2019 Forest Health highlights
ILLINOIS

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Forest Health Issues 2019: An Overview

Overall, the 2019 growing season was more active for forest health issues than previous years with a number of statewide issues including leaf tatters and possible herbicide injury to oak and other hardwood tree species, Japanese beetle feeding damage, decline of spruces and pines, rapid mortality of white oaks, and the usual foliar leaf diseases, namely anthracnose, sycamore anthracnose, and apple scab. In urban forests, honeylocust and spruce decline is increasing, associated with canker diseases. Magnolia scale is fairly common on ornamental landscape plants. Early season defoliators, such as eastern tent caterpillar, were prevalent in central and southern Illinois. Fall webworm was prevalent by late summer throughout the state. Heavy spring and early summer rains contributed to extensive flooding in southern and southwestern Illinois and late summer and fall in northern Illinois. EAB populations were high southern Illinois.

Insect Pests

Japanese Beetle (1,4)

The Japanese beetle was evident throughout state with defoliation heavier (60% to 75% canopy feeding damage) than in previous years (Figures 1 and 2). By early July feeding damage was very evident throughout central Illinois and by late July was quite common in northern Illinois. Like in previous years, little leaf linden (*Tilia cordata*) was the preferred host in both rural areas and farmstead landscapes and urban settings. Where linden was not prevalent, heavy feeding was also observed on Siberian elm (*Ulmus pumila*), crabapple (*Malus* spp.), grapes (*Vitis* spp.), and birch (*Betula* spp.).

Figure 1. Adult Japanese beetle damage.

Figure 2. Japanese beetle feeding damage.

Magnolia Scale (1)

Magnolia scale, common in northern and central Illinois, is a native scale and one of the largest North American scales, reaching the size of your thumb (Figure 3). Populations seem to be on the increase in urban areas. It attacks star magnolia (*Magnolia stellata*), cucumbertree magnolia (*M. acuminate*), saucer magnolia (*M. soulangiana*), and lily magnolia (*M. quinquepeta*). In contrast to other soft scales, bright red crawlers are not active until late summer (September-October). The scale overwinters as an immature female. Like other soft scales, magnolia scale produces large quantities of honeydew and can blacken the leaves of magnolia plants. It is very host specific, attacking only magnolias. Chemical management of magnolia scale may be warranted with heavy populations. Keeping plants healthy will help them prevail against the scale.

Figure 3: Adult magnolia scales with immature crawlers.

Viburnum Leaf Beetle (1, 6)

2019 saw the continuing spread of Viburnum leaf beetle (VLB) throughout northeastern Illinois. The beetle is causing visible feeding injury in Cook County and the surrounding collar counties in Northeast Illinois. The viburnum leaf beetle was initially found in 2009 in an urban Cook County landscape and feeds on a variety of commonly planted viburnums. Since both the larvae and adults feed on the leaves at different times during the summer, it can be an especially damaging pest.

Viburnum leaf beetle adults are about a quarter inch long with a thick, golden-grey pubescence (hairs) (Figure 4). VLB larvae are less than a half inch long when mature and are a light yellow with black spots (Figure 4). Like most leaf beetle larvae, they initially feed gregariously on viburnum foliage. Skeletonized leaves appear in the spring (May-June) and heavily chewed leaves follow in the summer (July-September) (Figure 5). Straight rows of egg “caps” (Figure 6) appear on terminal twigs and are visible from summer through winter.

Figure 4: Adult VLB (left) and VLB larvae and feeding damage(right).

Figure 5: Adult VLB feeding damage. **Figure 6: VLB “egg caps”.**

In Europe and North America, the viburnum leaf beetle overwinters in the egg stage. Adults are present from late June to early July until October and the females chew tiny holes in small branches or twigs of viburnum for oviposition on current year's growth, but occasionally in the previous year's growth. There is a sharp color contrast between the cap (brownish black) and the bark (green to brown) (Figure 6). This egg cap protects the eggs and provides a humid environment for the eggs. A single VLB female can lay up to 500 eggs during the summer. The eggs hatch by early to mid-May of the following spring and the larvae feed gregariously on the underside of tender, newly-expanding viburnum foliage. Larvae skeletonize viburnum foliage, usually starting with lower leaves and leaving only midribs and major veins intact (Figure 5). By early to mid-June, mature larvae crawl to the ground, enter the soil, and pupate. Adults emerge in early July and begin feeding on viburnum foliage. Complete development from egg hatch to adult emergence generally takes 8 to 10 weeks. Adult feeding damage consists of irregular circular holes, and severe feeding can nearly defoliate shrubs once again. Adults are active from summer through fall. There is one generation per year. Heavy infestations by viburnum leaf beetle can defoliate shrubs, cause dieback, and eventually kill plants.

VLB is host specific feeding only on *Viburnum* spp. However, it prefers some varieties of viburnum over others (see below). It is recommended to only plant the preferred species in this region. Removal and destruction of the branches with eggs between October and April can also help reduce the VLB population on a plant.

Preferred Species of Viburnum Leaf Beetle

- Arrowwood (V. dentatum complex)
- American cranberrybush viburnum (V. trilobum)
- European cranberrybush viburnum (V. opulus)
- Rafinesque viburnum (V. rafinesquianum)

Less Preferred Species of Viburnum Leaf Beetle

- Blackhaw viburnum (V. prunifolium)
- Nannyberry (V. lentago)
- Sargent viburnum (V. sargentii)
- Wayfaring tree (V. lantana)

Least Preferred or Resistant Species for Viburnum Leaf Beetle

- Burkwood viburnum (V.burkwoodii)
- Doublefile viburnum (V. plicatum var. tomentosum)
- Judd viburnum (V. × juddii)
- Korean spice viburnum (V. carlesii)
- Lantanaphyllum viburnum (V. × rhytidiophylloides)
- Leatherleaf viburnum (V. rhytidiophyllum)

Bagworms (17)

While bagworms typically occur in the more southern parts of the state, in the last several years we have seen more and more bagworms in Northern Illinois. The bagworm is a type of moth that builds a larval case out of plant material from its host plant, which gradually increases in size as the larva grows. (Figures 7 and 8). While its preferred hosts are arborvitae and junipers, bagworms can feed on a number of different conifers and hardwoods. Bagworm caterpillars emerge from the hanging cases of the previous years' adults in June, and begin to feed on the tree, growing from about 1/8-1/4 of an inch to about an inch in length. The young larvae can easily be blown to another tree. As they grow, they build an expanding case around themselves from material from their host tree and silk, which provides camouflage and protection from predators and the elements. The bagworms can be serious defoliators of trees (Figure 9). After about three months, the larva affixes its bag to a branch and pupates inside for about 7-10 days. Adult males emerge from the bags (Figure 10), but the females do not and remain in the bag for the remainder of their lives. The female lays up to 1000 eggs then dies, leaving the eggs to overwinter in the protective case, which they emerge from the next year.

Figure 7: Bagworm case on arborvitae.

Figure 8: Bagworm larva removed from case.

Figure 9: Arborvitae defoliated by bagworms.

Figure 10: Adult male bagworm.

In the winter of 2018, we attempted to perform an overwintering study to see what kind of temperatures bagworm can withstand and for how long. We collected bagworms from several types of trees from a location in Naperville at different weeks during the winter, and held them in a freezer for various amounts of time. However, our study was compromised because none of the bags collected after the Polar Vortex in January survived for the larvae to hatch. Before you get your hopes up about a polar vortex killing off this pest, however, in the summer of 2019 we observed several new bagworm infestations in more protected areas than the ones we collected from. Preliminary results of our study indicated that bagworms that fed on some species of trees (elm, bald cypress, hackberry, buckthorn and spruce) had larger bags and a higher rate of survival than bagworms feeding on other tree species (crabapple, honeylocust, maple and oak).

