky College of Agriculture, Food and the Environment.

Figure 5. The redbay ambrosia beetle on a finger for scale. Photo courtesy of USDA Forest.

OAK WILT (7)

Oak wilt is found in every Illinois county and has become a major urban and forest tree disease. Oak wilt levels for 2022 were comparable to previous years. This fungal disease is lethal to oaks, particularly oaks in the red oak group, and trees must be treated preventatively with fungicides to insure survival. Anthracnose may be confused with oak wilt later in the season. **(Figure 6)** Be sure to properly diagnosis the problem before employing management options. Prevention is important, so remember not to prune between April and September, and consult with experts before removing an infected tree because the disease can spread through the root grafts. The only way to be absolutely sure of a diagnosis is to send in samples to a plant clinic to confirm which fungus is involved. Keep in mind, that a tree could have both oak wilt and anthracnose at the same time.

For more information about Oak Wilt, please consult previous issues of *Illinois Forest Health Highlights* (IFHHs).

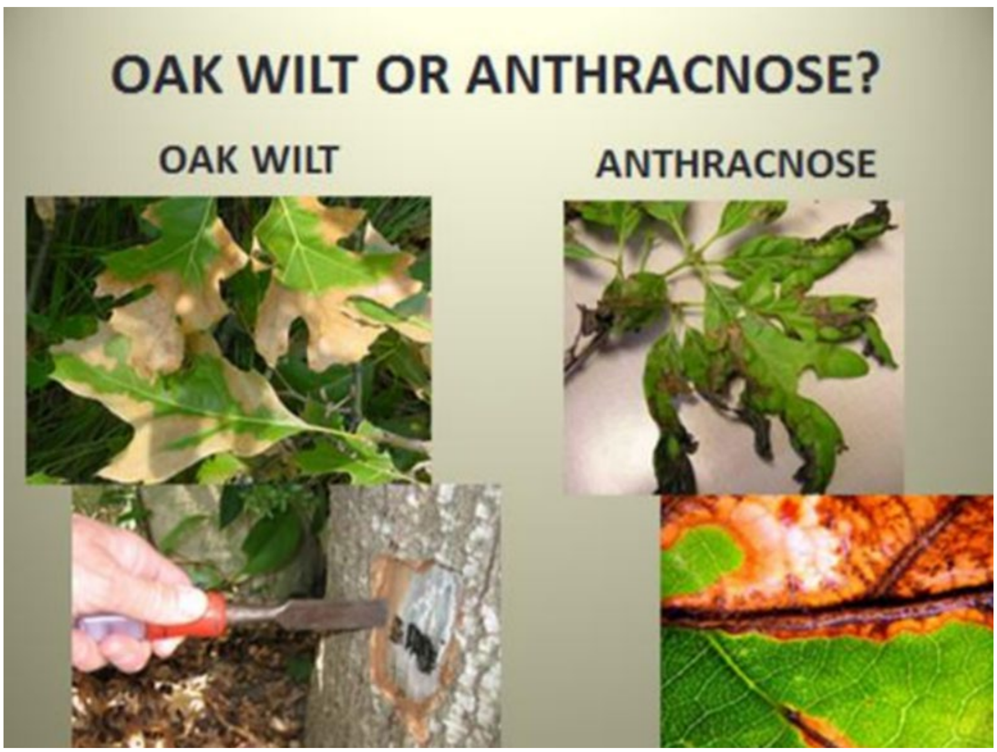

Figure 6. Side by side comparison of oak wilt and anthracnose symptoms in oak. The bottom left photo shows the dark streaking under the bark in oak wilt.

OAK DECLINE AND RAPID OAK MORTALITY (ROM) (6)

Multiple factors affect forest health, particularly exotic invasive plants, insects, and pathogens. Oak decline is fast becoming a prominent issue in Illinois and in the Midwest **(Figures 7 and 8).** In early 2023, the Illinois Forest Health program received USFS funding to begin a study to better understand the factor(s) responsible for the decline and rapid death of oaks occurring in both urban and rural forests. Objectives of this study are to 1) obtain a broad picture of possible factors and their interactions contributing to oak decline, 2) conduct a statewide survey of rural and urban forests to better understand root-rot fungi and their role in oak decline, 3) create an updated forest BMPs for rural landowners, natural resource managers, and urban foresters to assist in the management of existing oaks forests and future oak regeneration, 4) and conduct educational programs and workshops to assist residents of the natural resources and urban forest communities. The project will prioritize new and existing small tract private landowners, NGOs, parks and camps, and underserved municipalities and communities that desire and/or would benefit from assistance in developing forest management plans that lack adequate and effective forest management resources.

