2024 Forest Health highlights

ILLINOIS

Prepared by Fredric Miller, Illinois Forest Health Specialist, The Morton Arboretum, Lisle, Illinois

FOREST HEALTH ISSUES FOR 2024: AN OVERVIEW

2024 began with a fairly wet and cool spring for most of Illinois which led to somewhat higher levels of foliar diseases such as apple scab, cedar apple rust, powdery mildew, anthracnose, needle tip blight of pines, junipers, and arborvitae, and needle cast diseases. There was some flooding in parts of Illinois. Beginning in July and lasting through the time of this writing (i.e. early December), abnormally dry to moderate drought conditions progressed well into the fall. Several hurricanes in October brought some relief to the southern 1/3 of the state, but the northern 2/3 continued to progress toward drought conditions through early December. Most rain that was received was via heavy down pours with very limited infiltration into the soil.

As in 2023, ongoing statewide issues included herbicide injury to oaks and other hardwood tree species, decline of spruces and pines, and decline and rapid mortality of oaks. Emerald ash borer (EAB) populations are still present in areas of central and southern Illinois, but populations have pretty well crashed in the northern portion of the state. Monitoring will continue to determine if EAB populations will stay at low levels or begin to build once again. 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 in 2024 an additional spotted lanternfly infestation was detected at a second site in Cook County to add to the one found in September, 2023. Additionally, in 2024, a statewide invasive plant survey was expanded to determine the presence and environmental conditions favoring the establishment and spread of a number of herbaceous and woody invasive plants. The survey will ongoing into 2025.

Note: The 2024 issue of *Illinois Forest Health Highlights* (IFHHs) will address on-going forest health issues including herbicide drift damage, oak decline and rapid oak death, extreme weather events, and new and emerging, exotic pests, and diseases, such as the spotted lanternfly (SLF), elm zigzag sawfly (EZZSF), laurel wilt (LW), and box tree month (BTM), For details on chronic insect pests (i.e. EAB) and diseases (TCD, oak wilt, foliar and needle cast diseases, cankers), please refer to previous issues of *Illinois Forest Highlights* (FHHs).

ABIOTIC AND BIOTIC PLANT DISEASES

HERBICIDE DRIFT DAMAGE

Herbicide drift damage to trees statewide continued to be reported in 2024, particularly on state and private lands bordering agricultural fields. Due to increased costs associated with leaf tissue chemical analysis and forest health budget reductions, leaf tissue samples were not collected or submitted for analysis for the 2024 field season. For a more recent comprehensive report of herbicide drift in Illinois, please refer to the 2024 publication by Prairie Rivers Network entitled ***Hidden in Plain Site: Herbicide Drift and Chemical Trespass, A Summary of 6 Years of Monitoring and Tissue Analysis by Kim Erndt-Pitcher & Martin Kemper.***

SUDDEN OAK DEATH (SOD)

Sudden oak death (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, all test results have been negative and no symptomatic plants have been detected. Testing will continue in 2025.**

LAUREL WILT AND THE REDBAY AMBROSIA BEETLE

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 1)**. The redbay ambrosia beetle is very small (about 2 mm long) and is rarely seen **(Figure 2)**, 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 2025, we will continue to monitor for this destructive fungus and its insect vector.

Figure 1. 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 2. The redbay ambrosia beetle on a finger for scale. Photo courtesy of USDA Forest.

IS IT OAK WILT OR ANTHRACNOSE?

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

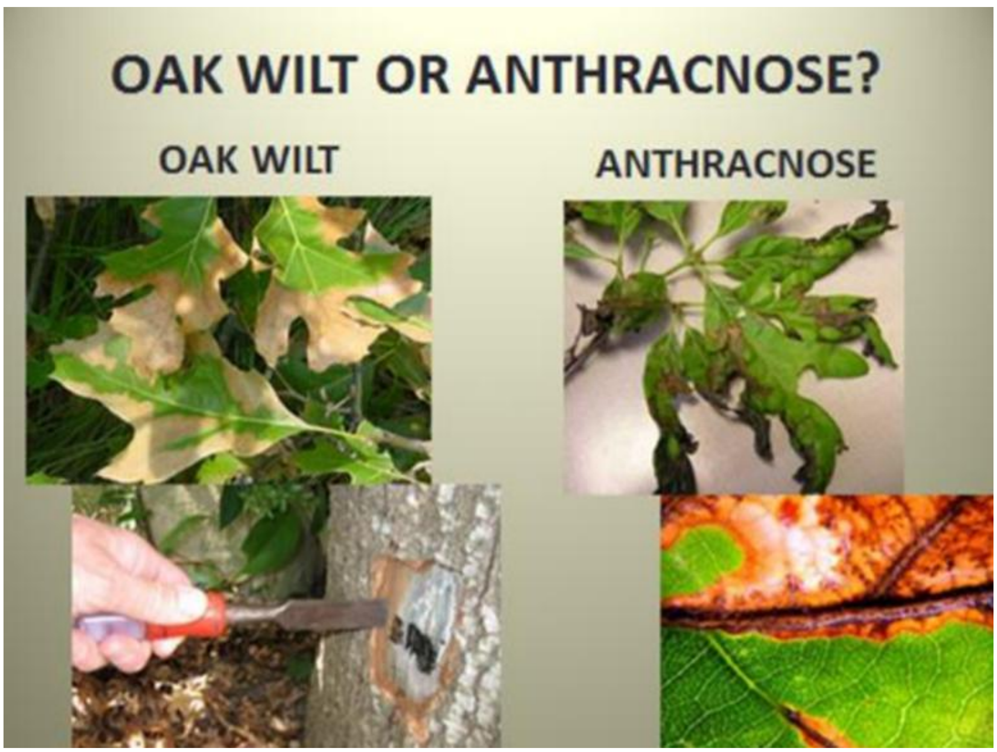

Figure 3. Side by side comparison of oak wilt and anthracnose symptoms in oak. The bottom left photo shows the dark streaking under the bark in oak wilt.

OAK DECLINE AND RAPID OAK MORTALITY (ROM)

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 4 and 5). 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 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 prioritizes 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.

During the 2023 and 2024 field seasons, over 400 oak trees at 40 different rural forest sites were sampled statewide. 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 for 2023 and 2024 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 indicates that these water molds are present in the rhizosphere where samples were taken.** 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.

A summary of Oomycete species (i.e. *Phytophthora, Pythium*, and *Phytophythium*) sequenced from root samples taken from both rural and urban forests (i.e. Adams and Resmen study) is presented in Table 1. A number of these Oomycetes taxa have been reported in the scientific literature to be associated with oak decline in Europe. Further studies are planned to determine which Oomycete species may be involved with oak decline locally.

Figure 4. "Stag-horning" and dieback in a declining oak tree.

Figure 5. Oak mortality in rural forests

Table 1. Summary of Oomycetes identified from oak root-rhizosphere samples

Oak Species	***Oomycetes Sequenced***
White Oak	***Phytophthora sp., Pythium sp. Isolate Pyt726, Pythium torulosum, Pythium vanterpoolii, Phytopythium vexans***
Bur Oak	***Phytopythium vexans, Pythium aff. diclinum***
Black Oak	***Phytopythium vexans***
Shingle Oak	***Pythium aff. diclinum***
Adams and Resmen Study	***Phytophthora pini, Phytopythium plurivora, P. littorale, Pythium macrosporum, P. latarium, Globisporangium heterothallicum Elongisporangium anandrum***

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 (SLF)

In September, 2023, an active infestation of the spotted lanternfly (SLF) (*Lycorma delicatula*) was detected in the Chicago area in southern Cook County and in 2024, two new adult populations were discovered in the same general area of 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 **(Figures 6 and 7).** 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 8**).