Plant Diseases and Herbicide Drift Damage

Herbicide Drift Damage (5, 8, 9)

Signs of herbicide damage to trees were reported statewide in 2019, particularly on state and private lands bordering agricultural fields, continuing a trend seen in recent years. This mirrors reports of herbicide damage in agricultural crops that have also been increasing in the past few years. According to the Midwest Center for Investigative Reporting (31 August 2019), "Farmers in Illinois, the nation's leading soybean producing state, have reported record levels of crop damage caused by herbicide drift in 2019, with 590 dicamba-related complaints as of 23 August." "In 2017, Illinois had 246 dicamba-related complaints. In 2018, the state had 330."(7).

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 11). Root uptake of these chemicals is usually more damaging to the plant and on grape the leaves will cup upward (Figure 12). 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-emergent 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 11: Suspected herbicide damage to oak leaves.

Figure 12: 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
Birch	Honeylocust	
Boxelder	Mulberry	
Amur cork tree	Oaks	
Elm	Silver Maple	
Hackberry		
Hickory		
Horsechestnut		
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° 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 trees impacted, or is damage more widespread? Possible factors contributing to herbicide drift damage include low temperature injury, foliar diseases (i.e. anthracnose), insect feeding (i.e. plant bugs, leafhoppers), herbicides 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. Are there other insect and disease issues present at the same time? 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 of girdling roots present, and has there a drought or flooding? **Remember, most of our 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 (i.e. livestock grazing) 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 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. **The Illinois Department of Agriculture has published a new list of dicamba application restrictions for 2020, with the intent to reduce the potential for off target movement of the product (Appendix I).**

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. In 2018 and 2019, leaf tissue samples were taken and submitted to a lab to test for evidence of dicamba and/or 2,4-D damage. A majority of the samples submitted in 2018 from throughout the state were found to have 2,4-D damage. A small number were found to have triclopyr damage, and only a few had Dicamba residue. In 2019, of the 27 leaf damage samples collected, 26 had 2, 4-D residue ranging from 4 to 237 parts per billion. All 27 leaf damage samples showed Dicamba residue, ranging from 3 to 50 parts per billion. Only 7 of the 27 samples contained triclopyr residue. Samples were received from Carroll, Mason, McDonough, Randolph, and Washington Counties (western counties ranging from north to south), and it is likely that if we receive more samples, we will see many more counties experiencing this sort of damage. Many different tree species were impacted. Since Dicamba breaks down very quickly if not frozen, we think that better sample handling in 2019 led to a higher detection rate. We plan to continue our plant damage survey in 2020 with additional lab analysis of leaf tissue samples and field studies. If you notice suspicious damage on your trees, please collect and freeze the leaves as soon as possible and submit them to us using the form found in Appendix II of this document. Public cooperation is much appreciated in helping us determine the extent of the damage.

Anthracnose (1, 12)

The spring and early summer months of 2019 were very wet, besides in Edgar and Coles counties. May 2019 was the 2nd wettest May on record with a statewide average of 6.35 inches (2.14 inches above normal). The combination of precipitation and humidity provided an ideal environment for foliar fungal leaf diseases such as and anthracnose. Sycamore anthracnose was particularly visible this spring, defoliating trees and causing “witches brooming” of the branches (Figure 13). However, the second flush of leaves later in the season was healthy and sycamores fully leafed out.

Anthracnose was very common this year and not just on sycamores. Anthracnose is a general term for many foliar diseases that attack a wide range of hosts including, but not limited to, sycamore, maple, oak, ash, and dogwood. Anthracnose is a foliar disease, infecting the foliage and causing black necrotic areas. Most anthracnose fungal species are host specific. Weather conditions promoting anthracnose are 50-55 ^{o}F temperatures along with high humidity and rainfall. The fungus may also infect twigs. There are also differences in susceptibility within hosts. For example, white oaks are more susceptible to oak anthracnose compared to red oaks. In the case of sycamore anthracnose, the fungus also infects the twigs, resulting in stem cankers. Spores produced from fruiting bodies associated with twig cankers have a short trip from the twig to the new foliage, making leaf infection much more severe. In addition, twig infection may result in witch’s brooms with short internodes and a “bushy” growth habit. The witch’s brooms are easy to see during the winter months (Figure 13).

Several tree diseases and abiotic factors may resemble anthracnose. Early in the growing season, late spring freezes and frosts may kill new growth. All the new leaves will be affected, and the entire leaf will probably be brown and may be killed. In addition, frost damage will extend across a wide variety of species and be very apparent in low-lying areas with cold air drainage. New growth will look normal. Most foliar fungal leaf diseases, including anthracnose, are not lethal to trees. However, repeated defoliation events such as those in 2016 can lead to tree stress and predisposition to secondary lethal agents.

Figure 13: Stem canker (L) and witches' brooming (R) associated with sycamore anthracnose

Oak Wilt (12)

The dreaded oak wilt is found in every Illinois county and has become a major urban and forest tree disease. **Oak wilt levels for 2019 were comparable to previous years.** This fungal disease is lethal to oaks, and trees must be treated to insure survival. Anthracnose may be confused with oak wilt later in the season. (Figure 14) Be sure to properly diagnosis the problem before employing management options. Prevention is important, so remember not to prune between April and June, 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 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 the Illinois Forest Health Highlights from previous years.

Figure 14: 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.

Rapid White Oak Mortality (RWOM) (11)

We continue to be on the alert for RWOM, which has been observed in parts of Missouri since 2012 and in Illinois for the last few years. Several reports were received from Illinois in 2019 involving rapid decline (within one growing season) and in some cases death of white oaks (Figures 15 and 16). Further monitoring and field studies are planned for 2020 to determine if RWOM is involved. If you notice oaks with similar symptoms, please fill out one of the forms in **Appendix III** and mail it in to us.

In 2018, we conducted a statewide survey similar to the larger one carried out by the Missouri Department of Conservation (MDOC) in 2014, which interviewed district foresters, private landowners, consulting foresters and other land managers to determine the extent of RWOM and possible factors contributing to the die off of white oaks Some of the results of the MO survey can be found in previous issues of this report. Results of the 2019 Illinois survey are pending at the time of writing this report.

Listed below are a few of the major findings from the 2018 Illinois RWOM survey.

- RWOM has been observed in widely distributed portions of Illinois (Figure 17)
- Common on dominant and co-dominant white oaks >10" DBH.
- Many trees were on sites with a history of herbicide damage and/or drought.
- Half or more of all trees still had wilted leaves attached, leaf cupping, and inner branch dieback.
- Nearly all were reports from private land with a majority oak (white oak) tree composition.
- Over half of the cases were found on ridgetops, the rest were on lower, toe and bottom slopes

For additional details, refer to *Missouri Forest Health Update* (December, 2014) pages 5-6 (11).

Figures 15 and 16: White oaks dying from RWOM

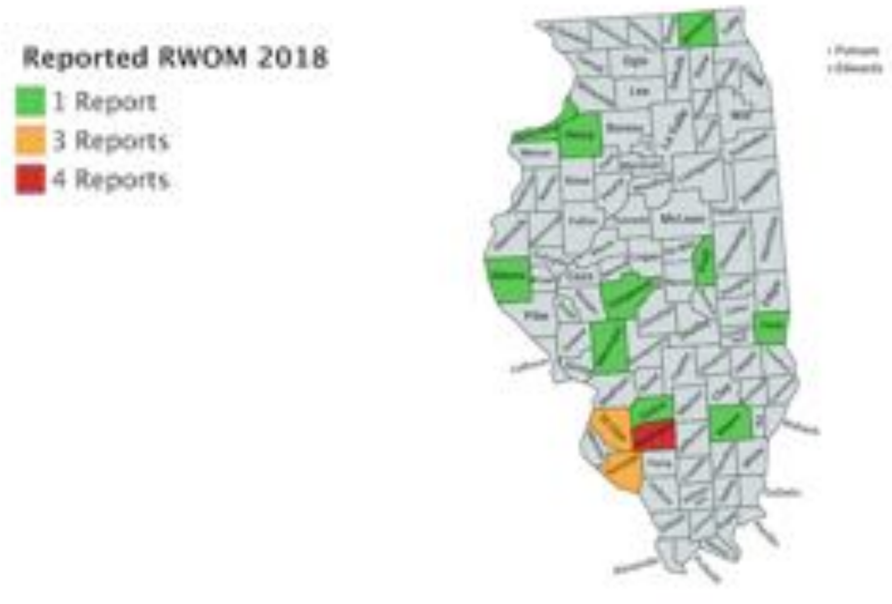


Figure 17: Statewide distribution of RWOM reports from 2018

Thousand Cankers Disease of Black Walnut

To date, neither the walnut twig beetle (WTB) nor the TCD fungus has been detected in eastern black walnut trees in Illinois. However, the causal agent of TCD, *Geosmithia morbida* (*Gm*) has been found throughout Illinois associated with a number of different ambrosia beetle species. **As of December, 2019, no new finds of TCD or WTB have been reported for the eastern United States.** As in previous years, four (4) unit Lindgren funnel traps (LFT's) were deployed throughout the state in state parks, natural and conservation areas, forests, and county forest preserves (Figure 18).

