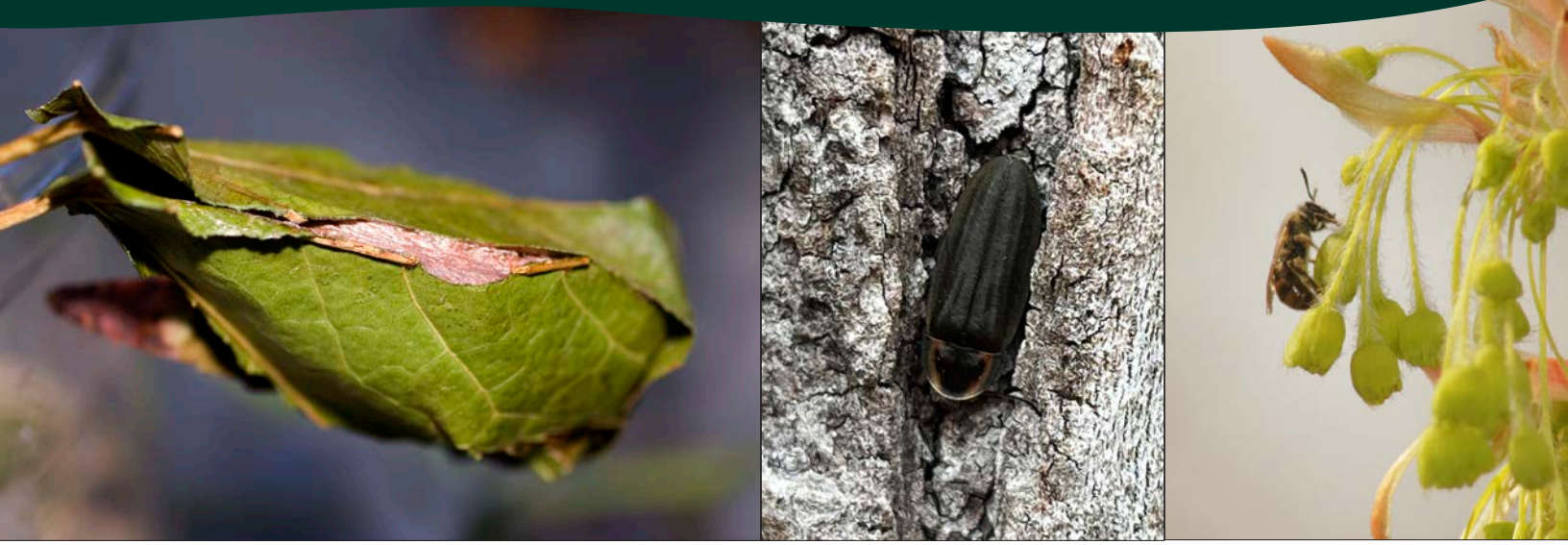
Responding to Insects and Diseases on Landscape Trees and Shrubs



Trees bring many benefits in addition to a beautiful landscape, including providing food and shelter for host of wildlife: [L–R] luna moth cocoon; firefly sheltering on bark; bee foraging on sugar maple. (Photos [L–R]: wanderingnome [BY-NC-ND 2.0]; Richard Joyce; Patrick Coin [BY-NC 2.0].)

There are so many reasons to celebrate trees, and their shorter cousins, shrubs. Their shade offers relief on hot summer days, they lend beauty to neighborhoods and parks, they enhance property values, and they can even improve our moods. Urban forests, especially mature trees, also provide critical ecosystem services, including stabilizing soil, absorbing stormwater, sequestering carbon, and providing habitat for wildlife.

Given all these benefits, spending some time each season observing your trees and shrubs, assessing their overall health, and getting acquainted with their insect and wildlife visitors is time well spent. If problematic insects or diseases appear on your woody plants, it is important to be thoughtful about if and how to respond.

Trees and Shrubs Offer Significant Value for Pollinators and Other Wildlife

For bees, woody plants play significant, sometimes underappreciated, roles. For example, a blooming mature tree canopy produces an enormous quantity of flowers, dwarfing the number of blooms from herbaceous plants occupying a similar footprint. As such, trees are very important food sources for bees. Spring-flowering trees and shrubs feed early-emerging bees such as mining and mason bees. Hollow shrub stems and tree openings harbor bee nest sites. Underground nesting places, needed by some 70% of native bees, are also frequently available in the hidden and protected soils under many woody plants.