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 9),** also non-native and invasive plant, 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 6. Spotted lanternfly nymph (Left) and adult spotted lanternfly (Right)

Figure 7. Adult spotted lanternfly

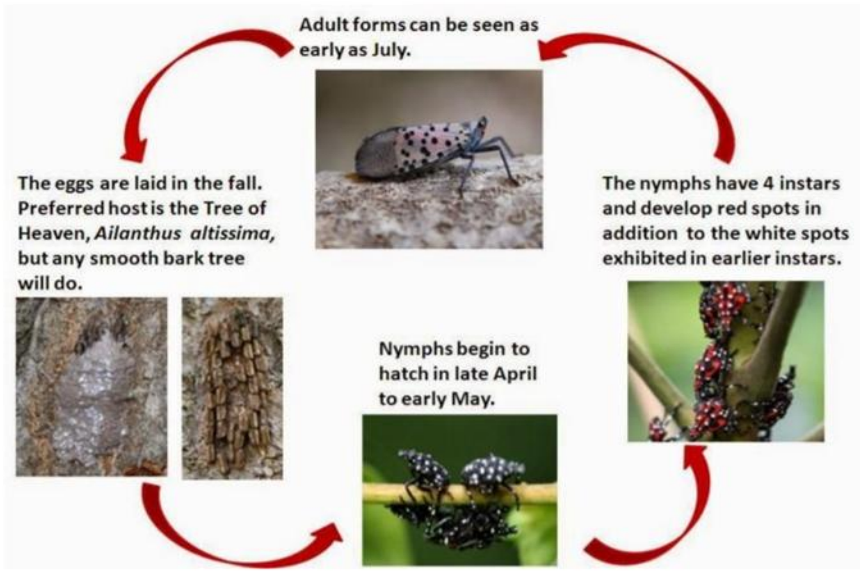

Figure 8. Life cycle of the spotted lanternfly

Figure 9. Photos of Tree-of-Heaven. Courtesy of USDA NRCS (L) and Northwest Michigan Invasive Species Network (R)

Zig-Zag Elm Sawfly (EZZSF)

In case of any of you are getting bored with the same old pests, I thought I would brighten your New Year with a new exotic invasive pest, the elm zig-zag sawfly (EZZSF) (*Aproceros leucopoda*) (Takeuchi, 1939). The EZZSF is a native of eastern Asia (i.e. Japan and China) and was originally found in Europe in 2003 feeding on *Ulmus* spp. in Austria, Hungary, Poland, Romania, Slovakia, Russia, and the Ukraine (Blank et al., 2010; Shchurov et al., 2012). Since then, it has been found in Belgium and the Netherlands. In Europe, EZZSF larvae are capable of completely defoliating native and non-native elm (*Ulmus* spp.) trees resulting in at least partial dieback (**Figure 10**). It is likely that it will continue to spread throughout Europe as evidence in its discovery in England in 2017, but to date has not been found in France.

In 2020, EZZSF was found in Canada (Quebec), and the United States in 12 eastern and central states including Minnesota, Wisconsin, and in Illinois in 2024 (**Figures 11 and 12**) (Martel et al., 2021). How it has spread throughout Europe and now to North America is uncertain, but like most invasives (i.e. spongy moth, emerald ash borer, Asian longhorn beetle, spotted lanternfly), it has probably resulted from human activity including the importation of elm trees for planting and reforestation, and on vehicles (Blank et al., 2010).

Figure 10. Defoliation by the elm zigzag sawfly

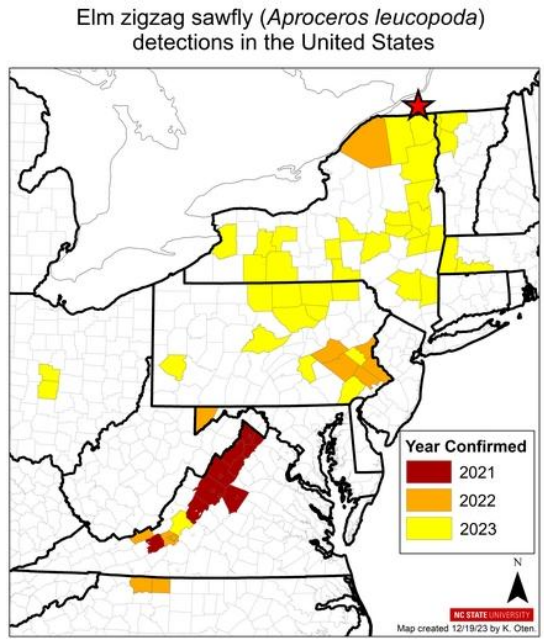

Figure 11. EZZSF Distibution in the Eastern U.S.

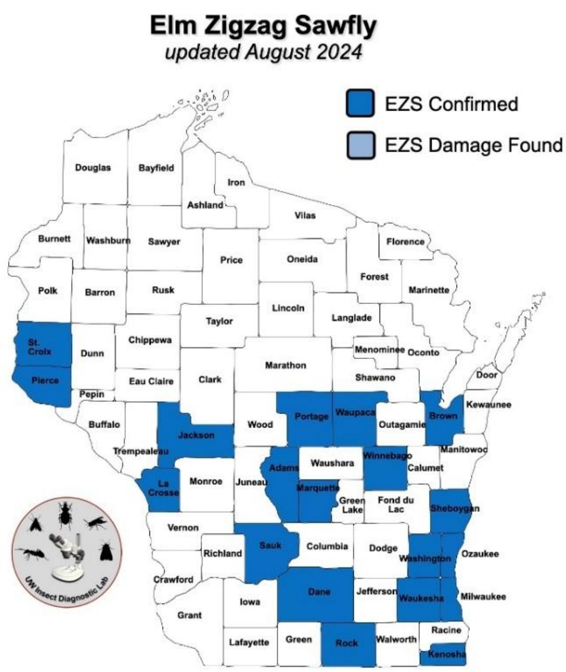

Figure 12. EZZSF Disstribution in Wisonsin

Why should we be concerned about the elm zigzag sawfly? The EZZSF has the potential to be a serious defoliator of elms (*Ulmus* spp.). Recent field observations and research studies suggest the EZZSF prefers Siberian elm (*U. pumila*), but also American elm (*U. americana*) (Martel et al., 2022). In a recent study by Blank et al (2010), EZZSF was found to prefer Siberian elm (*U. pumila*), and *U. pumila* var. *arborea* in Hungary. Additionally, in Romania, infested branches of Scots elm were found in the upper canopy of forests, and the top sections of the canopy were more severely damaged than the middle or bottom sections. The average defoliation of individual trees ranged from 74% to 98%, and the EZZSF did not show any preference for host trees by size class. (Blank et al., 2010). EZZSF is found commonly in its native habitat of Hokkaido, Japan and from 1991-1993, Siberian elm trees were severely defoliated by larval feeding, and then suffered dieback (Blank et al., 2010). Severe defoliation was documented in recent plantings of the Resista® cultivars of *U.* 'New Horizon', and *U.* 'Regal' (Blank et al., 2014). This same feeding preference for Siberian elm also has been observed in other studies for Siberian elm alone, and when it is incorporated into hybrids with other elm taxa where it appears to affect the susceptibility, preference, and suitability of elms for an extensive defoliating insect guild including Japanese beetle (*Popillia japonica*), elm leaf beetle (*Xanthogaleruca luteola*), spring cankerworm (*Paleacrita vernata*), fall cankerworm (*Alsophila pometaria*), and elm leafminer (*Fenusa ulmi*) (Miller et al. 1999; Miller, 2000; Miller and Ware, 2001; Bosu et al. 2007; Condra et al. 2010; Miller and Ware, 2014; Griffin et al. 2017).