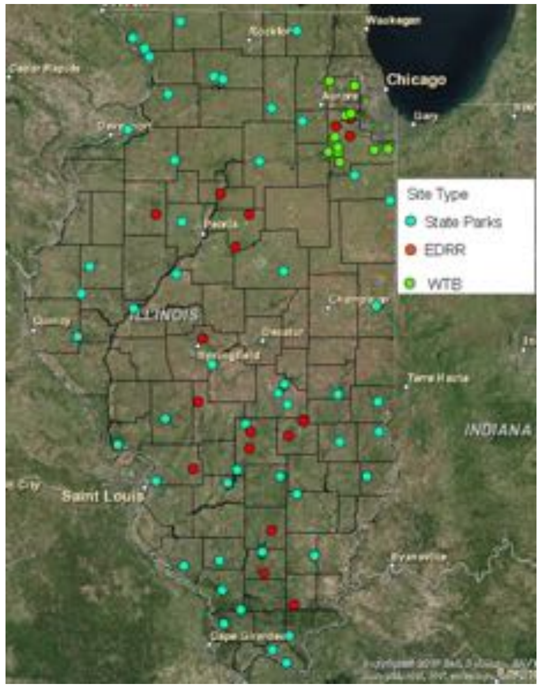


Figure 18: Distribution of WTB four-unit LFT's for 2019

Bur Oak Blight (7, 14)

Bur oak blight (BOB) was first reported in Illinois in 2012. Initial finds were in northern Illinois, but more recently, BOB has been found in central Illinois counties (Figure 19) Details on the biology, impact, and management of BOB has been reported in previous editions of the Forest Health Highlights (FHH) and also in the September 11, 2017 issue of the University of Illinois, Home, Yard, and Garden Newsletter.

Beginning in late summer, 2017, a county-by-county BOB survey was initiated. The survey was continued in 2019 to include central and southern Illinois. Results from our survey along with samples received at the University of Illinois Plant Clinic (UIPC) are presented in Figure 19.

The movement of BOB into central Illinois could be due to several factors including climate change making the environment more favorable for infection, better public awareness about BOB and symptoms to look for, and the suggested findings that *Q. macrocarpa* var. *oliviformis* is more susceptible to BOB. The wet weather this spring most likely encouraged this fungal disease.

BOB is not immediately lethal to bur oak but may eventually kill a tree over a period of years. Sampling for BOB is best conducted in late summer (i.e. August and September) when the disease is fully expressed (figures 20-23). Research on the biology, epidemiology, and chemical management of BOB is ongoing under the direction of Dr. Tom Harrington at Iowa State University.

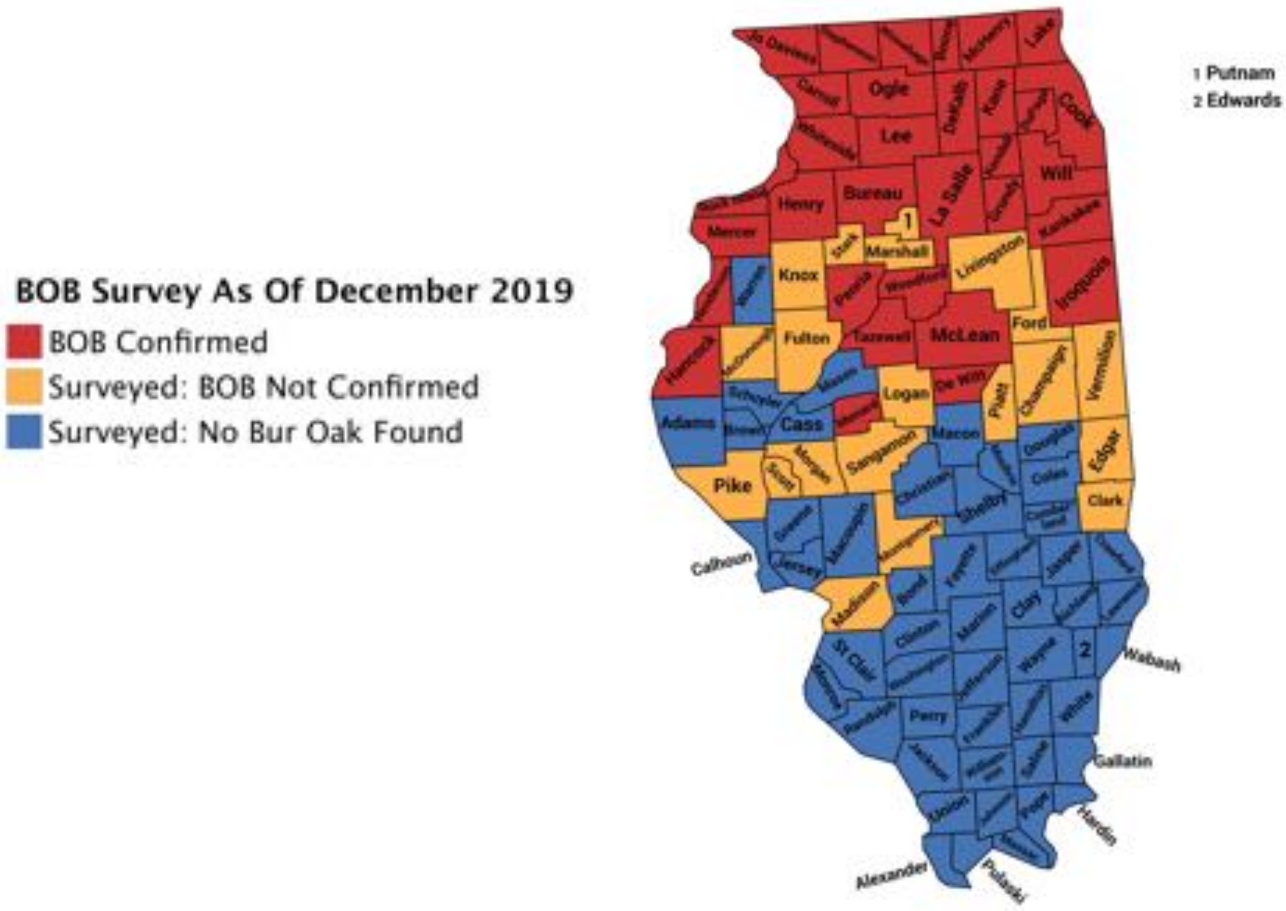


Figure 19: Distribution of BOB in Illinois, 2019

Figure 20: Bur oak blight (BOB) leaf symptoms on underside of leaf

Figure 21: Bur oak leaf blight symptoms

Figure 22: Bur oak blight (BOB) on bur oak

Figure 23: Black, pimple like fungal fruiting bodies on bur oak leaf petiole

General Decline of Conifers and Other Trees (16)

During 2019, we continued to receive a number of reports concerning the decline and death of spruces, pines, and hardwoods growing in windbreaks, privacy plantings, farmsteads, parkways, and home landscapes. While there are a variety of factors responsible, there are several pertinent abiotic and biotic factors to consider.