To date, 182 oak trees at 16 different sites were sampled throughout Illinois. At each site, tree DBH, tree species, slope, aspect, rooting depth, and any biotic and/or abiotic factors were noted and recorded. A composite soil sample was also taken to determine soil texture, soil pH and nutrient levels. Preliminary results have revealed that 85% of the roots samples taken from declining white oak, northern red oak, bur, black, swamp white, and shingle oaks tested positive (i.e. showed evidence) for the presence of water mold fungi (Oomycetes). **Please note: this is a qualitative measure and does indicate that the entire root system is infected, but only the roots that were sampled.** Additionally, 56% of the trees that had roots testing positive were growing on flat sites (<5% slope). Overall 62% of all of the 182 trees samples had rooting depths <10 inches and of those, 84% tested positive for evidence of Oomycete fungi. Further root tissue analysis is planned to determine which Oomycete fungal species are associated with oak roots and to identify which species are pathogenic or saprophytic. Additional root sample sites are planned for 2024.

For additional historical details on RWOM, refer to *Missouri Forest Health Update* (December, 2014) pages 5-6 (11) and the *2020 Illinois Forest Health Highlight* (page 8).

Figure 7. "Stag-horning" and dieback in a declining oak tree.

Figure 8. Oak mortality in rural forests

THOUSAND CANKERS DISEASE (TCD) OF EASTERN BLACK WALNUT

To date, neither the walnut twig beetle (WTB) or the TCD fungus has been detected in eastern black walnut trees in Illinois, and no new finds have been reported for areas of the eastern U.S.

NEW INVASIVE PESTS

Spotted Lanternfly (8, 11)

In September, 2023, an active infestation of the spotted lanternfly (SLF) (*Lycorma delicatula*) was detected in the Chicago area in southern Cook County. The SLF is native to China and also found in India, Japan, Korea, and Vietnam. It is considered highly invasive due to its wide host range of more than 70 plant species and lack of natural enemies. The young nymphs are wingless, initially black but develop red patches as they mature, and have white spots on their body and legs. Adults are large (1-inch-long and ½ inch wide) with black legs and head, yellow abdomen, and light-brown to gray forewings **(Figure 9 and 10).** The hind wings are scarlet red with black spots. SLF females lay egg masses containing 30-50 eggs that are gray-brown and covered with a shiny grey waxy covering. The SLF has one generation per year (univoltine) with eggs hatching in the spring and early summer and adults appearing July through August. Egg-laying begins in September and continues through November (**Figure 11**).

Upon egg hatch, the young nymphs disperse and begin feeding on a wide range of hosts producing large amounts of honeydew. Adults are found on tree trunks, stems, and near leaf litter at the base of the tree. Adults are poor flyers, but strong jumpers. They favor Tree-of-Heaven (*Ailanthus altissima*), black walnut (*Juglans nigra*), and grapevine (*Vitis vinifera*) as host plants.

In the fall, the adults seek out Tree-of-Heaven for feeding and egg laying. Adult females will tend to lay eggs on smooth-trunked trees or any vertical smooth natural and/or man-made surface. They are able to lay egg masses on trucks, train cars, RV's, etc. and can easily travel to new locations. Heavy feeding may lead to plant stress and plant death. Sooty mold typically develops in association with honeydew diminishing the plant's ability to produce food (photosynthates). The SLF has the potential to greatly impact the grape, orchard, logging, tree and wood-products, and green industries.

Since Tree-of-Heaven **(Figure 12),** also non-native and invasive, is a critical host for SLF for part of its life cycle, efforts to prepare for the potential spread of SLF have thus far included a statewide survey of locations of Tree-of-Heaven. Knowing the locations of populations of the tree will aid us in monitoring and responding to this pest threat.

Figure 9. Spotted lanternfly nymph (Left) and adult spotted lanternfly (Right).