In North America, the jury is still out as to whether it will be a serious pest for landscape and urban forest trees that are currently being planted as replacements for elm trees lost to Dutch elm disease (DED), and the emerald ash borer (EAB). Like most sawflies, the larvae consume all of the host leaf tissue and heavy populations can result in complete defoliation of the tree. With the potential for four (4) to six (6) generations per year, this can result in season-long defoliation putting the host tree under tremendous stress and making it vulnerable to lethal wood-boring insects and pathogens as well as loss of aesthetic and ecosystem services.

Identification and Life History of the EZZSF

Like all sawflies, the EZZSF belongs to the taxonomic order, Hymenoptera, which also includes bees, wasps, hornets, ants, and some leafminers. Sawfly larvae resemble Lepidopteran (moths and butterflies) larvae, but have six or more sets of abdominal prolegs (fleshy extensions of the abdominal wall), but lack crotches (i.e. hooks or "insect Velcro") on the prolegs. In contrast, Lepidopteran larvae have five (5) or fewer pairs of prolegs, but crotchets will be present on the prolegs. If you have every tried to pull a tomato hornworm off our tomato plant, you know all about the crotchets. For a good reference for distinguishing between pestiferous larvae and harmless ones, refer to Raupp (1990).

The EZZSF is a tiny green caterpillar-like larva that attaches itself to the inside edge of the leaf as it feeds (**Figure 13**). Young EZZSFs are a uniform green while older larvae will have a lateral stripe on each side of their head capsule which crosses their eyes. Their 2nd and 3rd thoracic or 'true legs' are brown and have a T-shaped mark (info@invasivespeciescentre.ca).

Figure 1. Elm zigzag sawfly larva and feeding damage.

The larvae hatch from eggs after 4–8 days, and begin feeding on leaves in mid to late May. Feeding by young larvae shows the characteristic zigzag pattern (**Figure 13**). There are usually multiple larvae feeding on the same leaf. As the larvae mature, they completely consume the entire leaf except for the midrib making it hard to determine if the damage is due to the EZZSF or other leaf-consuming caterpillars such as cankerworms (info@invasivespeciescentre.ca).

When full-grown the larva leaves the feeding area and travels a short distance to pupate. The distinctive lattice-like cocoon is a very reliable feature (**Figure 14**). The sawfly may have 4-7 larval instars and completes development within 15-18 days. Late instar larvae have been observed from late June to late September (Blank et al., 2010). To date, observations in Wisconsin suggest 2-4 generations per year.

Upon completing larval development the pupa constructs either a loosely spun, lightly-colored cocoon with a net-like structure consisting of a grid of silk strands fixed to the cocoon surface and attached to the lower leaf surface on woody parts of host plants, but rarely on twigs or the ground; or a more compact, solid-walled cocoon, the former being formed during the summer and the latter in preparation for overwintering (Blank et al., 2010; Pappet al., 2018) (**Figure 14**). Pupation occurs within the cocoons after 2–3 days and adults emerge 4–7 days after the cocoons are produced. The overwintering, solid-double-walled brown parchment –like cocoon is barrel shaped and is about 7–8 mm long and 4 mm side. The overwintering cocoons are typically found in the field in the litter or soil, and contain soil and organic particles (Wu, 2006;Blanket al., 2010; Lengesova, 2012; Martynov & Nikulina,2017, Vétek, personal observation). Overwintering individuals are produced from spring to autumn because both types of cocoons have been found in the field from early June, through late September. (Wu, 2006; Blanket al., 2010; Mol & Vonk, 2015; Mol, 2017; Pappet al., 2018).

Figure 14. Elm zigzag sawfly pupa

The adult EZZSF is a tiny black, wasp-like sawfly, less than 1 cm long, with whitish legs, but is rarely seen (**Figure 15**). Upon emergence, the adult female begins laying her eggs by inserting them into the leaf edge of young elm leaf tissue (Vetek et al., 2020). Adults may be found from mid-May to early September. In laboratory studies, adult females lived from one to six days with most living two days, and then began ovipositing soon after emergence. Female EZZSFs may lay a total of 7–49 eggs singly into the tips of consecutive indentations around the leaf margin (Blank et al., 2010). The adults are strong flyers and can disperse 27 to 54 miles per year. Total insect development for one generation (i.e. egg to adult) has been found to be between 24–29 days (Blank, et al., 2010).

Figure 2 Adult elm zigzag.

Management of the EZZSF

Early detection and monitoring of the EZZSF is essential in preventing extensive feeding damage to host trees. Intermittent or periodic defoliation is usually not a serious problem for healthy trees, but due its shorter development time leading to multiple generations, EZZSF larval feeding will occur all season long and the effects on tree health could be much more severe. While not desirable from an energy standpoint, most trees can re-foliate, but with continuous defoliation the tree will not be able to produce or replace photosynthates that its needs to properly function and thrive.

Human transport of EZZSF life stages from countries of pest origin is a major means for passive long- distance dispersal and spread. Careful and thorough inspection of host plant material for eggs, larvae and pupal cocoons will be vital in limiting the spread of the EZZSF throughout Europe and North America. (Blank et al., 2010; Wu, 2006).

Insecticidal sprays have shown to be effective (Blank et al., 2010), however, in view of the wide distribution of this species in Europe and now in North America, and the ability of its adults to quickly re-invade a treated area, the local application of insecticides is unlikely to prove an effective and sustainable method of controlling this pest . Like all leaf-feeding larvae, the older or mature they are, the harder they are to kill, and the more damage that occurs**. REMEMBER, microbial treatments of *Bacillus thuringiensis* will not be effective against sawfly larvae including the EZZSF.**

A tachinid parasitoid *Blondelia nigripes* (Fallén, 1810) (Diptera: Tachinidae), is a widely distributed Palearctic species, and is the only parasitoid that has been reared from the EZZSF (Shima, 1984, 2006). The distribution of *B. nigripes* within Europe includes the countries where *A. leucopoda* is currently recorded (Tschorsnig, 2007). This tachinid fly parasitizes larvae of numerous species belonging to three families of sawflies (Hymenoptera: Symphyta) and five families of moths (Lepidoptera). The wide host range of *B. nigripes* reduces its efficient control of the EZZSF. The introduction of natural and more specialized parasitoids in Europe and potentially in North America, accompanied by extensive monitoring of the future spread of the EZZSF may lead to possible sustainable control in the future (Pschorn-Walcher, 1977).

Will our winter temperatures impact overwintering survival of the EZZSF?

A common question that is asked is “can severe winter temperatures reduce overwintering insect pest populations?” The short answer is probably not. In a study by Vetek et al. (2020), they found the that supercooling point (SCP) of overwintering EZZSF individuals varied geographically, monthly and inter-annually, and ranged between 10^{o}F and -10^{o}F. Since none of the overwintering pupae survived once the SCP had been reached, the EZZSF is classified as a freeze-avoidant insect (Vetek, et al., 2020). It appears that low winter temperatures may not be an important limiting factor in the ability of the EZZSF to overwinter in temperate climates particularly with current trends of milder winters associated with climate change. Further, EZZSF might experience buffered temperature conditions in nature (i.e. under leaf litter and snow cover) that remain above the SCP. These factors, as well as the effects of periods of prolonged cold will likely determine the overwintering success of this species (Vetek et al., 2020).

In summary, further studies are needed to determine long-term sustainable management practices such as effective and efficient host plant inspections, monitoring of pest populations, biological control, host plant resistance, and environmentally safe chemical treatments to help mitigate and prevent the spread and associated feeding damage of the EZZSF.

