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THE PURDUE LANDSCAPE REPORT

In This Issue

Vascular Streak Dieback of Redbud: What Plant Pathologists Know so far

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The Problem

In recent years, nurseries in multiple states have reported moderate to severe dieback, chlorosis and stunting of redbud (Fig. 1). Dieback is defined as “the gradual but progressive death of individual branches or shoots from tips toward the main stem.” Dieback is a catch-all phrase that describes a constellation of symptoms that include discolored, blighted leaves, followed by wilting, flagging and branch death. Declining trees may produce water sprouts/epicormic shoots below the dead branches. This dieback may continue into the main stem or stems of the tree and ultimately cause tree death. Streaking may be observed within the water-conducting tissue (xylem) of infected branches. This issue is impacting seedlings, grafted plants, older nursery stock produced in container or field production settings and landscape plants.

Figure 1. Discolored foliage, dieback, vascular streaking and injury are a few of the symptoms observed with redbud dieback. Photos: NCSU Plant Disease and Insect Clinic

The Problem Diagnosing the Problem

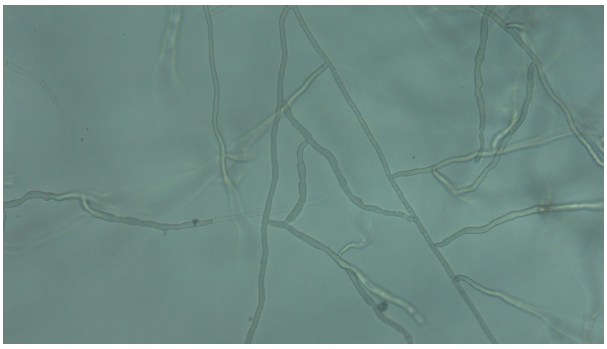

Figure 2. Fungi belonging to the Rhizoctonia complex are characterized by thick hyphae that commonly grow at right angles.

Multiple laboratories throughout the country have received samples of redbud with symptoms of dieback with vascular discoloration. These laboratories have isolated a diversity of fungi; however, no known redbud pathogens have been identified to date to explain the vascular streaking symptoms. Multiple isolation attempts to check for Verticillium wilt were negative. One type of fungus that has been repeatedly isolated from symptomatic plants has been tentatively named *Rhizoctonia theobromae*. It belongs to the Rhizoctonia complex that includes *Rhizoctonia* species, but also members of *Ceratobasidium*, *Thanatephorus*, and *Tulasnella*. These superficially similar fungi primarily spread via thick hyphae that grow at right angles (Fig. 2). They rarely produce spores, making conclusive identification by microscope alone impossible. Fungi in this group include not only plant pathogens, but also wood-inhabiting endophytes and mycorrhizal associates. Identifying the causal agent is the first step in diagnosing what is causing this redbud dieback. Remember, these vague symptoms can be due to other plant pathogens and abiotic disorders. To determine if any of these *Rhizoctonia*-like fungi are causing redbud dieback, Koch's postulates must be performed. Koch's postulates describe a process developed in the 1880s and still used today to reliably and reproducibly confirm that the isolated microorganism is in fact the cause of the observed disease problem. Koch's postulates provide four criteria that need to be fulfilled for an organism to be implicated in causing a specific disease. These criteria are:

1. The causal agent must be consistently associated with symptomatic plants but should not be found in healthy plants.
2. The causal agent must be isolated from a diseased host plant and grown in pure culture (where applicable).
3. Pure culture of the causal agent incites disease when inoculated into a healthy host.
4. The causal agent must again be reisolated from the inoculated, infected host and confirmed as identical to the original specific causative agent.

