Illinois Trees

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Understanding Healthy & Diseased Roots

by Stephanie Adams

Root rots of all plants can be confusing and frustrating. Root rots can be caused by many microscopic organisms or microbes and their successful management depends on an accurate diagnosis. Most root rots are caused by three different types of microbes including true fungi, fungal-like organisms (aka oomycetes or water molds), and bacteria. Each of these can be diagnosed in State Cooperative Extension Plant Diagnostic labs, such as the University of Illinois Plant Clinic.

Aboveground symptoms of root rot diseases are similar no matter the host plant. Diseased plants will underperform, meaning their growth and vigor are reduced, they may be off-color, and if many plants are involved there may be a localized area within the planting where plants are melting-out and dying. These aboveground symptoms are the first indicators we notice.

Unfortunately, root rot diseases, drought, and drowning can have similar aboveground symptoms. This is because in all three situations water and nutrients are not be transported to the canopy as needed. In all situations a further investigation is necessary to identify the primary cause of the aboveground symptoms.

The first part of an investigation needs to include checking the soil down to 16 inches in all four cardinal directions. This may be done using a soil probe, a hand trowel, or a shovel. This will help identify how moist or dry the soil is and whether it is appropriate for the host plant. It will also allow for the investigation of the fine hair absorbing roots, which should be present within this depth. Checking the roots in all four areas under the canopy will give a better idea of the overall root health for the tree. It is possible to have localized water problems or root rots.

Healthy roots are creamy white to white (Figure 1), round and firm when squeezed between two fingers, smell earthy like soil, and usually grow in dense populations uniformly in the root system. Keep in mind that some of these healthy characteristics may vary between species. Try to become familiar with what healthy roots look like for different plant species, this is especially helpful when trying to identify root problems.

Figure 1: Light-colored healthy roots can be found mixed in with dark and discolored diseased roots. If left untreated the infection will spread.

Symptoms of diseased roots include: tan to brown coloration, roots will be soft and squishy when squeezed between two fingers or flat and dry, brittle (Figure 2), they may smell sour or acrid like swamp-water, the root sheath may slough off (Figure 3) the inner root (stele) easily,

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Don't forget to hold this date for the upcoming IAA Annual Conference & Trade Show the week of November 14th, 2022

IAA Board of Directors

Illinois Arborist Association

Mission Statement

"Foster interest, establish standards, exchange professional ideas and pursue scientific research in Arboriculture"

President's Message

I hope that everyone has had a safe and successful winter thus far. As we begin another year, the Board of Directors and IAA office are working hard to put together another great year of training, social events, and camaraderie. At the end of January, the Board of Directors held its annual strategic planning meeting. At strategic planning, Board Members work on creating a plan for the current year, and sometimes beyond. Our partnership with ILDNR has provided significant funding to bring the most up-to-date training to IAA members and the initiatives we propose, and subsequently approve, are fostered directly from membership feedback. While the Board Members look at all the ideas pertaining to our industry, we always keep in mind that our approved plan and ideas must follow the IAA's mission statement: "foster interest, establish standards, exchange professional ideas and pursue scientific research in Arboriculture".

While the Finance Committee assesses the proposed strategic plan, we always refer to our mission statement before approving funding. Once funding is approved, I encourage you to monitor the programs you take part in. All the training and events are directly supported by you, the membership. As the year progresses, we encourage you to provide feedback on programs the IAA sponsors so that the Board Members can better serve the membership. Have a safe rest of winter. I am very excited for membership to take part in the training we have planned for 2022!

Illinois Arborist Association President,
Aaron Schulz

Understanding Healthy & Diseased Roots (cont.)

Figure 2: The root system collapsed due to a root rot infection.

and they will not be very numerous.

If you find the roots to be excessively wet and the roots and soil smell sour or acrid a bacterial soft rot is most likely to blame. The smell is caused by excess water and anaerobic conditions in the root zone and soil. This allows for anaerobic bacteria to grow. If the plant is not very effected, changing drainage or increasing air pores into the soil will help resolve this problem. If introducing air pores or changing drainage is not possible, then the plant will continue to decline and die due to the lack of oxygen.

Root rots caused by true fungi (examples Rhizoctonia, Fusarium, Thielaviopsis) and fungal-like organisms (aka water-molds or oomycetes) (examples Phytophthora, Phytopythium, Pythium) can have the same root rot and aboveground symptoms but their management, especially chemical control, are very different. These require laboratory diagnosis to confirm the causal microbe. This will ensure that the correct pesticide is applied and will result in the best outcome for the plant and your client. To contact and submit samples

Figure 3: Disease root tip. The crack in the bark shows where the bark is slipping or sloughing off of the inner root (the stele).

to the Illinois Cooperative Extension Plant Clinic, visit their website at https://extension.illinois.edu/plant-clinic

IAA Introduces New Advanced Training Instructors

by Norm Hall

The IAA has had Advanced Training Tree Worker Domain courses since 2002. I have shared the role of Lead Instructor since then and have enjoyed meeting and instructing the attending arborists. I would like to thank those who have generously given their time to help with this training effort, Todd Kramer, Don Roppolo, Eduardo Medina, Eric Celletti and Andrew Ranney to name a few.

The time has come for me to let others take over the responsibilities of running the courses and instructing. We have carefully chosen 4 individuals, 1 woman and 3 men, to share the Instructing role for the Tree Worker Domain. We have had an increase in women attendees in the Tree Worker Domain and wanted to add a woman Instructor to encourage more to attend Tree Worker courses.