Box Tree Moth (BTM)

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 16A,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 17**). 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 3A Box tree moth

Figure 16B Box tree moth

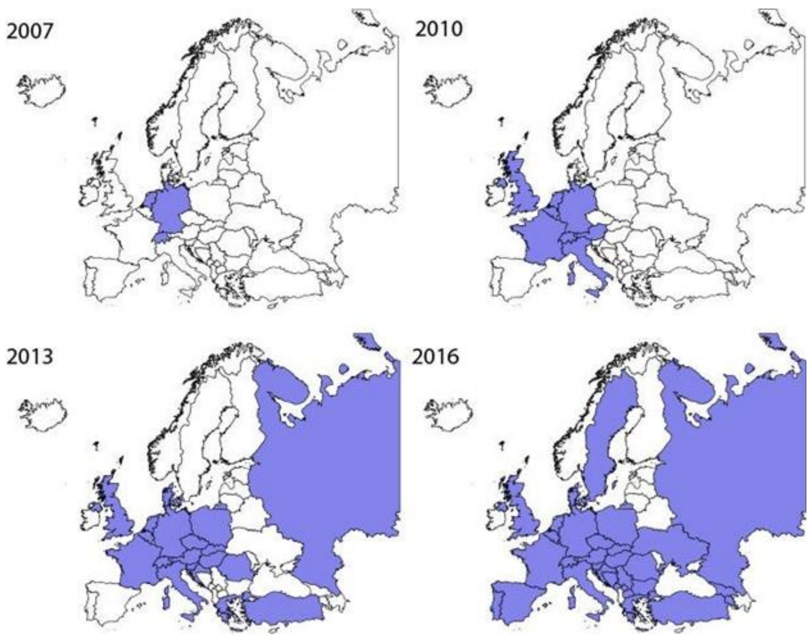

Figure 17. Box tree moth invasion of Europe. Modified from Bras et al. (2019) and EBTS (2020)

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 18A,B, and Figure 19**).

Figure 18A Boxwood tree moth larva and feeding damage

Figure 18B Boxwood tree moth larva and feeding damage

Figure 4. 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 20**) and are laid in groups of 5–20 and overlap like shingles. Eggs take three days to develop. Box tree moth larvae 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 21**). 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.

Figure 20. Box tree moth eggs

Box tree moths have 1–5 generations per year depending on the latitude and local climate. BTMs overwinter as 2nd to 5th 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 22**). 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 5. Box tree moth pupae

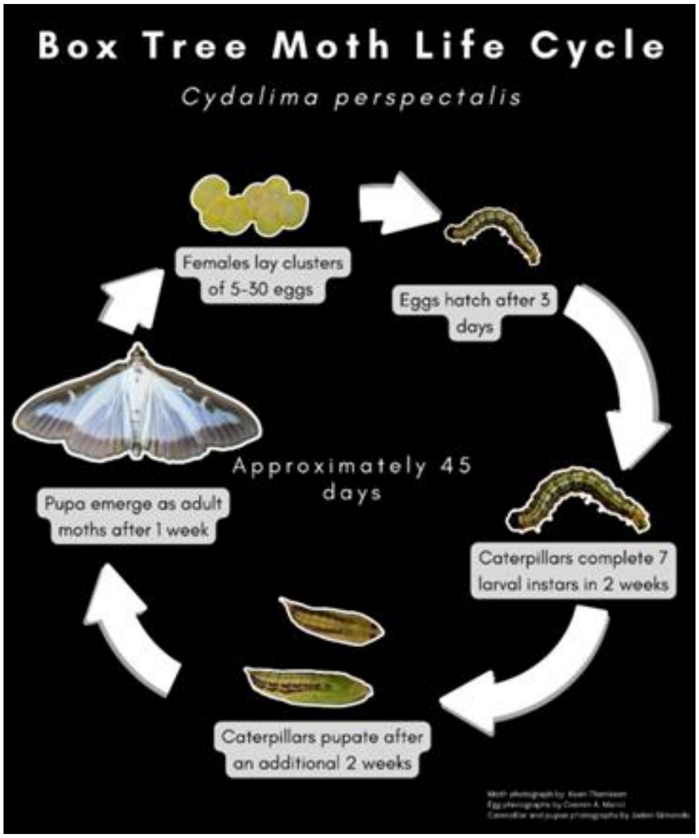

Figure 6. Box tree moth life cycle

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.

The Periodical Cicada Emergence of 2024

The spring of 2024 was a banner year for the periodical cicada with both the 13 and 17-year broods emerging throughout most of Illinois. With the exception of a few counties in extreme southern Illinois, the central portion (Springfield and south) welcomed the 13- year periodical cicada (Brood XIX) and areas north of Springfield experienced Brood XIII. Mathematically, it was a very rare event for both 13 and 17- year broods to emerge in the same year (see **Figures 23A,B**). In fact, the last time these two broods co-emerged (i.e. every 221 years) in Illinois, was in 1803 when Thomas Jefferson bought the Louisiana Purchase from France.

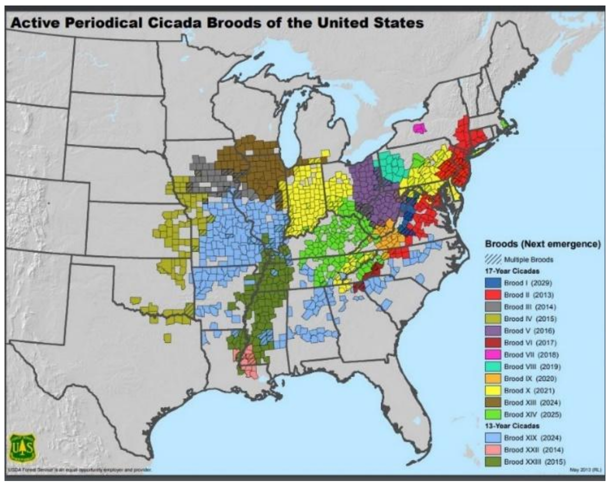

Figure 23A: Active Midwest periodical cicada broods

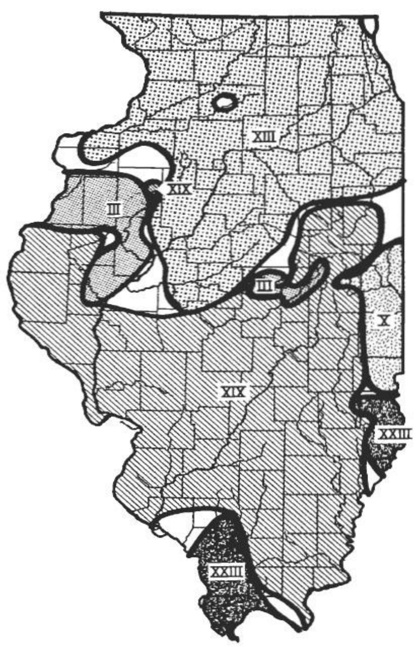

Figure 23B: Active Illinois periodical cicada broods

Adult ovipositional damage on mature trees and shrubs was usually no more than "natural pruning" or "flagging, but in some cases on younger plants there was breakage of stems and top kill (**Figures 24, 25, and 26**). Flagging from ovipositional damage was quite variable by location and woody plant species. Previous studies have shown that that there appears to be a minimum and a maximum twig/branch diameter that is preferred for oviposition ranging from 3 to 11 mm (1/8 to 7/16 in.) (White, 1980, Karban, 1982, Miller, 1997, Miller and Crowley, 1998).

Why were some woody plants more attractive to periodical cicadas than others? Host preference of the periodical cicada is not fully understood. Preference for native versus exotic plants, leaf arrangement, resin levels, light, and plant architecture may play a role in determining which plants are utilized for egg laying. For example, in a study in Delaware by Brown and Zuefle (2009) they found that non-native plants tended to be more favored that native plants. In contrast, in a study by Miller and Crowley (1998) at the Morton Arboretum, Lisle, Illinois, they found no significant differences in plant damage between natives and non-natives. Regarding plant architecture, Brown and Zuefle ((2009), in examining 428 plants, found that the probability of oviposition increased with increasing branch/twig diameter and plant structure. In other words, plants with "bushy", dense growth habits or with numerous long branches had higher rates of oviposition, but fewer wounds per stem length compared with plants with a less dense and a more upright growth habit. Their results suggest that "bushy" plants or plants with many stems may impeded cicada oviposition, and also may dilute the number of wounds.