To date, no one has successfully completed Koch's postulates with the fungus isolated from symptomatic redbud. This is both good and bad news: Good news, in that if this was a virulent pathogen that could spread easily from plant to plant then Koch's postulates would have been confirmed and reported. It is bad news in that we still do not know if a single pathogen is responsible for the symptoms that are being reported in nurseries in multiple states or whether the problems may be attributed to a complex of stress factors or other biotic stressors. The fastidious nature of this fungus (hard to isolate, grow and maintain in culture) presents challenges to obtaining sufficient material for DNA analysis and for fulfilment of Koch's postulates.

Best Management Practices with Incomplete Information

It is possible that this issue has been in the United States for some time but has been overlooked and/or misdiagnosed. This problem appears to also involve environmental factors and/or poor cultural practices, so any remediation of underlying problems will go a long way in reducing symptoms and potential infection events. Plants should be planted to the appropriate site, appropriate depth, and properly spaced. Remember, redbud is tolerant of a wide pH range but grows best where the pH is above 7.5; it cannot endure flooding or survive in poorly aerated soils. Drought stress should also be avoided. Keep in mind that redbud are also highly susceptible to phenoxy/2,4-D herbicides and other post-emergent herbicides; care should be taken whenever these are being used around young trees to avoid injury.

Excess nitrogen fertilization has been implicated in increasing plant susceptibility to several plant pathogens. Nitrogen fertility should be on the lean side, 50-100 ppm nitrate when plants are actively growing. Scouting for known pests (borers, Botryosphaeria canker, and Verticillium wilt) coupled with preventative chemical treatments are appropriate along with rigorous sanitation. Any symptomatic plants found during scouting should be sent in for diagnosis. Use only healthy, asymptomatic plants for any type of asexual propagation (chip or

bud-grafting).

It is possible that this issue is associated with or exacerbated by co-infections with other soilborne pathogens such as *Phytophthora* spp., *Pythium* spp. or *Fusarium* spp. that are commonly found in woody ornamental nurseries. Proper management of soilborne pathogens might be beneficial in reducing the damage caused by redbud vascular streak dieback issue. At this time, there are no chemical treatments recommendations as a specific pathogen has not been identified. If using preventative fungicide drenches to protect roots against *Rhizoctonia* and other soilborne pathogens, they should be applied in rotation. Some recommended rotations include:

- Empress or Heritage (FRAC 11), rotated with
  - Prostar (FRAC 7) or Medallion (FRAC 12) or Terraguard (FRAC 3).

OR

- Mural or Orkestra (both FRAC 7+11) rotated with
  - Terraguard (FRAC 3) or Medallion (FRAC 12).

More BMP for tree and shrub production is available at: https://hort.ifas.ufl.edu/woody/documents/BMP-container-production.pdf

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Integrated Pest Management: Balance Restored between Prey and Predator

(Karen Mitchell, mitcheka@purdue.edu)

Integrated Pest Management (IPM) is a proactive strategy that focuses on long-term prevention of pests by understanding the pest's biology and utilizing a combination of control techniques. There are IPM strategies for all types of pests including weeds, insects, and diseases. Regardless of type, scouting and identification are the first and most critical steps in IPM.

With the large variety of plants possible in a landscape, IPM becomes more complex than in a conventional agricultural field, but it's not futile and scouting a garden in bloom can be more interesting than a corn field. A diverse, pollinator-friendly garden in Indiana could easily host hundreds of insects. As a gardener or landscape professional, you should take a moment to watch what visits the flowers on occasion. Observe all the different insects, not just the pests, and you may find that it is too soon for chemical control.

While scouting in late June, numerous syrphid flies were found on the flowers of Ohio Spiderwort (*Tradescantia ohiensis*) (Figure 1). Syrphid flies, or hover flies, are often mistaken for a small bee and can be found hovering around flowers. Initially, they may seem like a pest but these harmless and beneficial insects actually feed on soft bodied pests like mealy bugs and aphids[1].