We would like to introduce the new 4 Instructors to the IAA membership.

Felicia Speranske is a graduate of the University of Illinois Urbana Champaign with a degree in Natural Resource Management. Felicia has been in the arborist industry for 7 years. She is a 2-time Women's Division Champion of the Illinois Arborist Association's Tree Climbing Championship, taking the crown in 2016 and 2018. Her strengths are climbing, rigging, pruning, and felling.

Phil Prohaska is a graduate of UW Stevens Point with 16 years of arboriculture field experience. Phil helped as an assistant instructor in many courses last year and those of you who met Phil have seen what an excellent instructor he is. Phil has a strong background in climbing, rigging, and felling. Phil instructs students at UW Stevens Point in Safe Climbing techniques. He also has shown interest in becoming the 'lead instructor' for the Tree Worker Domain.

Dale Day is an ex-Marine. Dale is in the Bloomington area where we would like to hold more Advanced Training courses. Dale has 5 years in the arborist industry and runs his own business. Dale has a strong background in climbing, rigging, and felling. Dale helped as an assistant Instructor in 2020 and 2021.

Jason Sochacki graduated from the University of Illinois Champaign Urbana with a degree in Ornamental Horticulture. Jason has been in the arborist industry for over 20 years. He is the pruning guru, as well as a climber, rigger, and feller. Jason helped instruct a Rigging Level 1 course in 2021.

The Advanced Training Tree Worker Domain is excited to have all 4 of these talented arborists join the Team. You will be seeing them in the spring and throughout the years.

Welcome aboard Felicia, Phil, Dale, and Jason.

Overwintering Insects, Climate Change, & Plant Healthcare

by Fredric Miiller

As I sit here writing this article, it is late January and up until recently, the winter has been fairly mild, with little snow, and the occasional Arctic outbreaks that last a few days, and then temperatures rise again. It is easy for us enter the "black box" of the fall-winter season, but not give too much thought to what pest issues might appear the following spring and early summer, or other words, what effects do winter conditions have on overwintering insects, and their pest potential in subsequent growing seasons?

In this article, I will attempt to explain the various tactics that insects use to overwinter, how weather conditions affect and/or influence overwintering strategies and insect mortality, and how this information can assist us in predicting and/or anticipating future pest population levels, and the employment of appropriate and effective Plant Health Care (PHC) practices.

CLASSIFICATION OF INSECT COLD HARDINESS

With respect to cold hardiness, insects can be categorized into two main groups; freeze tolerant and freeze intolerant (Figure 1). These groups are relative, involve complicated methods of cold-hardiness, and will vary greatly by species and seasonality. Freeze tolerance does not imply that insects can tolerate temperatures that lead to a frozen state. Likewise, freeze intolerance or freeze avoidance does not mean the insect can tolerate any temperature as long as it does not freeze (Somme, 1999). In order to avoid freezing at temperatures below the freezing point of their body fluids, freeze intolerant insects have the ability to supercool. Supercooling is the ability an organism to survive body temperatures below the freezing point of water and can be quantified by determining their supercooling point (SCP)

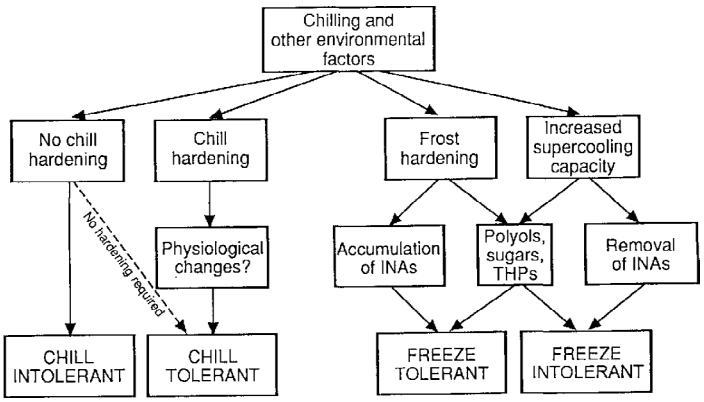

Figure 1: Chart of processes leading to different categories of cold hardiness in terrestrial arthropods. Chill tolerance includes survival above and below the freezing point of the body fluids in both freeze tolerant and freeze intolerant species. (Taken from Somme, 1999)

(Figure 2). There are a number of factors that affect an insect's SCP including the timing and duration of cold, presence of ice nucleating agents (i.e., food and dust particles, bacteria) in the insect's gut, overwintering sites, and rate of cooling (i.e., rapid or gradual). Once an insect reaches its SCP, body fluids freeze resulting in death for most insects and insect relatives (i.e., mites, spiders). In most cases, the lower the temperature the shorter the exposure that is needed to cause death. So, extended periods of extreme cold can be more lethal than periods of mild to moderate cold. Some arthropods are killed at temperatures above freezing and are considered chill intolerant, while chill tolerant

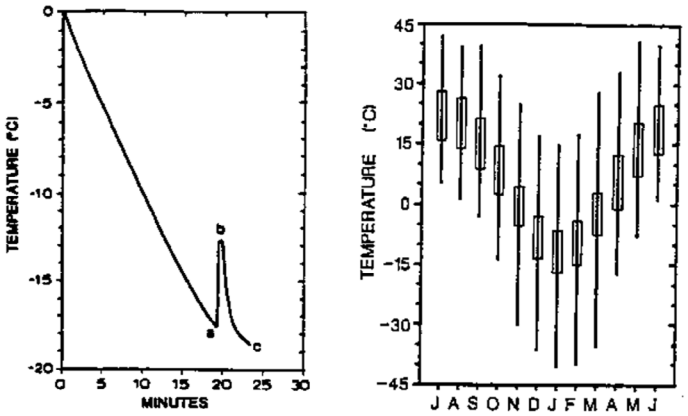

Figure 2. Supercooling point (SCP) graph (Left) and seasonal changes in the SCP temperature (Right)