Butterflies and moths also rely heavily on woody plants. Caterpillars feed on their leaves, while adults may feed on sap, nectar, or fruit. Trees also offer overwintering places.

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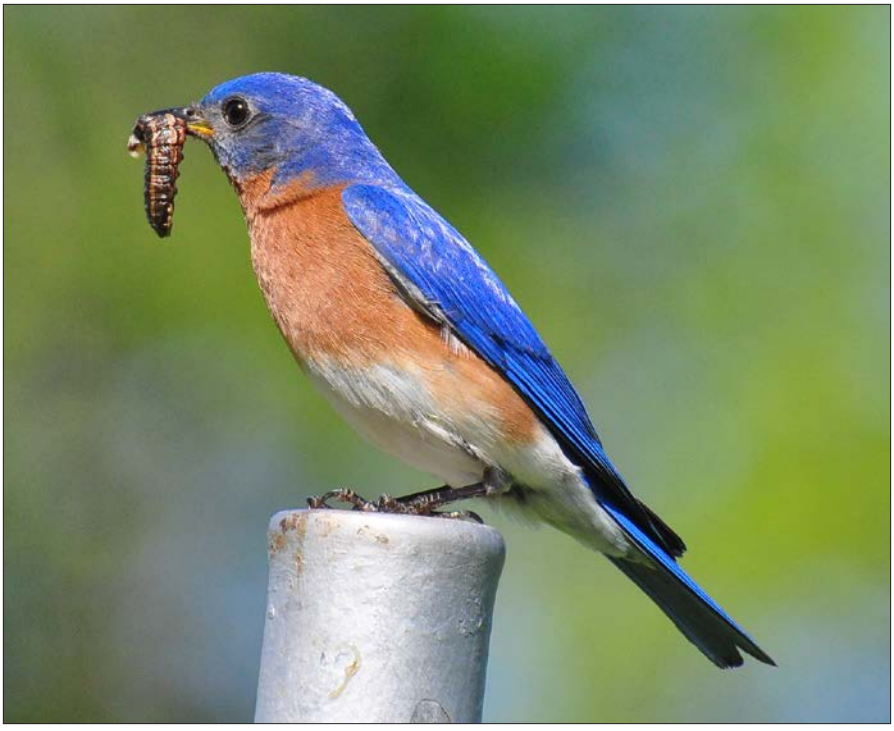
For example, the iconic monarch butterfly spends the winter hanging in large clusters within tree groves in Mexico and California. Butterflies, fireflies, and other wildlife may shelter in cracks, under bark, or in the leaf litter below woody plants during the cold season. Other examples of food, shelter, and camouflage provided by trees and shrubs to insects include:

- A sugar maple tree makes a hundred billion pollen grains. Oaks make even more. Tree pollens often make up 25–100% of the pollen in a bee's digestive tract and even wind-pollinated trees like maples and oaks are often visited by bees gathering both nectar and pollen.
- Certain trees and shrubs have outsize importance for butterflies and moths, supporting far more diversity than other plants. To sustain a wide variety of butterflies and moths, consider planting local natives in one of the following groups: oaks (*Quercus* spp.), willows (*Salix* spp.), stonefruit trees (*Prunus* spp.), pines (*Pinus* spp.), poplars and cottonwoods (*Populus* spp.), birches (*Betula* spp.), blueberries and huckleberries (*Vaccinium* spp.), maples (*Acer* spp.), hickories (*Carya* spp.), or crab apples (*Malus* spp).
- Luna moths wrap their cocoons in leaves to remain hidden in the branches, until fall, when they can drop to the ground as the tree sheds its leaves.
- Swallowtail butterfly chrysalises resemble dried leaves in shape and color, blending in with the foliage.
- Adults of the winter firefly *Photinus* (syn. *Ellychnia*) *corruscus* may be found in winter on the bark of oaks, tulip trees, and hickories.

The ecological values of trees and shrubs extend far beyond bees and butterflies. The energy these large plants capture directly from the sun is released to the broader wildlife community as herbivorous insects tap into the generous food reserves available in foliage, fruit, wood, and sap. These herbivores are then preyed upon, parasitized, or decomposed by a broad community of other insects, as well as eaten by birds, mammals, reptiles, amphibians, and fish. Without invertebrates such as beetles, caterpillars, and spiders, bluebirds, wood warblers, wrens, and many other cherished birds simply would not exist.