Let's review what we mean by tree decline and the possible factors that lead up and contribute to the decline process. Decline describes the most significant feature or general nature of disease syndrome, but typically does not identify causal relationships or the causal agent. Tree death is consequence of invasions by secondary, opportunistic and saprophytic organisms not capable of causing disease in healthy, unstressed trees.

The host-stress-decline (HSD) model is as follows:

- **Healthy tree plus stress leads** to altered trees/tissues and dieback begins
- **Altered trees/tissues plus more stress leads** to further dieback
- **Severely altered trees/tissues plus secondary organisms leads to** tree/tissue invasion and loss of ability to respond to improved conditions, resulting in decline and eventually death. The stress may be acute (i.e. sudden and death follows), chronic, or long term ending in tree death, or the tree may stabilize.

Symptoms associated with the HSD model include, but are not limited to, slow growth and thin canopies, undersized, distorted or chlorotic leaves, leaf scorch, premature fall color, abnormally large fruit crops (called "distress crops"), twig and branch dieback, and/or adventitious trunk sprouts.

Sinclair and Hudler (1988) described five different HSD scenarios:

- Perennial or continual irritation by one factor
- Drastic injury plus secondary stress
- Interchangeable pre-disposing, inciting, and/or contributing factors
- Synchronous cohort senescence (trees of a similar age declining as a group)

- Multiple factors may weaken a tree, then trigger decline and exacerbate problem by continual influence

The decline of maples, spruces, and other conifers tend to follow either the HSD synchronous cohort senescence or the multiple factor scenarios described by Sinclair and Hudler (1988). Interchangeable pre-disposing, inciting, and/or contributing factors include the introduction of new biotic or abiotic factor(s) or a change in supply of factor(s) in a stressful environment triggering decline or "***spiral of diminishing health***" (Figure 24). Synchronous cohort senescence suggests trees of similar age and growing together, display group behavior. For example, mature and over mature trees may come under stress due to seasonal water shortage, decline occurs combined with drought or climatic changes, and then opportunistic pathogens and insects hasten tree decline.

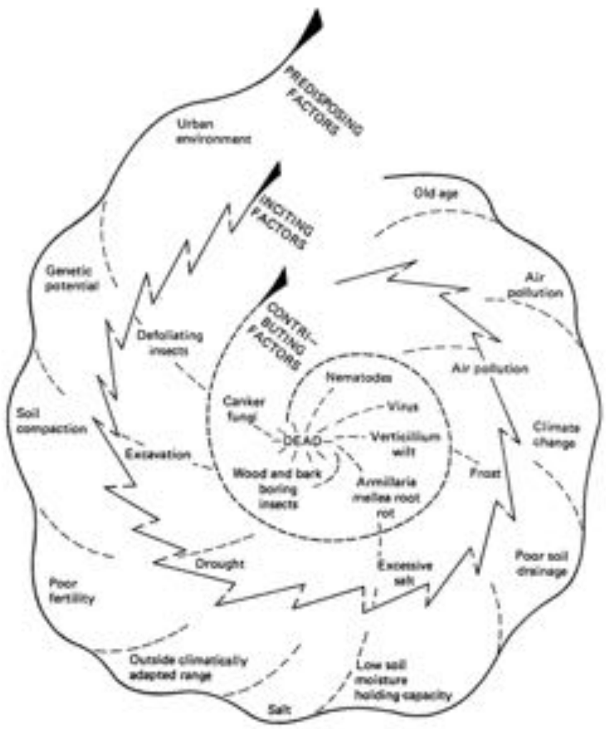


Figure 24: "Decline-death spiral" from Manion (1981)

Spruce and conifer decline. Since the 2012 drought, we have had extremes in weather each year with above average precipitation. From January through early July of 2019 we had record-setting precipitation followed by drier conditions beginning in early July through August, followed by record precipitation again September through October 2019. How does this affect the health of conifers? Conifers do not like "wet feet" so trees trying to grow in heavy (i.e. clay) wet and/or poorly drained soils on berms on in low areas will struggle. Saturated soils are very hostile to tree roots causing root rots and death of fine root hairs. These root hairs are very important in helping the tree take up water and nutrients necessary for tree growth. A second factor is air temperature. Think about the name "Colorado blue spruce" (as they say, "it is all in the name") and then consider our Illinois climate.

Spruces prefer moderate summer temperatures with coarse, well-drained soils. In particular, planting Colorado blue spruce in areas with poorly drained soils and potentially hot dry summers violates the axiom “right plant for the right place”. Once a conifer becomes stressed, then it is predisposed to a number of disease and insect problems, namely needle cast diseases and tip blights, cankers, pine wilt disease, wood-boring beetles and bark beetles. With the exception of pine wilt disease, none of these secondary agents are lethal to the tree but are just one more stressor the tree has to contend with.

Needle cast disease (1, 12). Two very common diseases affecting conifers, *Rhizosphaera* needle cast and *Diplodia* (i.e. *Sphaeropsis*), were observed throughout the state in 2018. Both of these fungal leaf diseases attack the needles of cone-bearing tree species causing premature needle cast or a browning and/or death of the growing tip, respectively (Figures 25 and 26).

Rhizosphaera needle cast attacks needles of Colorado blue, Norway, and white spruce and pines (Figure 25). The fungal needle disease is most common during cool, wet springs with high relative humidity (RH). Faint yellow bands will occur on the needles four to 11 months after infection. Later small, dark brown to black fruiting bodies (i.e. pycnidia) will appear in spring. Rhizosphaera needle cast disease usually starts on branches on the lower tree crown and progresses upward. Premature needle drop is common giving the canopy a thin appearance, branch dieback, and an unsightly appearance.

Figure 25: Rhizosphaera needle cast

Diplodia tip blight (1) (Figure 26) (*Diplodia pinea*) is a common fungal disease of stressed conifers, or two and three needle pines such as Austrian pine (*Pinus nigra*), Scots pine (*Pinus sylvestris*), red pine (*Pinus resinosa*), Mugo pine (*Pinus mugo*), Ponderosa pine (*Pinus ponderosa*) and occasionally Eastern white pine (*Pinus strobus*). Diplodia tip blight may also be found on Douglas-fir (*Pseudotsuga menziesii*), Norway spruce (*Picea abies)*, Colorado blue spruce (*Picea pungens*), American larch (*Larix laricina*), noble fir (*Abies procera*), silver fir (*Abies alba*), some true cedars (*Cupressus* spp.), arborvitae (*Thuja* spp.), and junipers *(Juniperus* spp.). The disease is rarely found on trees under 15 years of age and is more severe on trees over 30 years of age. It most often affects ornamental plantings under stress due to drought, hail or snow damage, over shading, compacted and unfertile soils, restricted rooting volumes, and insect activity. The fungus kills current year shoots and sometimes branches.

Diplodia tip blight kills needles at the tips of branches usually starting in the lower half of the tree and moves upward. Infected needles will be stunted, turn yellow, and then brown (Figure 26). Typically, all current season's needles are killed and resin droplets may be seen on the dead shoots. Pycnidia, which look like black pepper, appear during summer and fall, at the base of the needles under the fascicle sheath (Figure 26). They may also be found on the scales of second year seed cones. Under severe infections, whole branches may dieback to the trunk. Like Rhizosphaera needle cast, Diplodia tip blight is most common under cool wet conditions.

Figure 26: Diplodia tip blight (Left) and pycnidia fruit bodies (Right)

Cytospora, a stress-related canker disease (1, 12). *Cytospora* canker of spruce is definitely a stress-related disease, particularly of Colorado blue spruce (Figure 27). Spruces are a common urban forest and landscape species. The cankers are initially found on the undersides of the branches and result from some type of stress. Spruce trees growing in urban environments are very prone to this canker. While not fatal, the cankers cause branches distal to the canker to die resulting in a loss of ornamental quality and landscape function (1).