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Calendar of Events

February Events

February 17, NEMF – Data Strategy for Urban Forests, Ralph Nikischer virtual and in-person at the City of Park Ridge, 10am -12pm. Click here to register: https://illinoisarborist.org/february-northeast-municipal-forester-event/

February 23, TreeBiz Afterhours Social – Best Practices of Compact Aerial Lift Safety, Dave Webb Jr. from Wellbuilt Equipment. 4pm – 6pm at Two Hound Red Brewing Co. Click here to register: https://illinoisarborist.org/iaa-treebiz-social-after-hour-sessions/

March Events

Thursday's, March 3 – May 5 --Arborist Certification Workshops in Homewood 6pm – 8:30pm Click here to register: https://illinoisarborist.org/2022-homewood-spring-and-fall-classes/

Saturday's, March 5 – 19 . Arborist Certification Workshops in Person – Groveland, IL. 8am-2pm. Click here to register: https://illinoisarborist.org/2022-certification-workshop-groveland/

March 16, Arborist Certification Exam at the Mundelein Fire Station #1. Check in time 6pm. Click here to register: https://www.isa-arbor.com/Credentials/Which-Credential-is-Right-for-You

March 31, Arborist Certification Exam at the Village of Lombard. Check in time 6pm. Click here to register: https://www.isa-arbor.com/Credentials/Which-Credential-is-Right-for-You

March 9, IAA Board Meeting at 10am

March 17, NEMF – Climate Change, Erratic Weather and PHC, What is an Arborist to do? Dr. Fredric Miller. Virtual and in-person at the City of Park Ridge, 10am-12pm. Click here to register: https://illinoisarborist.org/northeast-municipal-forester-events-2/

March 19, Arborist Certification Exam at King Tree Specialists in Groveland, IL. Check in time is 1:30pm. Click here to register: https://www.isa-arbor.com/Credentials/Which-Credential-is-Right-for-You

April Events

April 21, NEMF – "Too Much or Not Enough?: Changes in Precipitation and Tree Health" Tricia Bethke. Virtual and in-person at the City of Park Ridge, 10am-12pm. Click here to register: https://illinoisarborist.org/northeast-municipal-forester-events-4/

April 27, TreeBiz Afterhours Social, OSHA, Brian Bothast. 4:30pm-6:30pm at Lil Beaver Brewery in Bloomington. Click here to register: https://illinoisarborist.org/iaa-treebiz-social-after-hour-sessions-2/

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critters can survive temperatures above or below the freezing point of their body fluids. The persistence of an insect in an extreme climate is good evidence that it has the ability to survive prolonged cold temperatures (Somme, 1999). For example, the smaller European elm bark beetle (SEEBB) (Scolytus multistriatus) and vector of Dutch elm disease (DED) has been reported to survive air temperatures of -40°F for long periods and below -45°F for weeks (Lozina-Lozinskii, 1974).

HOW DO ARTHROPODS PREPARE FOR OVERWINTERING IN TEMPERANT CLIMATES?

Like plants, insects are closely in tune with their environment particularly day length (photoperiod), temperature, and reduction in nutritional quality of food. I think we would all agree that day length is a much more consistent environmental cue compared with the unpredictable temperature variations and extremes that are becoming more and more common (i.e. 40°F one day in January and then dropping to near 0°F within just a few hours). As we say here in the Midwest, "If you do not like the weather, just wait five minutes". Additionally, there is a clear relationship between diapause in some species and cold hardiness. Diapause is a condition of suspended animation resulting in a cessation of all outward activity, movement, and feeding. Diapause is regulated by hormones that prepare insects for winter and is triggered by shorter days much like what we see in plants when they begin to enter dormancy. Diapause protects the insect from lethal winter conditions and ensures their survival. Some critters have obligate diapause or they have to enter diapause regardless of the time of year such as the gypsy moth and eastern tent caterpillar

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(ETC). Eggs are laid by the female in mid-summer, but the eggs overwinter, and do not hatch until the following spring. Borers, which commonly overwinter as larvae or pupae, usually take a full year to complete their life cycle. Insects with obligatory diapause are univoltine (one generation per year). Other insects demonstrate facultative diapause or may or may not enter diapause depending on current environmental conditions. They considered bivoltine (two generations per year) or multivoltine (many generations per year). Examples of bivoltine insects include plants bugs, some webworms, and some armored scales. Aphids, mites, whiteflies, and bark beetles are typically, multivoltine. The life stage that an insect overwinters in is also critical. If for whatever reason, the insect is caught in the "wrong" life stage when winter begins, that can be fatal. The egg is a common overwintering life stage for aphids, mosquitoes, armored scales, plant bugs, leaf-feeding caterpillars, and mites. Other insects may overwinter as larvae (i.e. borers) or pupae (i.e. mimosa webworm and other caterpillars), or as adults (i.e. stink bugs, soft scales, bark beetles), and finally some insects such as bark beetles are able to overwinter in any life stage (i.e. egg, larva, pupa, adult).