Figure 24: Adult periodical cicada

As you probably noticed, conifers were rarely attacked probably due to arrangement of needles on the twigs which impedes the ability of the female to oviposit and resin which can trap and kill eggs preventing egg hatch of young nymphs. This was also true for gum producing plants such as *Prunus* spp. (i.e. cherries, peaches, plums) (White, 1980, Karban, 1983, Cook et al., 2001). Miller and Crowley (1998) where they found that conifers and evergreens differed in their susceptibility to ovipositional damage. For example, plants with needles or leaf scales that did not completely encircle the twig and twigs that were less stout and flexible (i.e. hemlock, juniper, arborvitae, yew) did experience some damage as compared with conifers with stouter twigs and needles that completely encircled the branch (i.e. pines, spruces, firs). White (1980) found that black walnut (*J. nigra*), Osage orange (*Maclura pomifera*) were rarely used for egg laying due to their spongy pith which contributed to egg desiccation. Stem diameter is also a critical factor. Plants, such as tree of heaven (*Ailanthus altissima*), Kentucky coffee tree (*Gymnocladrus dioicus*), and sumac (*Rhus* spp.), which had thick, stout stems near or exceeding 10 mm (3/8 in.) in diameter were not attacked. Interestingly, however, female cicadas did attempt to oviposit in the leaf rachis of *G. dioicus* (diameter =4 mm or 5/32 in.) which is within the range of stem diameters for egg laying.

Figure 25: Ovipositional damage to woody twigs and branches

What about nymphal feeding on plant roots and plant health? In a study by **Speer et al. (2010)**, they found no effect from long-term root parasitism (feeding) by cicada nymphs prior to emergence when feeding on five Midwestern Forest trees, *Acer saccharum, Fraxinus americana, Quercus palustris, Q. velutina* and *Sassafras albidum*, but three of the species **chronologies** showed a significant reduction in growth the year of or the year after the emergence year, and three **chronologies** showed an increase in growth five years following the cicada emergence event. Bottom line, there should not be any significant plant health issues going forward.

How long will it take for ovipositional wounds to heal? In two studies by **Miller (1997)** and **Miller and Crowley (1998) at the Morton Arboretum following the 1990 periodical cicada emergence,** examining 140 exotic and native woody plant genera, and 14 different urban forest parkway tree taxa, they found that most plants calloused (healed) over their wounds within 1-2 years after a cicada emergence; exceptions being alder (*Alnus* spp.), black walnut (*Juglans* sp.), redbud (*Cercis* sp.), lilac (*Syringa* spp), lindens (*Tilia* spp.), honey locust (*Gleditsia triacanthos*), northern red oak (*Q. rubra*), hackberry (*Celtis occidentalis*), 'Redmond linden" (*Tilia americana* 'Redmond'), and Littleleaf linden (*T. cordata*) which took at least three years to heal. Of course, plant health, growing conditions, and level of injury all affect wound healing rates. In spite of heavy ovipositional damage and delayed wound healing on susceptible plants, no significant canker-causing pathogens or insect pest issues were observed on these same woody landscape plants, and urban parkway tree taxa.

If appropriate, pruning out of broken and dead twigs can be done during the winter months. In spring, follow up with acceptable plant health care (PHC) practices. Healthy and mature shrubs and trees should require minimal care, and recover just fine and resume normal growth (**Figure 26**).

Figure 26: Late season flagging due to egg laying by adult female periodical cicadas

2024 WEATHER AND ABIOTIC EVENTS:

May is considered the third wettest month climatologically in Illinois with the wettest in parts of southern Illinois. However, May, 2024 precipitation, was variable across Illinois, with extremely wet conditions in far southern Illinois and near to slightly drier than normal conditions in central and northern Illinois. Unfortunately, much of May's precipitation came from thunderstorms that also brought severe weather to Illinois. The NOAA Storm Prediction Center listed 24 tornado reports, 153 severe wind reports, and 56 severe hail reports in Illinois in May including an EF-# tornado which through Jackson and Williamson Counties, causing significant damage around the Lake of Egypt area. Climatological spring was wetter than normal for the entire state, with totals ranging from around 12 inches in central Illinois to nearly 18 inches in far southern Illinois. Most of the state was 1 to 4 inches wetter than normal this spring

However, by early summer, Illinois was starting to get a little dry after a drier than normal **June** with over half the state considered abnormally dry according to the July 2nd U.S. Drought Monitor. The remnants of one of the strongest early season Atlantic hurricanes on record, Beryl, bent up through the Midwest, producing significant rainfall over a 48-hour period across parts of central and east-central Illinois. Parts of Champaign and Douglas counties picked up more than 4 inches in two days from Beryl, dramatically improving soil moisture and streamflow.

Less than a week later, an intense storm system moved across the northern half of the state, producing very heavy rainfall and a derecho that brought severe straight-line winds. Additionally, most of Illinois picked up at least 1 inch of rain over the 48-hour period between July 14 and 16, and multiple spots had over 6 inches. Heavy rain in in southwestern Illinois caused significant flooding (**Figure 27**).

While Illinois' weather calmed down a bit in the last two weeks of **July**, most of the state stayed in an active, stormy pattern. Total July precipitation ranged from around 4 inches in parts of northeast Illinois to over 12 inches in south-central Illinois, or between 1 and 7 inches above normal. Statewide total July precipitation was 7.01 inches, 2.95 inches above the 1991-2020 average and the third wettest on record. By **August**, precipitation began to drop off and drier conditions prevailed (**Figure 28**).

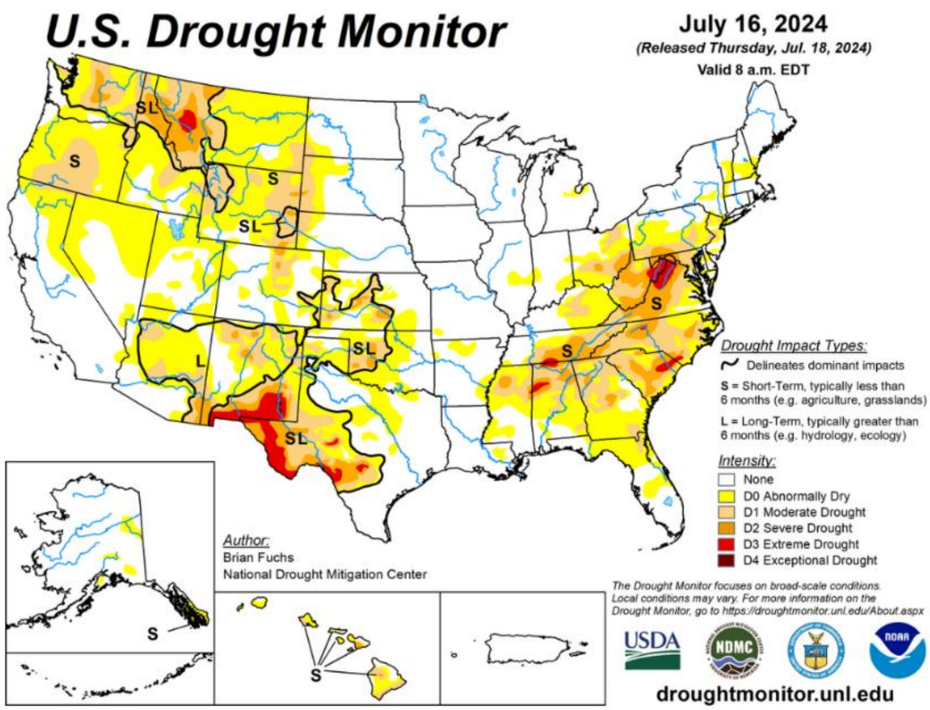

Figure 27: Drought monitor map for Illinois for mid-July 2024.