There are Insects on My Tree or Shrub and Parts Look Unhealthy—Should I Do Something?

Since a vast community of insects coexists with woody plants, it is quite normal to see insects or signs they have visited. Chewed leaves may simply indicate that some caterpillars had a nourishing breakfast. In all likelihood, they'll morph into moths or butterflies that will delight you later.



An estimated 98% of all insect species are beneficial, performing vital functions such as recycling nutrients, pollinating and serving as food for birds and mammals. As a group, caterpillars (the offspring of butterflies and moths) are the most important food for insectivorous birds. (Photo: kansasphoto [CC BY 2.0].)

Spiders, another important food source for birds, contain taurine, an amino acid essential to the early development of many songbirds. (Photo: Judy Gallagher [CC BY 2.0].)

Why Insecticides and Fungicides Shouldn't Be Your First Management Choice

While pesticides may be effective at killing, they don't address the conditions that attracted or maintain the pest. Pesticides may appear to resolve your issue, but chemical fixes are usually temporary. Besides threatening indispensable invertebrates like pollinators and fireflies, pesticides also pollute water, which harms freshwater mussels and aquatic insects, and some are linked with human health problems.

Moreover, applying pesticides is often counterproductive. Insect populations that seem unsustainably high often crash on their own without intervention. Pesticide applications can also short-circuit the work of the beneficial insects that act as natural enemies, worsening a problem, and resulting in repeat infestations. Furthermore, pesticide use can lead to "superpests" that are resistant to chemical management.

Both insecticides and fungicides pose concerns. Many insecticides available for use in the urban landscape are highly toxic and can harm a wide array of beneficial insects, including pollinators, lady beetles, and predatory syrphid flies. Fungicides, used in disease control, are not as innocuous as once thought. Research suggests that a number of fungicides can pose subtle yet severe effects. Some of these include: reducing bee foraging and reproduction; magnifying the effects of poor nutrition, pathogens, and exposure to some insecticides; and decreasing wing length in monarch butterflies, with potential impact to their migration.

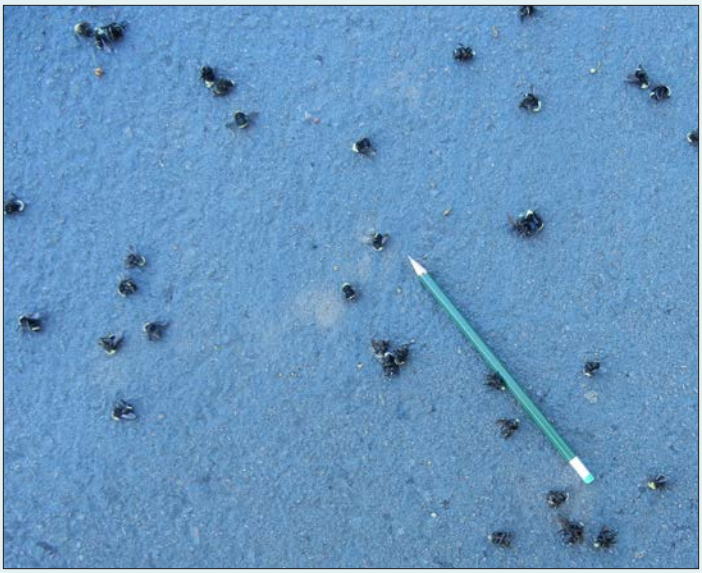
Pesticides also move around. Many insecticides and fungicides are systemic, meaning that they move into and throughout the plant. Applications such as bark sprays, soil drenches, soil injections, granules, and trunk injections often spread to the canopy, permeating leaf tissue that may be supporting the caterpillar stages of native butterflies. Systemics can also spread into pollen and nectar consumed by bees and numerous natural enemies. Nectar exposure can occur outside of the flowering season, because many trees and shrubs (such as those in the willow, rose, legume, and other families) contain extrafloral nectaries found on their leaves or stems.

Some systemic insecticides have been detected in woody plants as long as 3–14 years after application, meaning pollinators and other insects may deal with long-term contamination as they forage.

Non-systemic applications (contact sprays) pose their own problems. Sprays can kill visiting bees and other beneficial insects. Even horticultural oils, which are not persistent, can kill insects upon contact by clogging their spiracles, the small openings in their exoskeleton that allow them to breathe. Sprays also drift off target.