In addition to environmental cues and being in the proper overwinter life stage, insects also cease feeding, and begin eliminating any foreign substances (i.e., mineral and food particles, bacteria, etc.) from their gut that might serve as nuclei for ice crystal formation. The fewer ice nuclei, the better their chances of survival and their ability to supercool. Once ice crystal formation occurs, death usually follows. For example, in an experiment with an Antarctic springtail (Cryptopygus antarticus), individuals collected in summer were able to supercool down to a mean 20°F, but when starved for a few days (not pleasant if you are a springtail), their SCP decreased to a mean of nearly -13°F. Ice nucleating rod-shaped bacteria can cause nucleation at temperatures as high as 30°F or 28°F, and are common on plant surfaces. Insects that consumer these bacteria during feeding can be vulnerable to reduced supercooling ability (Lee et al., 1995). The bacteria have the potential for biological control as seen with the Colorado potato beetle (Leptinotarsa decemlineata) where after consuming the soil-borne bacteria Pseudomonas syringae, the beetle's SCP raised from 20°F to 36°F (Lee et al., 1995). Insects also have the capacity to produce cryoprotectants (antifreeze agents) in their haemolymph (insect blood), the most common being glycerol along with polyols, and sugars (i.e., trehalose) which assist in lowering the SCP. These agents are generally at low levels during the growing season (i.e., spring and summer) when supercooling is not needed, but then begin to increase throughout the fall and winter months peaking in mid-winter and then declining again with the outset of spring.

Another tactic insects use to enhance their survival is the production of thermal hysteresis proteins (THPs). These proteins depress the freezing point of the insect's blood and like other cryoprotectants are highest in mid-winter and disappear in summer (Somme, 1999). An added benefit of THPs is that they may also stabilize the supercooled state by inhibiting the growth seeding ice crystals as seen with the bark beetle, Ips acuminatus (Gehrken, 1992; Husby and Zachariassen, 1980). Insects that overwinter in soil or other habitats where they come in contact with water and/or ice run the risk of ice crystals forming and penetrating the cuticle. As we all know, "cold and wet" can be lethal for even us humans. THPs have been found in the epidermal cells underneath the cuticle helping to thwart ice crystal formation (Olsen et al. 1998). It appears that THPs are produced in the insect's fat bodies and

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is induced by the juvenile hormone which is cued by low temperature and short day length (Somme, 1999).

Like all biological systems, cold hardiness and supercooling involve a number of different mechanisms. Here is an example of the progression of events that the bark beetle (Ips acuminatus) goes through in preparation for winter; evacuation of the gut content, decrease in water content along with an accumulation of trehalose (insect blood sugar); increase in THPs in the haemolymph; and finally, increasing concentrations of ethylene glycol.

COLD HARDINESS AND OTHER LIFE HISTORY EVENTS

While cold-hardiness is an important strategy for overwintering insects, there are several other events that are equally important. One is synchronization of the life cycle with the overwintering season. As mentioned earlier, insect overwinter in a variety of life stages, but the insect must be in the correct life stage to ensure survival. Feeding adaptations, energy storage, and metabolism all play a role along with the ability (i.e., behavior) to find a suitable overwintering site, adaptation to relative moisture levels, and avoiding predators. For example, the mimosa webworm (Homadaula anisocentra), a common defoliator of honey locust has two generations per year and overwinters as a pupa. In the early fall, the larvae drop down on silk threads and begin seeking out overwintering sites where they pupate in preparation for winter. In a survey by Hart et al. (1987), they found overwintering mimosa webworm pupae on over 100 different sites (i.e., mailboxes, under eaves of homes and siding, on door frames, brick work, and trunks of scaly or rough bark of woody plants), and 50-80 feet from the host tree. These protected areas, which were found to be 5 to 10°F warmer than air temperature, provided good protection for overwintering pupae during cold winters (Miller and Hart, 1986).

Another example is the bagworm (Thyridopteryx ephemeraeformis). This insect overwinters as an egg in a bag consisting of silk and host plant material which is attached to the host plant. Studies have shown that the bag helps moderate temperature fluctuations, and enhances overwintering egg survival (Barbosa et al., 1983; Rivers et al. 2002). The female bagworm can lay between 100 to 1,700 eggs, and the number of eggs in a cluster may also influence survival helping to buffer against cold temperatures and desiccation (Stamp, 1980; Danks, 2002). Bagworm eggs have also been found to contain only low levels of glycerol and sorbitol, suggesting no major role for these cryoprotectants. The eggs are not freeze tolerant, and their high-water content implies that the eggs have neither been enhanced for water conservation or cold hardiness and indicates that use of the female bag as the overwintering site is crucial to higher egg winter survival.

Another battle insects face is desiccation, and it is not just restricted to hot, dry summer months. Insects have a very high surface area to volume ratio which makes water retention a challenge. For example, the water vapor pressure of air above ice is lower than that above water so due these differences, insects that are not frozen will lose water to their frozen surroundings (Remember, water always moves from areas of high to low concentration). The insect cuticle helps in reducing water loss much like in plants. Additionally, high concentrations of solutes (non-water molecules like glycerol, sugars, and polyols) will lower the vapor pressure in the insect's blood helping to reduce water loss (Ring and Danks, 1994). Ring and Danks (1994) determined that glycerol was more important in preventing desiccation in winter

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moth (Operophtera brumata) overwintering pupae that protecting from cold. For insects that live in the Arctic, such as the Arctic springtail, they employ an opposite strategy, "protective dehydration strategy". Since the critter is not freeze tolerant, it deliberately lowers its body water content to extremely low levels to avoid the formation of lethal ice crystals; all of this without lowering their SCP or the production of cryoprotectants (Somme, 1999).