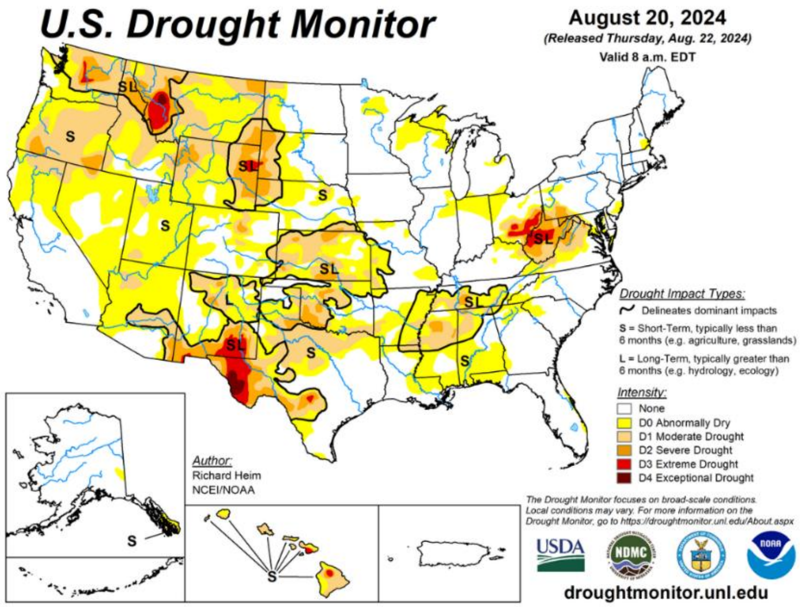

Figure 7: Drought monitor map for Illinois for late August 2024.

September is not usually a very wet month across Illinois, and the first two-thirds of last month had very dry conditions in the Midwest, however, because September is also the heart of Atlantic hurricane season, tropical weather toward the end of the month broke up our dry streak, at least in southern Illinois. Total September precipitation ranged from less than 1 inch in far northwest Illinois to over 8 inches in parts of southern Illinois. Most areas of the state south of Interstate 64 were 1 to 5 inches wetter than normal for the month while much of central and northern Illinois were 1 to 3 inches drier than normal (**Figure 29**).

Overall, **September** was extremely dry in northwest Illinois, but was the fourth wettest September on record at the Carbondale Water Treatment Plant, with over 8 inches for the month. The first three weeks of September were extremely dry across much of the Midwest. Much of the region had a top-five driest start to September on record, including the driest first 20 days of the month in Quincy, Danville, Moline, and Rockford. The dryness culminated in large expansion of moderate drought across Illinois in mid-September, including over 45% of the state in moderate to severe drought as of the Sept. 17 U.S. Drought Monitor. By the end of the month, drought was eliminated in most of the southern half of Illinois by the rains from Hurricane Helene.

Abnormally dry to moderate drought remained across the northern half of the state (**Figure 29**). Dry conditions continued throughout **October** with most of the state suffering from abnormally dry to sever drought conditions (**Figure 30**).

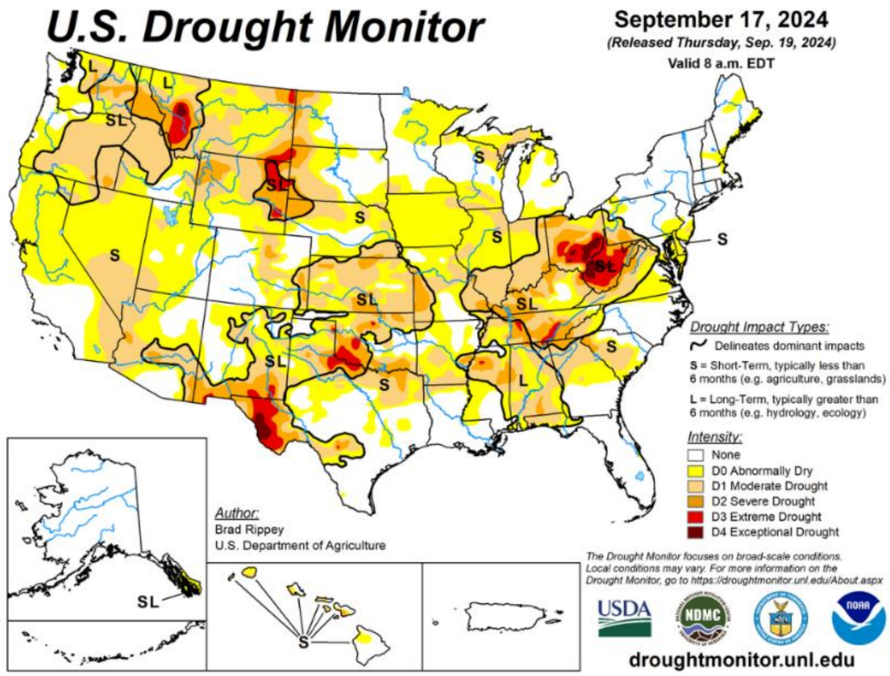

Figure 29: Drought monitor map for Illinois for mid-September 2024.

At the time of this writing in late November, about 2/3 of the state is still abnormally dry or is experiencing a moderate drought. A good portion of southern Illinois has recovered (**Figure 31**).

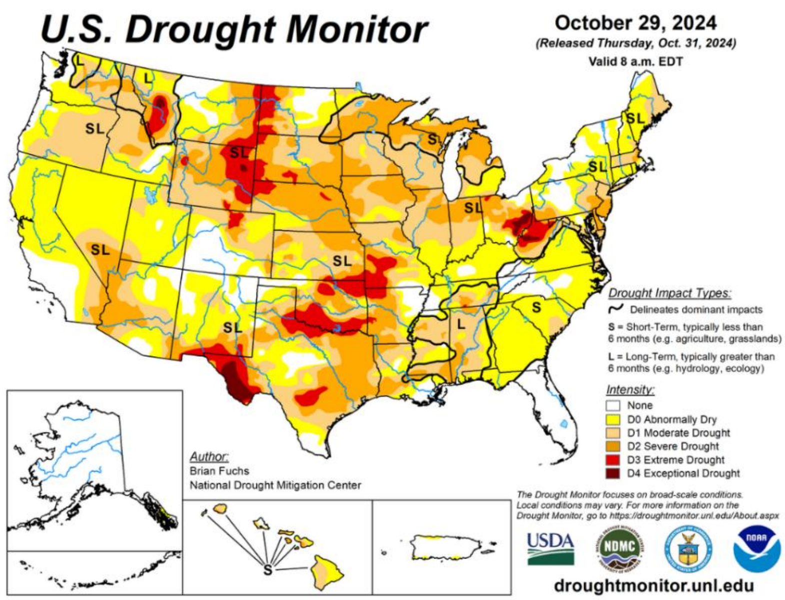

Figure 30 Drought monitor map for Illinois for late October 2024.