Figure 10. Adult spotted lanternfly.

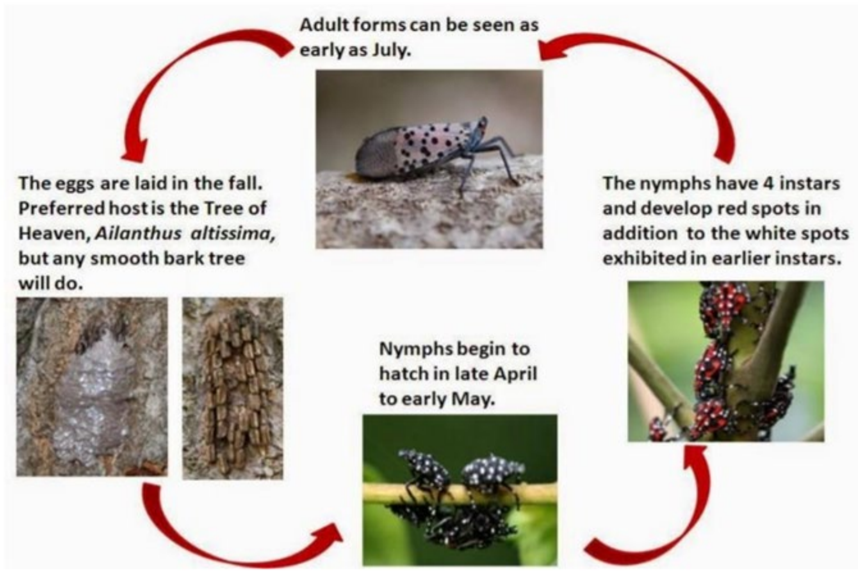

Figure 11. Life cycle of the spotted lanternfly.

Figure 12. Photos of Tree-of-Heaven. Courtesy of USDA NRCS (L) and Northwest Michigan Invasive Species Network (R)

Zig-zag Elm Sawfly (16)

What a name! The zig-zag sawfly (*Aproceros leucopoda*), which is native to Asia, found its way to Canada in 2000 and to the U.S (Virginia) in 2021. It is a defoliator of most elms, particularly Siberian elm (*Ulmus pumila*) and American elm (*U. americana*). The jury is still out as to whether it will be a serious problem for other elm species and hybrids. There is the potential for the insect to have important ecological impacts for elms used in urban forests and landscapes and the fact that 500 insect species depend on elms. The sawfly reproduces parthenogenetically (no males) and can have 4 to 6 generations per year (Scary!). The adults are strong flyers (can disperse 30 to 50 miles per year). The larvae feed from the edge of a leaf in a zigzag pattern. After pupation, very rapid adult emergence follows (**Figures 13 and 14**).

Figure 13. Elm zigzag sawfly larva and feeding damage.

Figure 14 Adult elm zigzag.

Box Tree Moth (BTM) (17, 18, 19, 20)

In July 2021, the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) confirmed the presence of box tree moth (BTM) (*Cydalima perspectalis)* in Niagara County, New York and probably originated from a nearby infestation in Canada (**Figures 15A and B**). Box tree moth (BTM) is moving south and west, and was later found by APHIS in Lenawee County, Michigan in November 2022. Presently, APHIS and the Michigan Department of Agriculture and Rural Development (MDARD) are determining the extent of the infestation in Michigan. More recently, BTM was confirmed by APHIS in Hamilton County, Ohio June 2023.

The BTM is an invasive pest, native to east Asia including Japan, China, the Russian Far East, Korea, and India. It arrived in Germany in 2006 and has continued to spread throughout Europe (**Figure 16**). BTM can significantly damage and potentially kill boxwood (*Buxus* spp.) plants if not managed. Boxwoods are a popular ornamental evergreen shrub common to almost all landscape environments in the temperate United States.