Finally, some overwintering insects may find themselves in saturated or water-logged soils either by choice or due to excessively wet fall conditions, irrigation, and/or poorly drained soils. Many beetle grubs, leafminer and sawfly larvae-pupae overwinter in the duff or in the soil. If these areas are saturated or become flooded in the fall and early and winter, and then the soil suddenly freezes, oxygen could be at a premium. Insect life stages that are encased in ice will suffer and may not survive. Insect respiration rates drop in winter, but it still may lead to anaerobic (i.e. lack of oxygen) metabolic conditions including a build-up of lactate; you know that stuff that makes your muscles sore after a hard workout or rough day at work.

INSECT OVERWINTERING STRATEGIES AND PHC PROGRAMS

In this article, we have talked a lot about insect behavior, physiology, and the weather. While that is all well and good, now it is time to discuss how we can use this information and our own observations in a practical and applied manner as part of a pest management and/or PHC program.

It all starts with "knowing our pest". Where the pest likes to overwinter, what life stage it overwinters in, how many generations does it have, and what life stage(s) causes plant damage. Let's look at a few examples to illustrate these points.

Earlier, I talked about the mimosa webworm (MWW) and its overwintering habits. Studies done in Iowa in the early 1980s revealed that severely cold winters with prolonged extremely cold temperatures (i.e., 4-6 weeks of polar vortex variety) dramatically reduced MWW populations the following growing season (Table 1). During the severe winters of 1981-1982 and 1983-1984, temperatures plummeted to - 22°F and -24°F in December and January, respectively. While MWW pupae were able to supercool to -24°F, prolonged cold with daily mean temperatures of 0oF for a period of 10-14 days proved lethal regardless of the overwintering sites. Did the cold totally eradicate the MWW, no, but first-generation larval feeding was greatly reduced (15% for 1st generation defoliation), and did not require control measures (Table 1). In contrast, the winter of 1982-1983 had a few isolated nights where the temperature dipped to -20°F, but the prolonged cold was not present, and defoliation levels of 55% and 80% were common for 1st and 2nd generation

Table 1. Percent defoliation (nearest 5%) of ornamental honey locust trees by mimosa webworm, *Homadaula anisocentra* in Ames, Iowa, second generation 1981 through second generation 1984 (Taken from Hart et al., 1986)

Year	Generation 1 (Summer) % Defoliation	N[1]	Generation 2 (Fall) % Defoliation	N
1981	---	---	40	50
1982	15	49	50	49
1983	55	44	80	45
1984	15	49	20	49

[1]Number of trees evaluated for percent defoliation
[2]Growing season following an extremely winter
[3]Growing season following an extremely warm winter

MWW, respectively (Table 1) (Miller and Hart, 1987; Hart et al., 1986). Additionally, very few parasitoids were recovered from the overwintering pupae suggesting that the extreme cold winter temperatures were the key factor in MMW pupal survivorship (Miller, et al., 1987). By observing winter conditions and noticing where the insect overwinters, practitioners can anticipate where and when

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honey locust trees will require insecticide treatments. Trees growing in landscapes with plenty of overwintering sites within reach of the host tree, and in protected areas (i.e., courtyards) probably will have higher MWW pupal survival.

A second example is the bagworm. Over the last four decades, here in northern Illinois, I have seen this insect come and go. In the 80's and 90's we really did not have to deal with it on a regular basis. However, beginning in the early 2000s, I noticed bagworm populations beginning to build north of I-80 (Oh yes, the I-80 syndrome). For a number of years bagworm was consistently defoliating evergreens (i.e., bald-cypress, junipers and arborvitae), but also lindens, honey locust, crabapple, and hackberry trees. Then the 2019 polar vortex came along. At the time my lab began monitoring bagworms populations in the western suburbs on a variety of common host tree species planted in the median of a major boulevard. Following the brief, but intense 2019 polar outbreak, bagworm populations crashed, and to date, there has been no visible defoliation of these same trees. Research by Rivers et al., (2002) showed that exposure of bagworm eggs to 14°F to 0°F was lethal. Severe winter conditions (lower temperatures or increased times at the same low temperature caused high mortality (>61%) within 24 hours. These results are consistent with a field study conducted by McMahan and Miller (unpublished) prior to and following the 2019 polar vortex, where air temperatures never exceeded 0°F for 48 hours resulting in a very high bagworm egg mortality. Additionally, there was very little evidence of parasitism, suggesting that the sudden drop in temperatures may have been a lethal event for overwintering bagworm eggs. Our study also revealed significant differences in bag size (i.e., length and width) depending on the host plant. Bagworm larvae feeding on bald cypress, buckthorn, elm, hackberry, and spruce had the longest and widest bags compared with larvae feeding on crabapple and oak which had the shortest, and larvae feeding on oak foliage had the narrowest bags (Figure 5). Also, the host appears to affect overwintering egg survival. The mean number eggs/female that survived and hatched were significantly different among

Figure 5. Mean length (blue bar) and width (red bar) of bags made using different host trees. Different letters indicate that measurements are statistically different from one another.

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host species even when cold treatment and field collection dates were considered. No eggs hatched bagworms that fed on maple, and very few from oak, honeylocust, or crabapple trees. Bald cypress had the highest egg hatch per female (Figure 7). It would appear that host plant nutrition is important in bagworm reproduction and overwintering survival.