Figure 27 (Left and Right): Branch dieback associated with Cytospora canker on spruce

Phomopsis Canker. A fourth disease, Phomposis canker, is getting renewed attention. This canker attacks spruce (*Picea* spp.), hemlock (*Tsuga* spp.), and true firs (*Abies* spp.). The causal agents of Phomopsis canker are *Disporthe eres* and *D. minospora*, the latter being more virulent. While symptoms are similar to Cytospora canker probably leading to mis-diagnosis in the field, Phomopsis cankers appear as sunken dark areas on the stem with browning vascular tissue, and canopy dieback (Figure 28). Unlike

Cytospora canker, resin is not always present, and you have to peel the bark back to see the discolored cankered area (Figure 29). Pycnidia fruit bodies are formed resulting in black pads of branch tissue from which the spores erupt (Figure 30).

Figure 28 (Left and Right): Phomopsis canker symptoms on Colorado blue spruce

Figure 29: Cankered area versus healthy tissue

Figure 30: Fungal pycnidia on spruce

Management of spruce and pine decline

- **Cultural.** Since cones and dead tips contain the fruiting bodies that produce millions of spores, remove and destroy all infected cones and dead and dying branches and shoots during dry weather. Pruning tools should be disinfected between cuts by dipping them in alcohol or bleach (one part bleach to nine parts of water). Maintain tree health because the disease is more severe on trees that are under stress. Keep the tree watered during dry periods. Maintain a layer of mulch under the tree to conserve moisture. Because the fungus can also infect wounded tissues, avoid pruning trees from late spring to early summer when they are most susceptible. Plant less susceptible conifer species and provide good air circulation by proper tree spacing.
- **Sanitation.** Remove trees in poor condition to prevent future fungal infections and insect infestations
- **Chemical.** Registered fungicides can be applied for control of Rhizosphaera needle cast disease and Diplodia tip blight by spraying on a regular basis for the first two months after bud break. Fungicide treatments have not shown to be effective for Cytospora or Phomopsis cankers

New Invasive Insects to Watch Out For

Spotted Lanternfly (13, 18)

The spotted lanternfly (SLF) (*Lycorma delicatula*) has recently been detected in Pennsylvania, New York, Virginia, New Jersey, and Delaware. Native to China, India, Japan, Korea, and Vietnam, the SLF apparently is able to survive and 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, black initially, but developing red patches as the nymphs 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 31 and 32). 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 in July through August. Egg-laying begins in September and continues through November (Figure 33).

Upon egg hatch, the young nymphs disperse and begin feeding on a wide range of hosts and 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*) and grapevine (*Vitis vinifera*) as host plants. In the fall, the adults also favor 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., so can easily travel to new locations. Heavy feeding may lead to plant stress and may lead to 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.

Figure 31: Spotted lanternfly nymph (Left) and Adult spotted lanternfly (Right)

Figure 32: Adult spotted lanternfly

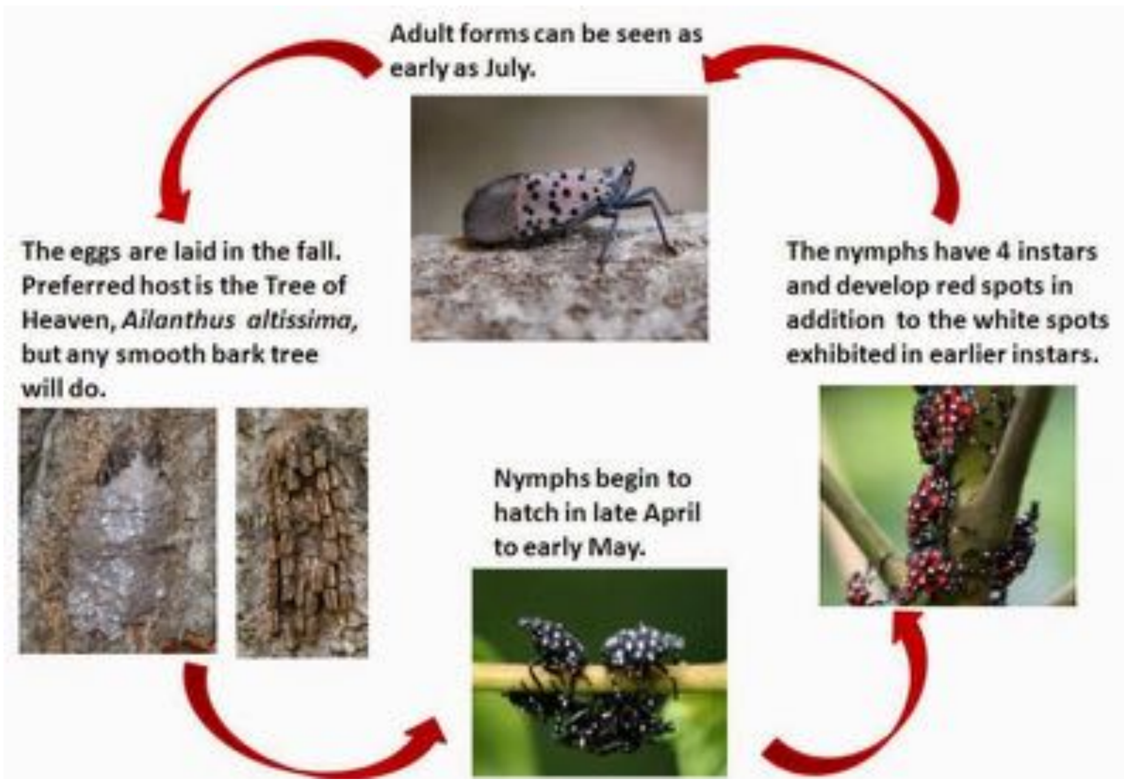


Figure 33: Life cycle of the spotted lanternfly

Weather and Abiotic Events (2, 10)

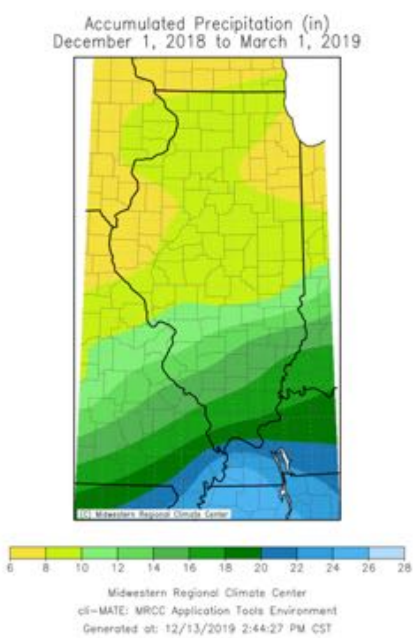
Table 2 presents a quick glance at temperatures and precipitation each month throughout the year as compared to the normal amounts (average of data from 1981-2010). 2019 was the second wettest year on record for the state of Illinois with a total of 48.03 in of rainfall, 10.76 in above normal, 1.62 inches below the wettest year, 1993. While spring temperatures were cooler than usual, the average temperature for the whole year was within the normal range. (63rd out of 125 years).

Month	Precipitation (in) 2019	Normal Precipitation (1981-2010)	Avg. Temperature 2019	Normal Avg. Temperature (1981-2010)
January	2.40	1.77	25.4	26.4
February	3.59	1.72	29.3	30.9
March	2.83	2.52	37.4	41.3
April	3.81	3.33	52.6	52.6
May	6.35	4.21	62.5	62.7
June	5.01	4.25	70.9	71.9
July	4.13	4.06	77.4	75.4
August	3.80	3.66	72.8	73.6
September	4.47	3.44	71.6	66.2
October	4.84	3.01	53.6	54.4
November	2.26	2.78	36.2	42.5
December	TBD	2.21	TBD	Not Listed

Table 2. Monthly precipitation and temperature for 2019 compared to the normal levels

Winter

While late January brought a Polar Vortex to much of the state, the average statewide temperature for the month was only slightly below normal. It is difficult to say whether this cold spell had a significant impact on pest and disease populations, although some pests such as bagworms might have a reduction in their numbers in some areas. Most of the state experienced higher than average precipitation, particularly the southern part of the state (Figure 34). Precipitation was well above average this winter with total precipitation at 9.77 in, 2.95 in above normal. Temperatures were slightly cooler than normal in the northwest corner of the state and slightly warmer than normal in the southern part of the state



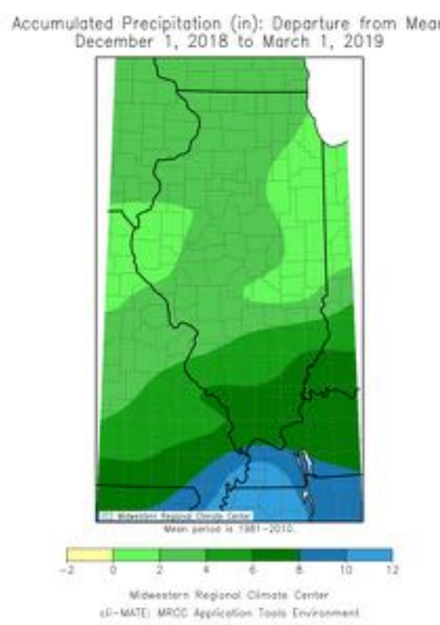


Figure 34: (Left) Total accumulated precipitation and (Right) departure from average precipitation for December 2018 - March 2019.