Figure 15A Box tree moth

Figure 15B Box tree moth

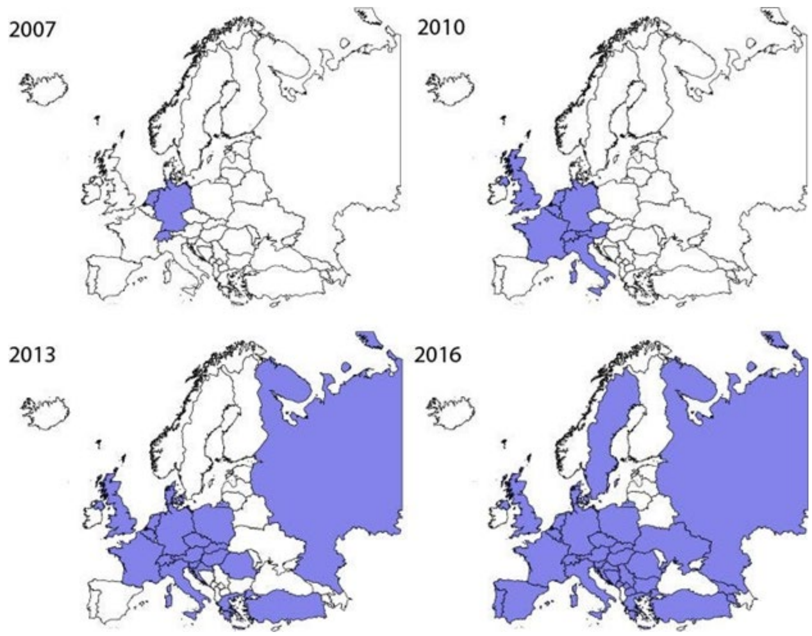

Figure 16. Box tree moth invasion of Europe. Modified from Bras et al. (2019) and EBTS (2020).

Box tree moth larvae feed exclusively on boxwoods (**see Table 2 for a listing of potential plant hosts**) with young larvae feeding on the undersides of leaves, which give them a "peeled" appearance from the top. Young pupae are green with brown stripes. Older larvae consume the entire leaf except for the midrib. In addition to feeding damage, caterpillars web together leaves and construct silken retreats. Once the leaves have been eaten, the larvae begin consume the bark which leads to girdling and even plant death. Extensive feeding may kill individual plants and entire plantings (**Figures 17A, B, and Figure 18**).

Figure 17A Boxwood tree moth larva and feeding damage.

Figure 17B Boxwood tree moth larva and feeding damage.

Figure 18. Box tree moth larval feeding damage.

Table 2. List of *Buxus* spp. and alternate hosts of the boxwood tree moth

Family	Scientific name	Common Name	Confidence
Buxaceae	*Buxus microphylla*	Littleleaf boxwood	Host status certain
Buxaceae	*Buxus microphylla* var. *japonica*	Japanese boxwood	Host status certain
Buxaceae	*Buxus sempervirens*	Common boxwood	Host status certain
Buxaceae	*Buxus sinica* var. *insularis* (=*Buxus microphylla* var. *insularis*	Korean boxwood	Host status certain
Rutaceae	*Murraya paniculata*	Mock orange	Host status certain
Celastraceae	*Euonymus alatus*	Burning bush	Host status uncertain
Celastraceae	*Euonymus japonicus*	Japanese spindletree	Host status uncertain

Box tree moth eggs are pale yellow (**Figure 19**) and are laid in groups of 5–20 and overlap like shingles. Eggs take three days to develop. Box tree moth larvae (**Figure 17-A,B)** are green and yellow with white, yellow, and black stripes, and black spots. They are the only caterpillars that feed on boxwood, so identification is relatively easy. The larvae take about 14 days to mature. Pupae are found in the webbing and damaged leaves, and take about 14 days to develop (**Figure 20**). Most adult box tree moths are white with a brown border. Adult box tree moths can survive for about a month. They are strong fliers and can disperse 4–6 miles (**Figures 17-A, B)**.

Figure 19. Box tree moth eggs

Box tree moths have 1–5 generations per year depending on the latitude and local climate. BTMs overwinter as 2^{nd} to 5^{th} instar larvae and can survive temperatures to at least -22°F (-30°C). Overwintering larvae have a minimum development threshold of 46–53°F and will begin feeding in early to mid-spring (i.e. late May to early June) in the Midwest (**Figure 21A and B**). BTM larvae have an obligatory diapause (when the caterpillars stop eating and rest) of 6–8 weeks when day lengths reach 13.5 hours which occurs between 15–20 April with feeding beginning again in late May to early June.