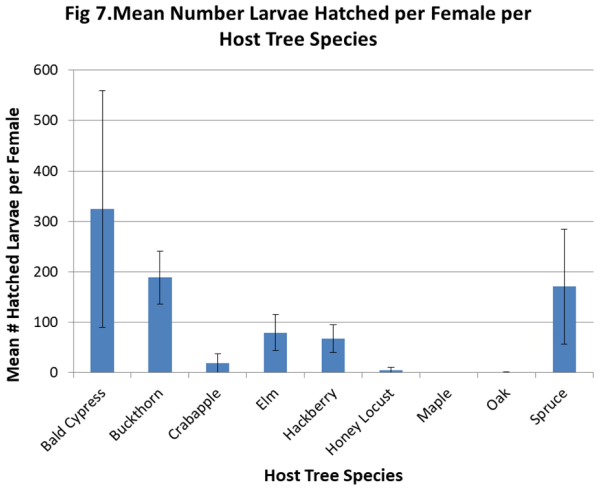

Figure 7. Mean number of larvae hatch per female in different host species. Differences are statistically significant, although different letter could not be calculated.

However, I have received reports of bagworms being found in Chicago and other areas. For those that manage trees in Chicago or along Lake Michigan, you have a moderated environment compared with the suburbs. The heat island effect and the moderating effects of Lake Michigan can determine whether an insect survives or goes to the big tree in the sky. Temperature differentials of 5-10°F can make all the difference. We will see what 2022 brings and whether bagworm populations rebound. The bagworm illustrates a very important example of an insect that lives at the northern edge of its natural range. If climate change continues, then the bagworm may become more of a chronic pest.

Insects like Lymantria dispar (formerly called the gypsy moth) and eastern tent caterpillar (Malacosoma americanum) both overwinter as eggs masses on exposed woody plant twigs and bark. In the case of Lymantria dispar, the egg mass is covered with hairs from the body of the female moth and the ETC egg mass has a varnish-like covering. For Lymantria dispar egg masses laid near the base of trees, snow cover plays a critical role in overwintering survivorship. The eggs are able to supercool to -22°F due to glycerol (Smitley et al., 1998; Andresen et al., 2001). When under snow, the eggs have been found to survive air temperatures of -26°F and -60°F in Maine and Siberia, Russia, respectively. Biologists speculate that geographic spread of the Lymantria dispar will not be limited by host plants, but depth of snow.

Another example, concerns insects that overwinter in protected sites such as the soil or under tree bark. Reflecting back on a winter in the mid-1990's, we had very consistently cold temperatures throughout the winter and very little snow cover with frost down 6 to 8 feet in the soil by February. Two insects that overwinter in the top few inches of the soil (i.e., Japanese beetle grubs, and elm leafminer pupae) had heavily defoliated their host plants the previous summer, but following the cold-no snow cover winter, feeding damage caused by the elm leafminer (Fenusa ulmi) dropped from 36% to 16%. Japanese beetle (Popillae japonica) grubs can only supercool to 20°F and are considered freeze susceptible. Most overwintering grubs overwinter at soil depths of two to eight inches but may go deeper (11 to 12 inches) if necessary (Potter and Held, 2002). However, without the insulating properties of snow, grubs are killed at soil temperatures near 15°F or when soil temperatures remain near 32°F (freezing) for several months (Miller, 2015; Potter and Held, 2002). Trap catches of adult Japanese beetles following the cold winter of 1995 -1996 dropped by 50% suggesting that soil temperatures were cold enough to kill the overwintering grubs. This

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Overwintering Insects, Climate Change...

is why mulch, sod, and snow cover can greatly enhance the overwintering survivorship of soil dwelling insects. Pay attention to which comes first, the cold weather followed by snow or vice versa. Snow provides great insulation.

Borers and bark beetles, overwinter under the bark of trees. The temperature under the bark of a tree can differ significantly from ambient temperature and is affected by the insulating effect of snow, bark thickness, tree species, and tree water content. Studies monitoring winter temperatures have revealed that temperatures under tree bark, sod, and mulch can be considerably warmer that air temperature (Shirazi and Vogel, 2007). Aspect is also important. Sakai (1966) found that bark temperature on the south side of a tree increased sharply by mid-day to 70oF whereas the north side of the trunk remained constant from 28 to 30°F. He also reported that the temperature in the center of the trunk is dependent on stem diameter. The temperature in the center of an Ulmus davidiana tree remained nearly constant throughout a winter day fluctuating from a few degrees (i.e., 28 to 31°F). Coupled with ability of these insects to produce glycerol and supercool, they have a very high probability of surviving even the coldest winters. In the case of the emerald ash borer (Agrilus planipennis) (EAB), which is native to northern China, it is capable of supercooling down to -22°F (Crosthwaite et al., 2011). Recent field studies near St. Paul, Minnesota and Grand Rapids, Michigan revealed that 40% and 90% EAB larval mortality occurred when larvae were exposed to low temperatures for up to 5.5 weeks at -20°F and -25°F, respectively (Crosthwaite et al., 2011; Vennette and Abrahamson, 2010). The fact that EAB is currently thriving in Moscow, Russia, Minnesota, and the Dakotas suggests it will probably continue to do just fine here in Illinois.

In summary, in this article, I have attempted to provide some insight into the overwintering habits of insects and some examples of how winter conditions can affect pest population dynamics. In closing, here are some suggestions on how we, as practitioners, can use this information to our advantage in our PHC programs. Please pay attention to insect pest biology, “watch and monitor the weather”, make observations, utilize the coincide methods (i.e., combination of degree days and plant phenology), and keep records (written and/or mental) on insect pressure from year to year. Use this information to anticipate and plan what your pest pressure will be and what management practices you will need to employ the following season. Where possible, make things as difficult for the pest as you can by keeping your plants healthy, removing, or minimizing overwintering sites, conserving natural enemies, and using less susceptible plants, where possible.