Spring

As in previous years, most of Illinois had another very wet spring. Spring 2019 was the fourth wettest spring season in Illinois state history (March-May). The statewide average precipitation for May was 6.35 inches or 2.14 inches above normal (Figure 35), making it the 2nd wettest May on record (since 1895). Precipitation was especially high in a band through the northern and central part of the state. An area west of Peoria received 8-10 inches above normal, setting the state record for the wettest May. The consistent heavy rains and high humidity contributed to outbreaks of anthracnose on most hardwood species, particularly oaks continuing into early July. Flooding was a frequent occurrence, particularly along river and farmers throughout the state were delayed in planting their crops because of flooding and wet weather, and some were unable to plant at all. The northern half of the state was 1-3 degrees cooler than normal, but the rest of the state had normal temperatures.

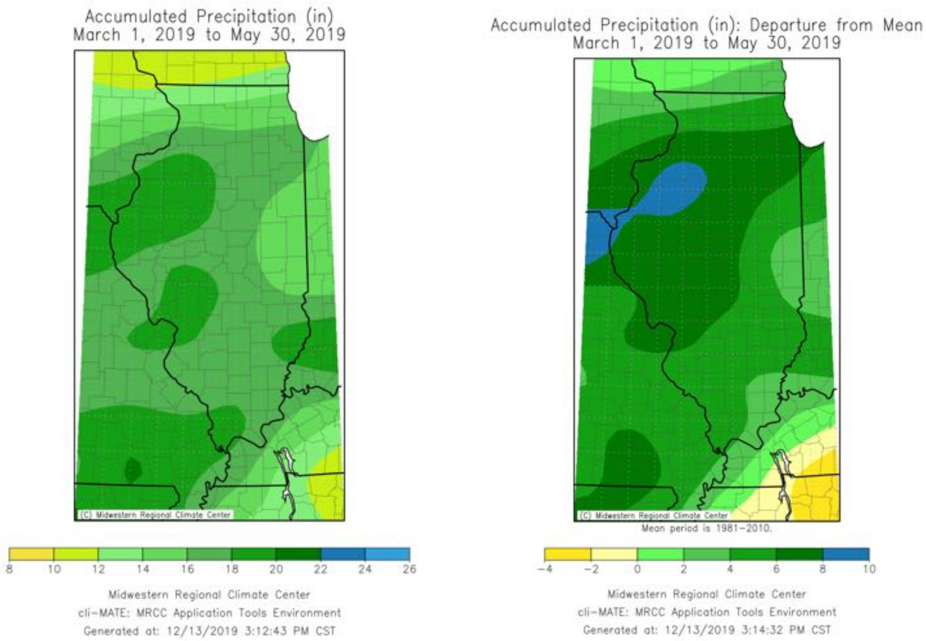


Figure 35: (Left) Total accumulated precipitation and (Right) departure from average precipitation for March-May 2019.

Summer

The wet weather continued throughout early June with rainfall returning to normal levels in July-August 2019. In the summer, most of the northern half of the state experienced lower than normal rainfall, down 2-4 inches in some areas. The southern half of the state had higher than normal rainfall, up to 6-8 in above normal in a small central area. In general, the mean summer precipitation statewide was only .39 in. above normal (Figure 36). Temperatures were normal statewide.

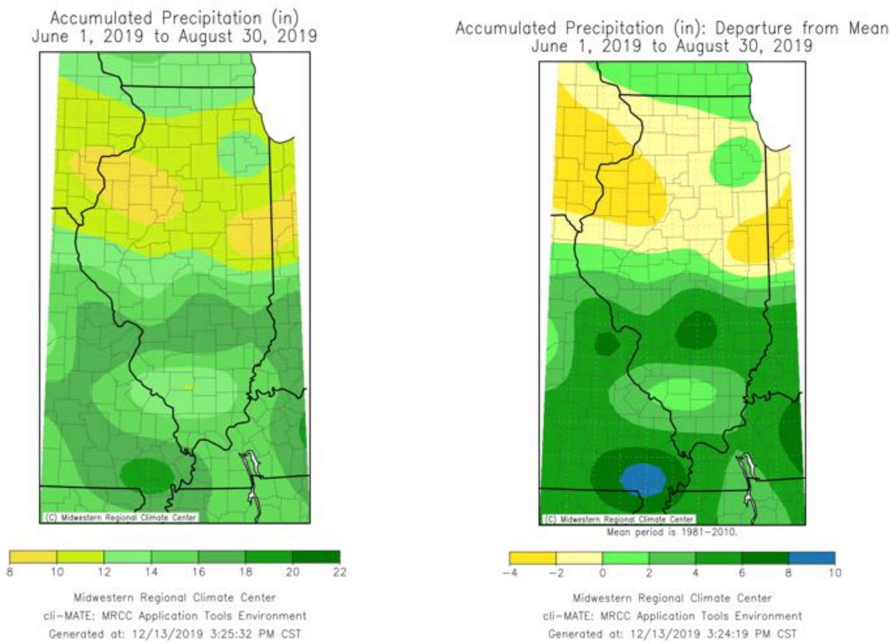


Figure 36: (Left) Total accumulated precipitation and (Right) departure from average precipitation for June-August 2019.

Fall

Throughout the fall, the statewide average rainfall for September was 12.45 inches, 2.51 inches above normal and the 19th wettest fall on record. The northern part of the state received considerably higher rainfall than normal, up to 8-10 in above normal from about Rockford west and north (Figure 37). More flooding was seen along the Rock and other rivers. The northern half of the state was 1-2 degrees cooler than normal, but the southern half had normal temperatures.

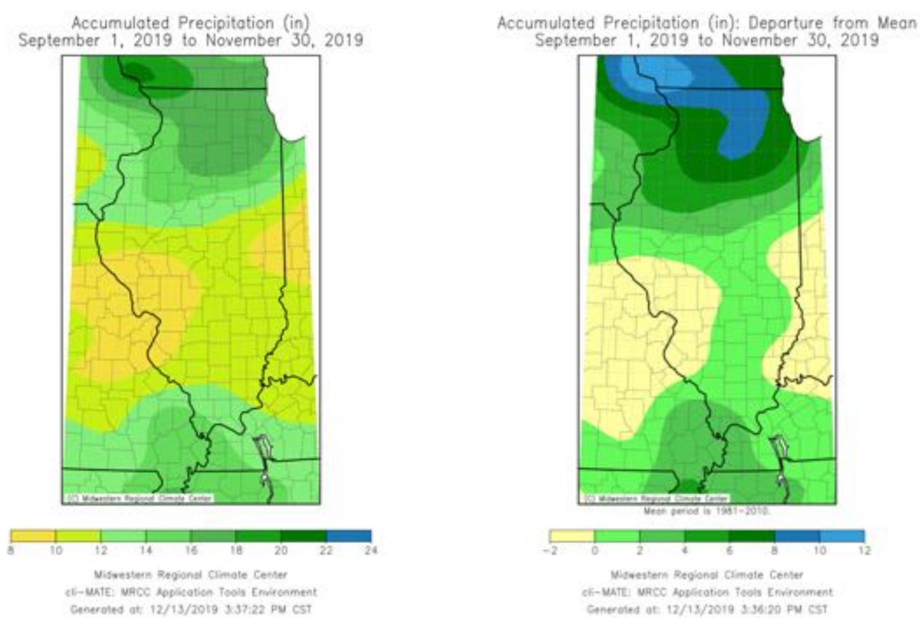


Figure 37: (Left) Total accumulated precipitation and (Right) departure from average precipitation for September-November 2019

Appendix I-IDOA 2020 Dicamba Restrictions:

IDOA 2020 dicamba restrictions
Intent is to reduce the potential for off-target movement of the product
PUBLISHED ON October 15, 2019

The Illinois Department of Agriculture (IDOA) has announced additional label restrictions for the 2020 growing season for the herbicide dicamba.