Figure 20. Box tree moth pupae.

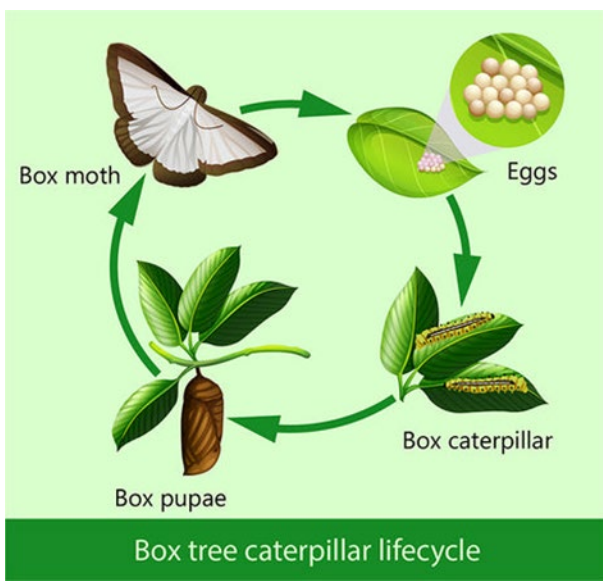

Figure 21A. Box tree moth life cycle.

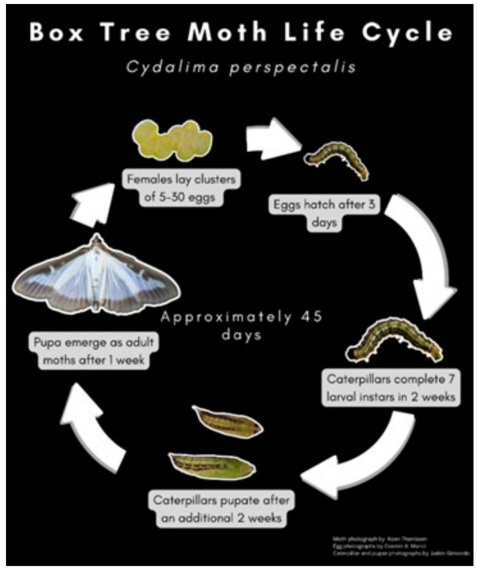

Figure 22B. Box tree moth life cycle

Management of BTM may be accomplished when infestations are small by **hand-picking** caterpillars and disposing of them in soapy water or by using high pressure water jets to knock them off plants. This will prove to be lethal and will not enable the larvae to climb back up the plant before starving.
There is a commercially available sex pheromone and pheromone traps which can be used for **monitoring of BTM.**

Biological control (BC) is possible including a variety of parasitoid wasps and flies from the BTM's native range but all of these natural enemies are generalists and will probably not provide adequate control of BTM.

Chemical management using horticultural oil and insecticidal soaps can be effective against young caterpillars, but will require complete coverage. Biopesticides, such as *Bt* and Spinosad, may also be effective as well as broad spectrum pesticides, but care should be taken not to impact natural enemies and pollinators. However, adequate coverage can be difficult to achieve as the young caterpillars feed only on the undersides of leaves and older caterpillars are protected by silken webs.

WEATHER AND ABIOTIC EVENTS: 2023 WEATHER TRENDS

The 2023 growing season began with a chronic drought beginning in early spring and peaking by mid-July which made for a very stressful growing season for many of woody plants (**Figure 22**). There was a brief respite by late August (**Figure 23**), but abnormally dry to mild drought conditions returned for much of September and October. At the time of this writing (early November), most of the state has recovered or is dry, with the exception of western and extreme southeastern Illinois which are still suffering from moderate drought conditions (**Figure 24**). During the summer, several severe storms moved across the central part of the state in an east-west band causing minor to moderate tree damage and some structural damage in affected communities.