The takeaway? Unless the symptom is caused by an insect or disease capable of causing significant damage or death to the tree if left unchecked, there is usually no justification for a pesticide in residential, park, or other developed spaces.

Plants have their own methods for protection. Plants getting attacked by herbivorous insects emit chemical signals called HIPVs (herbivore-induced plant volatiles). These waft into the air and lure in predatory and parasitic insects to come to the rescue. However, this survival mechanism means that some damage has to be accepted. In this photo we see a parasitoid wasp attacking caterpillars in their tree tent. (Photo: Katja Schultz [CC BY 2.0].)



Neonicotinoid insecticides applied to trees in an Oregon parking lot caused the largest bumble bee kill ever recorded in North America. An estimated 46,000–107,000 bumble bees died in front of shocked customers. The insecticide application was ordered because aphids in the trees were dripping honeydew onto cars below, and this was thought to be irksome to customers—not because the trees were threatened by the aphids. (Photo: Xerces Society / Rich Hatfield.)

Not every blemish or bug is a problem. Plants coevolved to be food to and home for insects. They can support a wide diversity of insect life and sustain some disease pressure without dying. In fact, a plant without insects can't contribute much to the ecological food web. Still, we're conditioned to reach for pesticides as a quick fix, often not even knowing if we truly have a problem.

There is a better way.

A Thoughtful Approach to Handling Possible Insect and Disease Issues

Identify the concerning insect or disease

Figuring out what is causing the symptoms you see is the first step. By identifying what you have, you can determine what (if any) risks it poses, and how best to respond. You may not have a problem with insects or diseases at all; symptoms such as leaf dieback can also be caused by winter injury, drought, and other stresses. Local extension services often offer identification services and identification apps such as iNaturalist and its companion Seek can also help. There are also books that will help, often regional insect or gardening guides. Ask at your local library or bookseller.

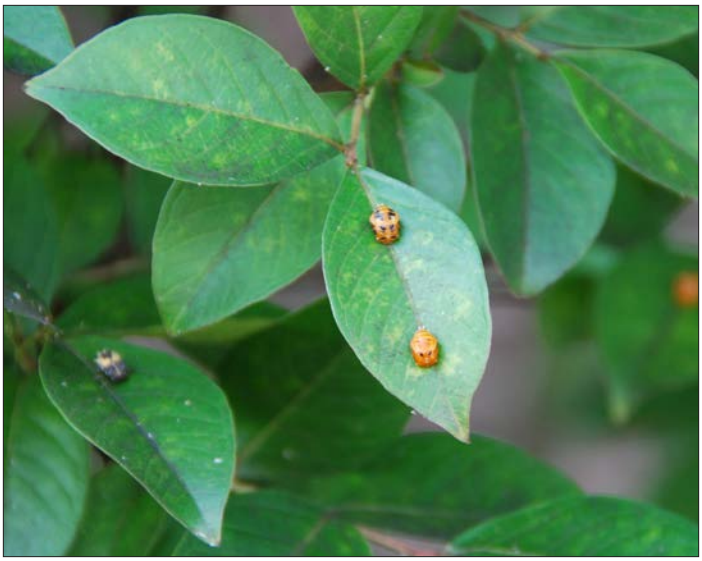
There's no need to panic if you spot galls—odd swellings on your plants. Common on willows, oaks and other species, galls serve as food and shelter for over 1,500 different species of arthropods and rarely result in harm to the host. Many gall-forming species are even natural enemies of other "pest" insects. (Photo: hedera.baltica [CC BY-SA 2.0].)

Reframe your perspective

It may be frustrating to see chewed leaves or leaf lesions, even if you know the tree won't die. A useful practice when examining an inconvenient issue is to ask: Does this "problem" serve a larger ecological community? Can a bit of aesthetic damage be tolerated? With such a perspective, it's easier to avoid unnecessary intervention and a reactive cycle of using pesticides to achieve an ideal of perfection. Observing insects closely and learning about their behaviors, life history, and what likes to eat them can help with this reframing and sometimes yield fascinating information.