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Decision Making in a Data Rich Environment

by Sara Dreiser

Throughout my career my focus has cycled from innovation to simplification. We have a great idea, we implement it, and then we build on it until we've lost sight of the original goal. In this article I want to explore a framework to help break this cycle and develop simple solutions to use our wealth of data to help inform decision making.

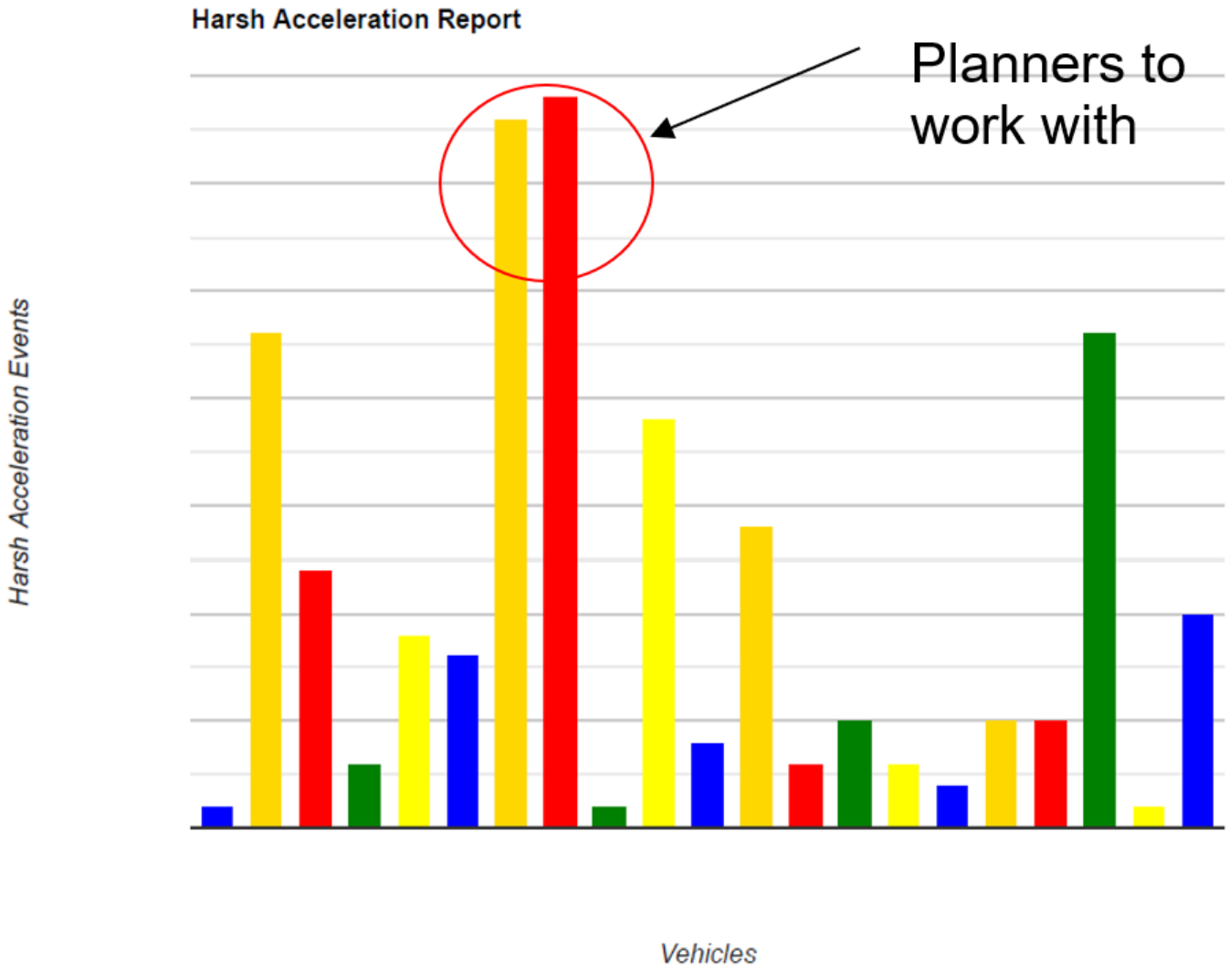
Our implementation of GPS tracking on vehicles is a perfect example. We know there is value in tracking. The technology is readily available and cost effective. With driving as one of our biggest exposures, this is a great tool to help improve our safety.

Currently, we can track harsh braking and accelerating, speeding, live time locations, route review, vehicle idle time, and more! I now receive 3 weekly reports on 40 different vehicles for all the metrics mentioned above.

Is my team safer?

We found ourselves in an all too common place. We were incredibly data rich but didn't have the tools needed to make decisions about drivers and improve safety. How can we turn these three spreadsheets into something usable? Data isn't about having the most information. It needs to be a resource to help make informed decisions.

The steps below are a framework that I've been thinking about to help develop simple and usable metrics from the start of any project.



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Decision Making in a Data Rich Environment

Slowing down and asking these questions can help ensure we end up with actionable knowledge and not just 10,000 lines of data.