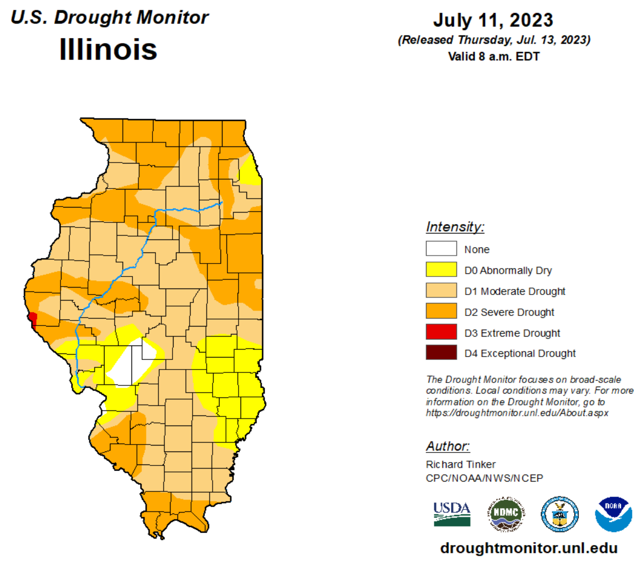

Figure 22 Drought monitor map for Illinois for mid-July 2023.

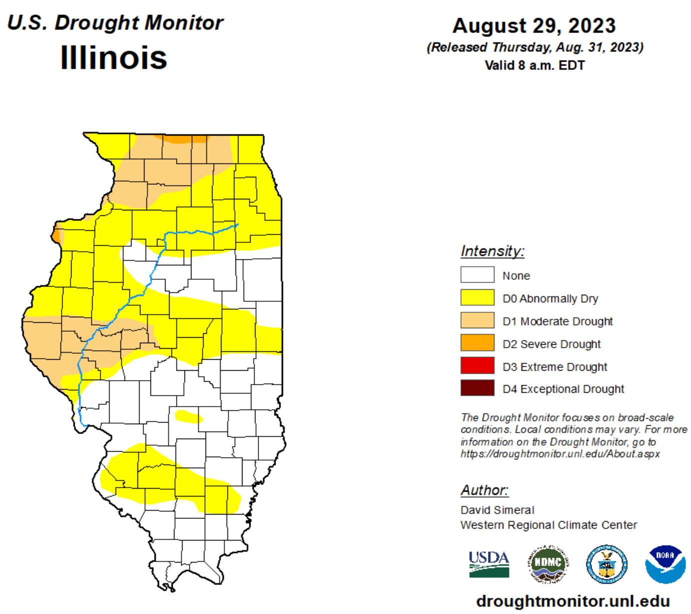

Figure 23 Drought monitor map for Illinois for late August 2023.

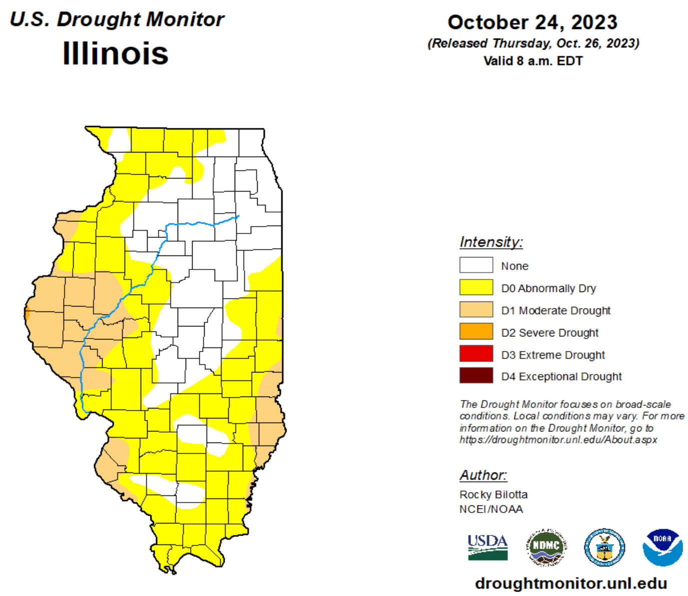

Figure 24 Drought monitor map for Illinois for 24 October 2023.

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PLEASE NOTE: *The information presented in this summary is not to be considered comprehensive or all inclusive. Information presented here is based on visual and observational surveys and reports by Fredric Miller, Ph.D., IDNR Forest Health Specialist, and Morton Arboretum, Research Interns., IDNR Forest Health field technicians, IDNR district foresters, private landowners, homeowners, The Morton Arboretum Plant Diagnostic Clinic, and members of the green industry.*

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