Alleviate underlying stresses

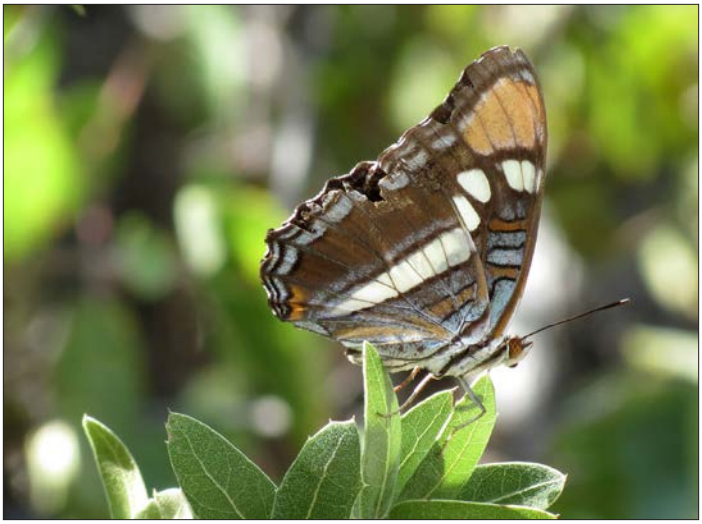
Healthier plants are generally more able to withstand insect feeding and diseases. Urban trees, especially street trees, frequently encounter air pollution, soil compaction, drought, excessive temperatures, limited root space, or mechanical injury. These stresses can create heightened susceptibility to insects or diseases. Fortunately, sometimes simple changes such as modifying irrigation, pruning, or providing soil inputs (compost, wood chips, etc.) can go a long way to restoring plant health and can even prevent problems in the first place. Don't forget to plant trees and shrubs in the right spot, because a sun-lover won't thrive in the shade and vice-versa. Protecting the root zone (the "lungs of the tree") within a circle measuring 1-foot radius for every inch of trunk diameter will also help limit damage and stress.



You may notice cosmetic issues on trees and shrubs, such as leaf blemishes or defoliation. Such sights do not necessarily signal that the plant is dying or even unhealthy. It is important to distinguish the source of such issues and whether natural enemies are present. On this crape myrtle, lady beetles and a fungus called black sooty mold are both present. The mold grows on leaves where honeydew has accumulated. A sweet and sticky substance secreted by aphids, scale, and other true bugs (order Hemiptera), honeydew is an important food source for many natural enemies and even bees. Rather than using a pesticide to kill off the honeydew producers, consider allowing natural enemies like lady beetles to do the work, or you could consider pruning or washing the sooty mold off the leaves. Most plants can tolerate both the sucking insects and the sooty mold. Honeydew production can be enhanced by excessive fertilizer, so ensure you're not using too much. (Photo: University of Delaware Cooperative Extension [CC BY 2.0].)

Smarter Strategies for Maintaining Healthy Trees and Shrubs

- Plant a diversity of native trees and shrubs and inspire others to do so. Natives plants coevolved with native insect communities, are less likely to become invasive, and can usually withstand common local insects and diseases. Choose species valuable to wildlife. If a native is susceptible to a damaging disease or insect, consider a different native species or a resistant cultivar.
- Complex insect food webs are less likely to allow problematic pests to build up. Build resilient insect communities that support natural enemies (and provide bird food!) by providing a diverse community of native plants. As a bonus, learn how to identify some of the beneficial insects already operating on your property.
- Practice non-chemical strategies to enhance your plants' health and resilience, and prevent or reduce the spread of any problematic species. For example, low-risk management techniques include handpicking or using strong water jets to check insect populations, or pruning to increase air flow. These options should be attempted before you use a pesticide. And remember that sometimes no action is needed as natural enemies resolve the issue on their own.
- Only use or contract for pesticide applications when the life or health of the tree is threatened, and when other options have been exhausted. If you use an arborist or landscaper, work with them to limit harm to beneficial insects and the broader environment. Ensure that if any pesticides are used, they are applied at the right time to be effective and to limit harm, they are as selective as possible, and they will break down quickly.



Arizona sister butterfly (*Adelpha eulalia*) on an oak tree, the host plant for its caterpillars. (Photo: Katja Schulz [CC BY 2.0].)

Oaks, such as this white oak (*Quercus alba*), support a greater diversity of butterflies and moths than other trees. You should always consider planting species native to your region. Other trees that are important host plants for caterpillars include willows (*Salix* spp.), poplars and cottonwoods (*Populus* spp.), birches (*Betula* spp.), maples (*Acer* spp.), and crab apples (*Malus* spp). (Photo: Katja Schulz [CC BY 2.0].).