- **Goals:** What's the goal?
  - Our goal here needs to be SMART, maybe most importantly, specific (If you're not familiar with the SMART acronym I highly recommend a google search, it's a great framework for goal setting). Use this SMART goal to help inform the rest of the steps below.
- **What:** What data do you need to collect?
  - What data do you need to collect versus want to collect? What's the cost to collect data? The cost to analyze? In a world where it has become increasingly easy to collect and store information, more is not always better. Just because we can collect it doesn't mean we should.
- **How:** How are you going to collect the data?
  - Choose discrete options whenever possible. Typos in free entry cells can destroy an entire set of information. Can the data collection be automated or passive?
- **How Long:** How long do you want to collect data for?
  - Is this something you want to add to your program in perpetuity or once a decision is made can you scale back or stop collecting? It can be too easy to start collecting data and simply continue, but unless the collection is fully passive, there is a cost here.
- **Review:** How do you review the data? What time intervals are going to be the most valuable? Who is your audience and what are their needs?
  - If you're looking for trends, you don't want daily reports. If you want to see improvements this quarter, quarterly isn't going to cut it.

Returning to our example of vehicle GPS:

Early in the roll out of our GPS tracking I found myself up late one Friday rewatching planner routes and trying to figure out why one planner had visited the same parking lot 3 times in one day. I speculated about his job tasks, searched google earth, discussed with my husband, and couldn't figure out how this was an effective use of time (for the planner, or for me!). Turns out it was a clean, heated bathroom!

This was clearly not going to help me improve safety. It is easy to get lost in the details, and for most of us time is a very limited resource. So, I reviewed the above framework. How could we create a tool that helped us make quick decisions about improving safety?

1. **Goal:** Specifically, I want to know which planners are braking, accelerating, and speeding more than others.
2. **What:** Collect data on harsh braking and accelerating, speeding, driver, miles driven
3. **How:** Fortunately, here all data collection is automated. We do need to ensure that we're reviewing data by individual drivers.
4. **How Long:** Ongoing, we can always continue to improve, and since the data collection is passive, there is no reason not to continue collection.
5. **Review:** I decided on weekly. For us trends are more valuable than individual instances, but I also want to be able to act quickly enough to provide the drivers with timely feedback.

In the end I have a weekly report that shows me each planner and tells me their harsh braking and acceleration per mile. Weekly I can identify the outliers, and work with them to improve their safety on the road.

It's not glamorous, and that's the point! Maybe one day we'll start the cycle again and build geo fences so we know when all the planners are home safely every night, create reports that compare timesheets to hours driven, and brainstorm on how to utilize the GPS to create routing efficiencies. Hopefully we'll be smarter about it and use the above framework! For now, we have something that is easy to use and can help make a difference in ensuring everyone is home safely every night.

2022 IAA/IFA Forestry Field Day

by Paul Filary

We are excited to support and partner with Southern Illinois University and the Illinois Forest Association at the SIU Forestry Field Day event running from May 10 – 12, 2022. We are grateful to have been a part of this event over the past many years and always have a great time interacting with the forestry students at SIU, the professors/ faculty as well as the great people at Touch of Nature Environmental Center and Dixon Springs Agricultural Center.

The SIU Forestry Field Day event is a course for SIU forestry students that is completely hands on. The students get to apply what they learn in the classroom and take it to the field. They have training and applications with chainsaw operation, tree felling, invasive species identification and management, tree climbing, chipper operation and a career fair event. This is an excellent opportunity for the students as well as all of the volunteers, sponsors and industry represented to help display real life day to day operations in the field of arboriculture.

We have been lucky as an organization to be a part of this event and many of our members to be represented and interact with the students. The career fair is a newer aspect of the event over the past couple of years and has lead to students identifying and placing themselves with a professional company or organization and helping advance and grow the arboriculture work force and industry.

The event is a two and a half day filled with training, collaboration and interaction with the students. All students, faculty and volunteers stay at the Touch of Nature Environmental Center with the first day taking place at Dixon Springs Agricultural Center.

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2022 IAA/IFA Forestry Field Day (cont.)

Industry professionals train and educate the students on safety and safe work practices in arboriculture. Students have hands on training with professional guidance and interaction, a great way to meet and introduce the next generation of the arboriculture workforce. Day two is spent at Touch of Nature, focusing on further application of skills learned along with tree climbing training and application. The career fair has been an added piece to introduce students to the various aspects of the industry and diversity of career paths. From non-profit organizations to commercial, municipal and much more. The third and final day of the event caps off with the students providing a day of service at Touch of Nature Environmental Center applying the skills they learned over the first two days of the event.

As a sponsor or volunteer of this event, you will have an excellent opportunity to interact one on one with students pursuing careers in forestry and arboriculture. You will be able to make your organization known to the upcoming workforce and display your career opportunities at the growing career fair that has been added to this event. Additionally, you will also have the fun opportunity to take a tour of Champion Trees in Southern Illinois with University of Illinois Extension Forestry and Research Specialist, Chris Evans, on May 9th.

There are unlimited opportunities to have a booth and/or sponsorship at the career fair and volunteer opportunities are filling up. Keep an eye out on the events page on the IAA website to learn of areas in need for volunteers. If you have questions, contact one of our Commercial Directors, Paul Filary for complete details.

Contact – Paul Filary, IAA Commercial Director, pfilary@kramertree.com

IAA/IFA Forestry Field Day Event
Southern Illinois University

May 10 – 12, 2022
Touch of Nature Environmental Center,
Carbondale, IL & Dixon Springs Ag Center

Sign up for the 2022 Summer Conference

July 13 - 14 in Bloomington/Normal Marriot
Normal, Illinois

Click here to register

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