SPRINGFIELD, Ill. — The Illinois Department of Agriculture (IDOA) has announced additional label restrictions for the 2020 growing season for the herbicide dicamba. After careful consideration, IDOA Director John Sullivan has determined the Department will be forwarding 24 (c) registration requests to the United States Environmental Protection Agency (USEPA) for Illinois specific labels for the use of dicamba on soybeans in 2020 requiring the following additional provisions:

DO NOT apply this product if the air temperature at the field at the time of application is over 85 degrees Fahrenheit or if the National Weather Service's forecasted high temperature for the nearest available location for the day of application exceeds 85 degrees Fahrenheit.
(Local National Weather Service forecast are available at https://www.weather.gov.)

DO NOT apply this product after June 20, 2020.

Before making an application of this product, the applicator must consult the FieldWatch sensitive crop registry (https://www.fieldwatch.com) and comply with all associated record keeping label requirements.

Maintain the label-specified downwind buffer between the last treated row and the nearest downfield edge of any Illinois Nature Preserves Commission site.

It is best to apply product when the wind is blowing away from sensitive areas, which include but are not limited to bodies of water and non-residential, uncultivated areas that may harbor sensitive plant species.

"The number of off-target complaints received during the 2019 growing season rose dramatically, and the Department is taking action to reduce those numbers," said John Sullivan, Director, IDOA. "These additional restrictions were reached after careful consideration with our Environmental Programs team at the Department, as well as input from stakeholders in the agriculture industry."

In addition to these provisions', applicators must follow the federal guidelines when it comes to applying dicamba, including taking an annual certified applicator training course.

The intent of these additional restrictions is to reduce the potential for off-target movement of this product, thereby reducing the potential for possible adverse impacts to dicamba-sensitive crops/areas. Dicamba is primarily used on soybeans to control post-emergence broadleaf weeds. The decision to pursue state-specific Special Local Needs (SLN) labels was made in response to the record number of misuse complaints the IDOA received during the past three years.

— Illinois Department of Agriculture

Appendix II-Herbicide damage sampling protocol and submission form:

IDNR-MORTON ARBORETUM

Plant Diagnostic Clinic

How to Collect and Submit Woody Plant Samples
For Herbicide Damage Testing

- **Provide Information**
  - Fill out Herbicide Damage sample submission form **completely.**
  - Make additional copies of the form as needed. (Request sample submission forms from **fmiller@jjc.edu**)
  - If possible, take photos of the damage for future reference
- **Collect the Plant Sample**
  - Collect 8-10 symptomatic leaflets/leaves.
  - Place leaves into a plastic ziplock bag with a dry paper towel.
  - Clearly mark each ziplock bag with the sample ID.
  - **Keep sample on ice/cold until it can be frozen (no more than 12 hrs)**
  - **Keep sample frozen during shipment** by packing on ice and sending overnight is best, but no more than two day delivery. Sample MUST stay frozen during shipment.
  - Send samples Monday-Thursday to be received no later than Friday. There is no mail collection on the weekends, so plan accordingly.

Contact Information:

Dr. Fredric Miller

IDNR Forest Health Specialist

The Morton Arboretum

4100 Illinois Route 53

Lisle, Illinois 60532

630-719-2427

fmiller@jjc.edu

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

The Morton Arboretum

Forestry-Dicamba Sample Submission Form

IDNR-Morton Arboretum
4100 Illinois Rte. 53
Lisle, IL 60532
Phone: (630) 719-2427 E-mail: fmiller@jjc.edu

For Lab Use Only

Rec'd: ____________

Condition on Arrival
☐ Excellent ☐ Good
☐ Fair ☐ Poor

Sample # ________

STATE COOPERATOR

Cooperator name: ____________
Agency: ____________
Address: ____________
City/State/Zip: ____________
Phone: ____________ Cell: ____________
E-mail: ____________

COLLECTOR

Collector name: ____________
SAMPLE INFORMATION
State/County: ____________
Address: ____________
City: ____________
Or
Lat: ____________ Long: ____________

Documentation for suspected dicamba drift / vapor injury

Please provide as much information on the sample as possible

Date Collected: ____________ Site Name: ____________

Species: ____________ Site Type: ☐ Home Landscape ☐ Orchard ☐ Nursery ☐ State Land ☐ National Park/Forest

Symptom pattern on tree

Leaf: ☐ cupping upwards ☐ cupping downwards curling ☐ petiole twisted ☐ tatters
☐ abnormal elongation ☐ abnormal leaf venation ☐ interveinal chlorosis
Symptoms mostly on: ☐ new growth ☐ old growth

Shoot: ☐ twisted ☐ flattened ☐ proliferation of leaves at nodes ☐ witches brooming

Canopy: ☐ 1-20% ☐ 21-40% ☐ 41-60% ☐ 61– 80% ☐ 81-100% affected

Symptoms appear: through-out canopy ☐ on one or two sides ☐ only

Symptom pattern in landscape

Symptoms appear ☐ only on this tree ☐ only on this species ☐ other species (list if possible)

Other possible agents: ☐ environmental ☐ insects/mites ☐ pathogens

Please describe on reserve side of this sheet

Appendix III- RWOM Reporting forms for foresters and landowners:

Rapid White Oak Mortality Survey - Foresters	
OBSERVER NAME AND PHONE / EMAIL	DATE
SITE LOCATION	
NAME OF LOCATION	**COUNTY**
LAT/LONG, UTM, OR LEGAL DESCRIPTION (E .G. SE1/4NW1/4, SECTION23, T.1.S., R.1E)	SOIL MAP UNIT FROM SOIL SURVEY:
CHECK ALL THAT DESCRIBE THE SURVEYED AREA:☐ PRIVATE ☐ PUBLIC (☐ LOCAL ☐ STATE ☐ FED) ☐ PLANTATION ☐FOREST ☐URBAN ☐PARK ☐RIPARIAN ☐ROADSIDE ☐PASTURE ☐OTHER (DESCRIBE)	
SURVEY ½ ACRE (1/3 FOOTBALL FIELD). AFTER A BRIEF WALK, LIST BOUNDARY MARKERS ON BACK (E.G. TOE SLOPE NEXT TO DRAINAGE)	
SITE CHARACTERISTICS FOR SURVEYED AREA (ALL THAT APPLY)	
ELEVATION: ☐FT. ☐M.	ASPECT OR COMPASS DIRECTION SLOPE FACES (E.G. NW):
SLOPE SHAPE: ☐FLAT ☐CONVEX (OUTWARD) ☐CONCAVE (INWARD)	STEEPNESS (0 – 45º OR 0-100%)
SLOPE POSITION: ☐SUMMIT ☐SHOULDER ☐UPPER BACKSLOPE ☐ LOWER BACKSLOPE ☐FOOT/TOE SLOPE ☐BOTTOMLAND	
SOIL USUALLY: ☐ MOIST ☐ PERIODICALLY MOIST ☐ USUALLY DRY	SITE CONTAINS: ☐ POOLED WATER ☐ DRAINAGE AREA ☐ NONE WATER IS ☐ SEASONAL ☐ PERMANENT LIST NAME FOR BODY OF WATER IF KNOWN_______________________________________
APPROXIMATE DISTANCE TO NEAREST AGRICULTURAL FIELD: ☐BORDERING ☐OTHER DISTANCE _________	DIRECTION OF NEAREST AGRICULTURAL FIELD (E.G. NW): _____________ CROPS GROWN (IF KNOWN): ☐ CORN/SOY ☐OTHER
STAND INFORMATION FOR SURVEYED AREA (ALL THAT APPLY)	
COMPOSITION: ☐WHITE OAK GROUP ☐RED OAK GROUP ☐PINE ☐OTHER	% OF ALL LIVING TREES WHITE OAK GROUP: ☐<25 ☐25-50 ☐50-75 ☐ALL
DECLINING/DEAD TREES: ☐RED OAK GROUP ☐PINE ☐OTHER ☐Q. ALBA ☐OTHER WHITE OAK GROUP MEMBER, LIST__________________________	WHITE OAK GROUP REGENERATION PRESENT: ☐YES ☐NO
ONLY DECLINING/DEAD QUERCUS ALBA IN SURVEYED AREA (ALL THAT APPLY)	
% TREES DECLINING/DEAD: ☐<25 ☐25-50 ☐50-75 ☐ALL	AFFECTED Q. ALBA TREE DBH: ☐<10 IN ☐≥ 10
DISTRIBUTION:☐SCATTERED ☐POCKETS ☐LOWER SLOPE ☐UPPER SLOPE ☐ASSOCIATED WITH DRAINAGE	
CROWN POSITIONS: ☐DOMINANT ☐CO-DOMINANT ☐INTERMEDIATE ☐SUPPRESSED ☐OPEN GROWN	
CROWN DIE-BACK: ☐LOW (5-30%) ☐MODERATE (30-60%)☐SEVERE (60-95%)☐COMPLETELY DEAD (100%)	
VISUAL SYMPTOMS, DECLINING QUERCUS ALBA ONLY (ALL THAT APPLY)	
VISIBLE SYMPTOMS AND SIGNS: ☐ BLEEDING CANKERS ☐ FALLEN BARK AT TREE BASE ☐UPPER BRANCH DIEBACK/DEATH ☐ WILTED LEAVES ATTACHED ☐ FALLEN LEAVES ☐ LEAF BRONZING AT MARGINS FIRST, THEN BASE (OAK WILT) ☐ SMOOTH SLICK GREY OR BLACK PATCHES ON THE TRUNK (HYPOXYLON) ☐ MUSHROOMS ON TREES ☐ DOWNWARD/UPWARD CUPPING LEAVES	
☐ INSECT HOLES ☐ ROUND ☐ OVAL ☐ D-SHAPE HOLE SIZE:☐ PIN ☐ PENCIL LEAD ☐ PEN ☐ LARGER	
KNOWN SITE HISTORY (ALL THAT APPLY)	

CHECK ALL EVENTS THAT HAVE HAPPENED SINCE 2005: □ MOD. -SEVERE BURN □ TIMBER STAND IMPROVEMENT **□ SOIL COMPACTION □ SEVERE DEFOLIATION □ SEVERE GALL OUTBREAK □ SEVERE WINDS □ MOD – SEVERE DROUGHT** **□ EXCEPTIONALLY WET GROWING SEASON □ FLOODING □ LATE SPRING FROST □VERY COLD WINTER □VERY WARM WINTER**
if known, please describe the event and year(s)

ADDITIONAL COMMENTS AND NOTES ON BACK

MAIL FORM TO DR. FREDRIC MILLER, MORTON ARBORETUM, RESEARCH BUILDING, 4100 ILLINOIS ROUTE 53, LISLE, IL 60532 OR EMAIL SCANNED COPY TO FMILLER@JJC.EDU

Rapid White Mortality Visual Survey-Landowners

Observer Name	Date
Can we contact you if follow-up needed ☐Yes ☐No	If yes, phone or email

Surveyed Area

Latitude and Longitude or nearest road intersection	County
☐ Private land☐ Public (☐ Local ☐ State ☐ Fed)	
Check all that describe the immediate area around the dead trees: ☐Forest ☐ woodlot ☐pasture ☐roadside ☐park ☐yard ☐within city, town, village limits ☐riparian	Surveyed area Size: ☐≤ Football field ☐ larger
Approximate distance to nearest agricultural field: ☐bordering ☐other distance _________	crops grown (if known): ☐ corn/soy ☐other

Information About Declining/Dead White Oaks within survey area

The approximate number of living and dead trees you are surveying:☐< 10 ☐11 - 50 ☐›51

The approximate number of Dead/ Declining white oaks: ☐< 10 ☐11 - 50 ☐>51

dead/declining white oak trunk diameter measured at chest height (all that apply): ☐Small (<10 in across) ☐Large (≥ 10 in)

Location of Declining/Dead trees relative to hillside (all that apply): ☐top of a hill (summit or plateau) ☐upper half of hill ☐Lower half of hill ☐At the base of a hill (Bottom) ☐None of these, area is flat

If forest/woodlot, declining/dead trees are (all that apply): ☐tallest ☐intermediate ☐shortest ☐NA

Did leaves remain attached to dead tree branches for several months: ☐yes ☐no ☐ branches not dead

Trees died (all that apply): ☐several years ago☐ last year ☐this year ☐ not dead ☐ not sure

Comments and Notes Below or on Back

Mail form to Dr. Fredric Miller, Morton Arboretum, Research Building, 4100 Illinois Route 53, Lisle, IL 60532 or email scanned copy to fmiller@jjc.edu

References

1. **Adams, S., 2016.** *The Morton Arboretum Diagnostic Plant Clinic and Plant Health Care Reports*. The Morton Arboretum, Lisle, Illinois.

2. **Angel, J. 2019. Illinois CoCoRaHS Newsletters.** Volumes 13: 1-12.

3. **Cleveland, T. and D. Plewa. 2017.** University of Illinois, Home, Yard, and Garden Newsletter, Issue 15, 11 September 2017.

4. **Condra, J., C. Brady, and D.A. Potter. 2010.** Resistance of landscape suitable elms to Japanese beetle, gall aphids, and leaf miners, with notes on the life history of *Orchestes alni* and *Agromyza aristata* in Kentucky.

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

6. **Gill, C. 2010.** *Plant Health Progress*. Pennsylvania State University (PSU) (17 October 2010).

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

8. **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/

9. **Hibbs, R. 1978.** Recognition of weed-killer injury to trees. Journal of Arboriculture 4(8): 189-191.

10. **Midwestern Regional Climate Center**. 2000-2019. cli-MATE: MRCC Application Tools Environment. https://mrcc.illinois.edu/CLIMATE/welcome.jsp

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

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

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

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

15. **Samtani, J.B., J.E. Appleby, and J.B. Masiunas. 2011.** Common farm herbicides may cause leaf tatters on oaks. *Tree Care Industry*, February, 2011. Pages 22-23.

16. **Sinclair, W.A. and G.W. Hudler. 1988.** Tree decline: Four concepts of causality. Journal of Arboriculture 14(2): 29-35.

17. **The Morton Arboretum Plant Clinic.** Help with pests: Bagworms. https://www.mortonarb.org/trees-plants/tree-and-plant-advice/help-pests/bagworms

.

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

PLEASE NOTE: The information presented in this summary is not to be considered comprehensive nor all inclusive. Information presented here is based on visual and observational surveys and reports by Fredric Miller, Ph.D., IDNR Forest Health Specialist, Erin McMahan, M.Sc., Research Assistant, The Morton Arboretum, IDNR Forest Health field technicians, IDNR district foresters, private landowners, homeowners, The Morton Arboretum Plant Diagnostic Clinic, and members of the green industry.

REPORT PREPARED BY: Fredric Miller, Ph.D. IDNR Forest Health Specialist, and Erin McMahan, M.Sc., Research Assistant, The Morton Arboretum, Lisle, Illinois.

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