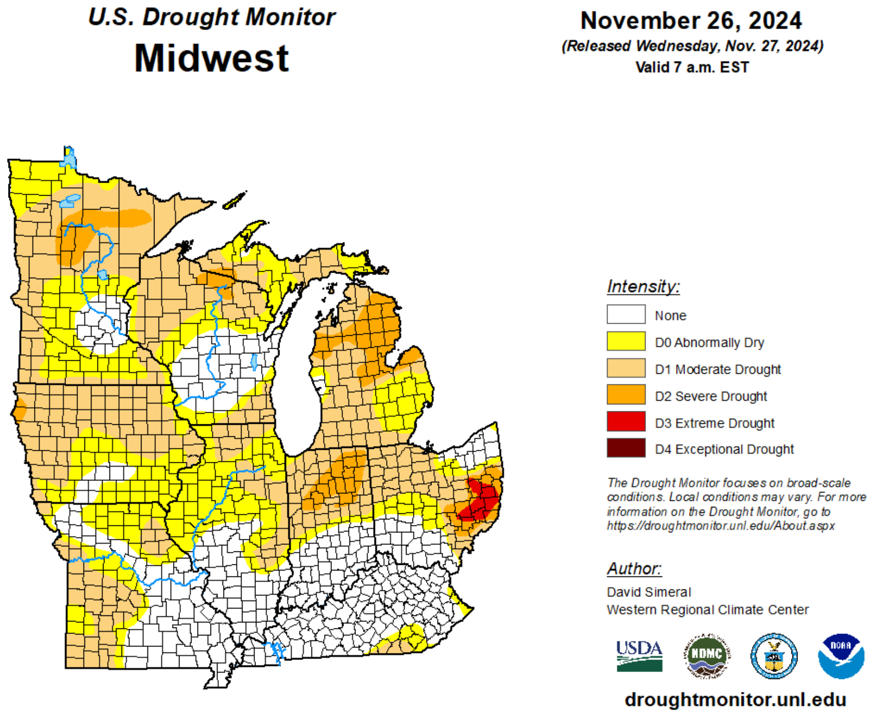

Figure 31: Drought monitor map for Illinois for late November 2024.

REFERENCES CITED AND RECOMMENDED READINGS

California Oak Mortality Task Force. Sudden Oak Death Homepage. https://www.suddenoakdeath.org/

Fraedrich, B.R. 2018. Diagnosing and Preventing Herbicide Injury to Trees. Bartlett Tree Research Laboratories Technical Bulletin TR-43. 5 pp.

Harrington, T. 2011. It looks like bur oak blight (BOB) really isn't new. Iowa State University, Horticulture Home Pests News. February, 2011

Hettinger, J. 2019. Despite federal, state efforts, dicamba complaints continue. Midwest Center for Investigative Reporting (August 27, 2019). https://investigatemidwest.org/2019/08/27/despite-federal-state-efforts-dicamba-complaints-continue/

Missouri Forest Health Update (December, 2014). Pp. 5-6.

Pataky, N. and S. Porter. 2008-2016. Woody Plant Disease Updates. University of Illinois Plant Clinic (UIPC). Urbana, Illinois.

Pennsylvania Department of Agriculture. 2019. Spotted Lanternfly Alert. https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/Entomology/spotted_lanternfly/SpottedLanternflyAlert/Pages/default.aspx5.

Pokorny, J. and T. Harrington. 2011. Bur oak blight. Pest Alert-NA-PR-02-11. USDA Forest Service.

University of Kentucky. Kentucky Pest News: Laurel Wilt Disease: A Threat to Kentucky Sassafras Trees. July 7, 2020. https://kentuckypestnews.wordpress.com/2020/07/07/laurel-wilt-disease-a-threat-to-kentucky-sassafras-trees/

USDA APHIS. Spotted Lanternfly. https://www.aphis.usda.gov/aphis/resources/pests-diseases/hungry-pests/the-threat/spotted-lanternfly/spotted-lanternfly

USDA APHIS Hungry Pests. Sudden Oak Death. https://www.aphis.usda.gov/aphis/resources/pests-diseases/hungry-pests/the-threat/sudden-oak-death/hp-sudden-oak-death

USDA APHIS. Laurel Wilt. https://www.invasivespeciesinfo.gov/terrestrial/pathogens-and-diseases/laurel-wilt

https://www.aphis.usda.gov/plant_health/plant_pest_info/pram/downloads/pdf_files/usdaprlist.pdf.

Saucedo-Carabez, J. R., Ploetz, R. C., Konkol, J. L., Carrillo, D., & Gazis, R. 2018. Partnerships between ambrosia beetles and fungi: lineage-specific promiscuity among vectors of the laurel wilt pathogen, *Raffaelea lauricola*. Microbial Ecology, 76(4), 925-940.

Miller, F. 2022. What is in a name, the elm zig-zag sawfly. ISA Arborist News (April): 32-37.

Bras, A., D. N. Avtzis, M. Kenis, H. Li, G. Vétek, A. Bernard, C. Courtin, J. Rousselet, A. Roques, and M.-A. Auger-Rozenberg. 2019. A complex invasion story underlies the fast spread of the invasive box tree moth (*Cydalima perspectalis*) across Europe. Journal of Pest Science, 92: 1187–1202.

(EBTS) European Boxwood & Topiary Society. 2020. Box tree moth & caterpillar. Available online.

Strachinis, I., C. Kazilas, F. Karamaouna, N. E. Papanikolaou, G. K. Partsinevelos, and P. G. Milonas. 2015. First record of *Cydalima perspectalis* (Walker, 1859) (Lepidoptera: Crambidae) in Greece. Hellenic Plant Protection Journal, 8: 66–72.

Wan, H. T. Hays, M. Kenis, S. Nacambo, H. Xu, F. Zhang, and H. Li. 2014. Biology and natural enemies of *Cydalima perspectalis* in Asia: Is there biological control potential in Europe? Journal of Applied Entomology, 138: 715–722.

Brown, W. and M.E. Zuefle. 2009. Does the periodical cicada, Magicicada septendecim, prefer to oviposit on native or exotic plant species? Ecological Entomology 34: 346-355.

Cook, W.M., R.D. Holt, and J. Yao. 2001. Spatial variability in oviposition damage by periodical cicadas in a fragmented landscape. Oecologia , 127: 51-61 .

Cook , W.M. and R.D. Holt. 2002. Periodical cicada (*Magicicada cassini*) ovipositional damage: visually impressive yet dynamically irrelevant. American Midland Naturalist, 147: 124 – 224 .

Forsyth, H.Y. 1975. Ovipositional Host Plants of 17-Y ear Cicadas. Ohio Agricultural Research and Development Center Research Circular #210. 20 pp.

Karban, R. 1982. Experimental removal of 17-year cicada nymphs and growth of host apple trees. Journal of the New York Entomological Society 90: 74-81 .

Karban , R. 1983. Induced responses of cherry trees to periodical cicada oviposition. Oecologia , 59: 226 – 231 .

Miller, F. 1997. Effects and control of periodical cicada, *Magicicada septendecim* and *Magicicada cassini* oviposition injury on urban forest trees. J. of Arboriculture. 23(6): 225-232.

Miller, F. and W. Crowley. 1998. Effects of periodical cicada (Homoptera: Cicadidae: *Magicicada septendecim* and *Magicicada cassini*) ovipositional injury on woody plants. J. of Arboriculture 24(5): 248-253.

Speer, J.H., K. Clay, G. Bishop, and M. Creech. 2010. The effect of periodical cicadas on growth of five tree species in Midwestern deciduous forests. The American Midland Naturalist, 164(2): 173-186

White, J. 1980. Resource partitioning by ovipositing cicadas. American Naturalist 115: 1-28.

Ford, T. 2024. *Illinois State Climatologist Monthly Illinois CoCoRaHS Scoreboards (January-December).*

Blank, S.M., H. Hara , J. Mikulas ,G. Csoka , C. Ciornei , R. Constantineanu , I. Constantineanu , L. Roller , E. Altenhofer , T. Huflejt and G. Vetek. 2010. *Aproceros leucopoda* (Hymenoptera: Argidae): An East Asian pest of elms (Ulmus spp.) invading Europe. European Journal of Entomology 107: 357–367, 2010

Blank S.M., T. Köhler, T. Pfannenstill, N. Neuenfeldt, B. Zimmer, E. Jansen, A. Taeger, and A.D Liston. 2014. Zig-zagging across Central Europe: recent range extension, dispersal speed and larval hosts of *Aproceros leucopoda* (Hymenoptera, Argidae) in Germany. Journal of Hymenoptera Research 41: 57–74. Doi: 10.3897/JHR.41.8681

Bosu, P.P., F. Miller, and M. R. Wagner. 2007. Susceptibility of 32 elm species and hybrids (*Ulmus* spp.) to the elm leaf beetle (Coleoptera: Chrysomelidae) under field conditions in Arizona. Journal of Economic Entomology 100(6): 1808-1814.