Further Reading

- Consult the Xerces Society's Pollinator Conservation Resource Center for regional tree and shrub recommendations. https://xerces.org/pollinator-resource-center
- Learn how to provide "Soft Landings" (diverse native plantings under keystone native trees) to support native butterflies. https://www.pollinatorsnativeplants.com/softlandings.html
- Learn to avoid common stressors on landscape trees. https://ag.umass.edu/fact-sheets/helping-trees-to-manage-stress
- Keeping trees and shrubs healthy is easier if you provide habitat that maintains a robust population of natural enemies. Consult Xerces regional plant lists (https://xerces.org/publications/plant-lists) or Jessica Walliser's book *Attracting Beneficial Bugs to Your Garden* to get ideas for plant choices favorable to beneficial predators and parasitoids.
- Learn how to scout for beneficial insects that help control unwanted pests. https://xerces.org/publications/scouting-guides
- Learn about the risks of systemic insecticides. https://xerces.org/systemic-insecticides-reference-and-overview

What About Exotic Tree Pests?

A number of exotic tree pests are currently present in the United States. Residents and parks managers should regularly monitor their properties for highly problematic insects and diseases inhabiting the local area, and follow the specific protocols developed to limit their spread, such as avoiding movement or purchase of ash firewood, lumber, mulch/chips, or nursery stock. If faced with a particularly destructive invasive, such as the emerald ash borer (EAB) pictured here, weigh all your options. Unfortunately, until introduced biological controls begin making a substantial dent in this species, current management for ash trees in areas where EAB has already arrived relies heavily on recurring applications of highly toxic insecticides. Unless the tree is a highly valued specimen in your landscape, it may make more sense to replace ash (or other landscape plants that cannot survive without regular pesticide applications). If so, replace with a resilient native that offers value to wildlife.

(Photo: U.S. Department of Agriculture [CC BY-ND 2.0].)

References

Czaja, M., A. Kołton, and P. Muras. 2020. The complex issue of urban trees—stress factor accumulation and ecological service possibilities. *Forests, Trees and Livelihoods* **11**:932. doi:10.3390/f11090932

Hatfield, R. G., J. P. Strange, J. B. Koch, S. Jepsen, and I. Stapleton. 2021. Neonicotinoid pesticides cause mass fatalities of mative bumble bees: A case study from Wilsonville, Oregon, United States. *Environmental Entomology* **50**:1095–1104. doi:10.1093/ee/nvab059

Narango, D. L., D. W. Tallamy, and K. J. Shropshire. 2020. Few keystone plant genera support the majority of Lepidoptera species. *Nature Communications* **11**:5751. doi:10.1038/s41467-020-19565-4

Nyffeler, M., Ç. H. Şekercioğlu, and C. J. Whelan. 2018. Insectivorous birds consume an estimated 400-500 million tons of prey annually. *Die Naturwissenschaften* **105**:47. doi:10.1007/s00114-018-1571-z

Raupp, M. 2001. Effects of cover sprays and residual pesticides on scale insects and natural enemies in urban forests. *Journal of Arboriculture* **27**: 203–14. doi:10.48044/jauf.2001.022

Raupp, M. J., C. S. Koehler, and J. A. Davidson. 1992. Advances in implementing integrated pest management for woody landscape plants. *Annual Review of Entomology* **37**:561–85. doi:10.1146/annurev.en.37.010192.003021

Sponsler, D. B., C. M. Grozinger, R. T. Richardson, A. Nurse, D. Brough, H. M. Patch, and K. A. Stoner. 2020. A screening-level assessment of the pollinator-attractiveness of ornamental nursery stock using a honey bee foraging assay. *Scientific Reports* **10**:831. doi:10.1038/s41598-020-57858-2

Urban-Mead, K. R. n.d. Billion pollen grains estimates for sugar maple by DBH. Unpublished data.

Walczak, U., M. J. Giertych, and E. Baraniak. 2024. Persistence of imidacloprid in trunk injected horse chestnut and its impact on Cameraria ohridella (Lepidoptera: Gracillariidae). *Applied Entomology and Zoology* **59**:203–210. doi:10.1007/s13355-023-00856-3

War, A. R., H. C. Sharma, M. G. Paulraj, M. Y. War, and S. Ignacimuthu. 2011. Herbivore Induced Plant Volatiles: Their Role in Plant Defense for Pest Management. *Plant Signaling & Behavior* **6**:1973–78. doi:10.4161/psb.6.12.18053

Disclaimer

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