Condra, J.M., C.M. Brady, and D.A. Potter. 2010. Resistance of landscape-suitable elms to Japanese beetle, gall aphids, and leaf miners, with notes on life history of *Orchestes alni* and *Agromyza aristata* in Kentucky. Arboriculture and Urban Forestry 36: 101-109.

Griffin, J.J., W.R. Jacobi, E.G. McPherson, C.S. Sadof, J.R. McKenna, M.L. Gleason, N.W.

Gauthier, D.A. Potter, D.R. Smitley, G.C. Adams, A. B. Gould, C.R. Cash, J. A. Walla, M.C.
Starrett, G. Chastagner, J.L. Sibley, V.A. Krischik, and A.F. Newby. 2017. Ten-year performance of the United States national elm trial. Arboriculture and Urban Forestry 43(3): 107-120.

Larcenaire, C., K. Oten, P. Merten, N.W. Siegert, and A. Elledge. 2024. Pest Alert: Elm zigzag sawfly. USFS. R9-PR-016-24. 2 pp.

Lengesova, N.A. 2012. Elm sawfly (*Aproceros leucopoda* Takeuchi, 1939) – new to the territory of Ulyanovsk region pest of elm. *Priroda Simbirskogo Povolzh'ya*, **13**, 136–139 (in Russian).

Lengesova, N.A. and A.V. Mishchenko. 2013. Biology, ecology, and molecular characterization of *Aproceros leucopoda*(Takeuchi, 1939) (Hymenoptera: Argidae), pest of elms in the middle Volga region. Caucasian Entomological Bulletin,9, 163–167. (in Russian with English abstract). https://doi.org/10.23885/1814-3326-2013-9-1-163-167

Martel, V., O. Morin, S.K. Monckton , C.S. Eiseman , C. Béliveau1, M. Cusson , and S. M. Blank. 2021. Elm zigzag sawfly, *Aproceros leucopoda* (Hymenoptera: Argidae), recorded for the first time in North America through community science. The Canadian Entomologist, Pages 1-18. doi:10.4039/tce.2021.44

Martynov, V.V. and T.V. Nikulina. 2017. Population surge of zigzag elm sawfly (*Aproceros leucopoda* (Takeuchi, 1939): Hymenoptera: Argidae) in the northern Cis-Azov region. Russian Journal of Biological Invasions,8, 135–142. https://doi.org/10.1134/S2075111717020059.

Miller, F., S. Jerdan, and G. Ware. 1999. Feeding preference of adult Japanese beetles (Coleoptera: Scarabaeidae) for Asian elm species and their hybrids. Journal of Economic Entomology 92(2): 421-426.

Miller, F. 2000. Insect resistance of elm genotypes. [Proceedings of the First International Elm Conference.] Entitled: *The Elms: Breeding; Conservation, and Disease Management*. ed. C. Dunn. pp. 137-154.

Miller, F. and G. Ware. 2001. Resistance of Temperate Chinese elms (*Ulmus* spp.) to feeding by the adult elm leaf beetle (Coleoptera: Chrysomelidae). Journal of Economic Entomology 94(1): 162-166.

Miller, F. and G. Ware. 2014. Seasonal activity, within-tree distribution, and ovipositional and feeding preference of the elm leafminer, *Fenusa ulmi* (Hymenoptera: Tenthredinidae). Journal of Environmental Horticulture 32 (1): 29-48.

Mol, A.W.M. 2017. *Aproceros leucopoda* (Hymenoptera: Argidae) in 2016 wijd verspreid in Nederland.Entomologische Berichten,77, 215–218 (in Dutch with English abstract).

Mol, A. and D. Vonk. 2013. De iepenzigzagbladwesp: een nieuwe exoot in Nederland. natuurbericht.nl, http://www.natuurbericht.nl/?id=12191 [accessed 20.02.2014]

Papp, V., Ladányi, M., Vétek, G., 2018. Temperature-dependent development of *Aproceros leucopoda* (Hymenoptera: Argidae), an invasive pest of elms in Europe. Journal of Applied Entomology, 142(6), 589-597. https://onlinelibrary.wiley.com/journal/14390418

Potter, D.A. and C.T. Redmond. 2013. Relative resistance or susceptibility of landscape-suitable elms (*Ulmus* spp.) to multiple insect pests. Arboriculture and Urban Forestry 39(5): 23-243.

Pschorn-Walcher. H. 1977: Biological control of forest insects. Annual Review of Ecological Systems. 22: 1–22.

Pschorn-Walcher. H. 1982: Unterordnung Symphyta, Pflanzenwespen. In Schwenke W. (ed.): Die Forstschädlinge Europas. Vol. 4. Paul Parey, Hamburg and Berlin, pp. 4–196 + 232–234

Raupp, M.J. 1990. Recognizing the larvae of key pests and beneficials found on woody landscape plants. Journal of Arboriculture Vol. 16(3): 49-54.

Shchurov, V.I., Gninenko, Y.I., Lengesova, N.A. & Gninenko, M.Y. 2012. Elm sawfly in the European part of Russia.Zashchita i karantinrasteniy, 2, 37–39 (in Russian with English abstract).

Shimah, H. 1984: Study on the tribe Blondeliini from Japan (Diptera, Tachinidae) V. The genera Blondelia RobineauDesvoidy and Compsilura Bouché. Kontyû 52: 540–552.

Shimah, H. 2006: A host-parasite catalog of Tachinidae (Diptera) of Japan. Makunagi, Acta Dipt. (Suppl. 2): 1–171.

Takeuchi, K. 1939: A systematic study on the suborder Symphyta (Hymenoptera) of the Japanese Empire (II). Tenthredo 2: 393–439.

Tschorsnig, H.P. 2007: Tachinidae. In Fauna Europaea. Version 1.3. http://www.faunaeur.org.

Vetek, G., D. Bartha, and R. Olah. 2017. Occurrence of the alien zigzag sawfly, *Aproceros leucopoda* (Hymenoptera: Argidae), in arboretums and botanical gardens of Hungary. Periodicum Biologorum 119(2): 101-106.

Vétek, G., V. Fekete, M. Ladányi, E. Cargnus, P. Zandigiacomo, R. Oláh∗,M. Schebeck,and A. Schopf. 2020. Cold tolerance strategy and cold hardiness of the invasive zigzag elm sawfly, *Aproceros leucopoda*(Hymenoptera: Argidae).   Agricultural and Forest Entomology 22: 231–237. DOI: 10.1111/afe.12376

Vétek, G., K. Csávás, J. Failand M. Ladányi. 2021. Host plant range of *Aproceros leucopoda* is limited within Ulmaceae. Agricultural and Forest Entomology (2021), DOI: 10.1111/afe.12463

WORLD CLIMATE HOME 2008: Sapporo, Japan: Climate, Global Warming, and Daylight Charts and Data. http://www.climate-charts.com/

Wu, X.Y. 2006. Studies on the biology and control of *Aproceros leucopoda*. Plant Protection (Beijing) 32: 98–100. [in Chinese].

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.*

THE 2023 IFHH REPORT WAS PREPARED BY: Fredric Miller, Ph.D. IDNR Forest Health Specialist, The Morton Arboretum, Lisle, Illinois.

This project was funded in whole or in part through a grant awarded by the USDA, Forest Service, Northeastern Area State and Private Forestry. The USDA is an equal opportunity provider and employer.