Figure 1. Syrphid fly on Ohio Spiderwort (Credit: K. Mitchell)

Figure 2. Ants harvesting aphid honeydew, a sugar-rich sticky liquid, on underside of Joe Pye Weed leaf (Credit: K. Mitchell)

Figure 3. Mature Joe Pye Weed in bloom (Credit: K. Mitchell)

Not far away, a line of ants climbing the stem of a Joe Pye Weed (*Eupatorium maculatum*) led to a colony of aphids (Figure 2). This symbiotic relationship between the ants and aphids is not beneficial to me or the plant. However, considering my high tolerance for insect damage, the vigor of Joe Pye Weed, and the thriving syrphid fly population nearby, intervention did not seem necessary. Instead, I monitored the pest population. Over the next two weeks, the aphid population dwindled to zero and the Joe Pye Weed is now over 6' tall (Figure 3) and the flowering privacy screen remains.

By delaying, and ultimately avoiding the use of chemicals, the balance in the small garden ecosystem was restored without any human intervention. In a landscape seemingly full of pests, identify the good guys and let them do the dirty work for you. No PPE required.

More information on protecting pollinators and other beneficial insects can be found:

https://extension.entm.purdue.edu/publications/pubs/PollinatorProtection.html

References:

1. University of California IPM program, Natural Enemies Gallery: https://www2.ipm.ucanr.edu/natural-enemies/syrphids/

Beware the Honeydew List

(Cliff Sadof, csadof@purdue.edu)

In early to mid-summer when sucking insects are active and rain becomes less frequent the liquid excrement of sucking insects, called honeydew can accumulate on leaves. The sweet sugary honeydew can create a nuisance when it attracts stinging insects to the leaves or a shady seating area beneath the tree. The sticky coating itself can be a problem when it coats your windshield or pits the finish of your car. In this article I will cover how you can reduce the problems with insecticides and by using my honeydew list (Table 1) to avoid planting trees that are prone to sucking insects near parked cars and picnic tables.

Unlike mammals, insects consume plants by either chewing or sucking- not both. The waste products of dedicated chewers like bagworms and eastern tent caterpillars are in a dry pellet form that entomologists call frass. The excrement left by insects who suck plant sap is a sugary liquid that is rich in protein that we call honeydew. This liquid is excreted as clear droplets that build up on leaves and branches. In the absence of rain that washes off the honeydew, it can accumulate making the leaves appear shiny as if coated in a sugary glaze. In time, the honeydew can become contaminated with a black sooty mold giving the leaves and branches a black appearance. The sticky honeydew is an important source of nutrition for insects that pollinate plants, including butterflies, moths, bees, wasps and flies.

Figure 1. A large droplet of honeydew produced by this adult female spotted lanternfly is clearly visible at the end of its abdomen (Photo by E. Barnes).

Figure 2. Droplets of honeydew produced by the tuliptree aphid accumulated during dry weather. (Photo by C. Sadof)

Common sucking insects that feed on trees and excrete include aphids, softscales, mealybugs and the newly introduced spotted lanternfly. Each of these insects have tube like mouthparts that penetrate leaves or thin bark to feed on liquids moving through the plant circulatory system. For this reason, you will often find aphids, scales and mealybugs feeding close to leaf veins.

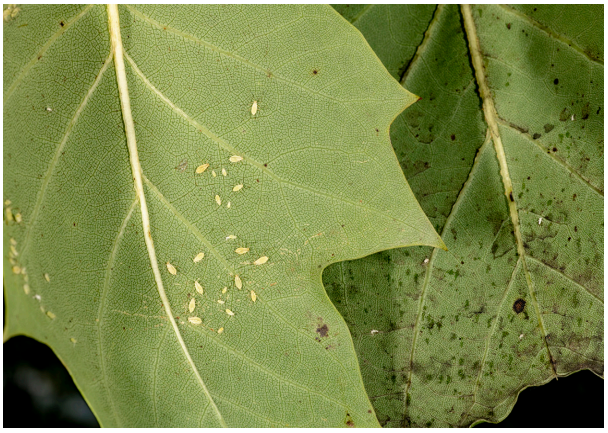

Figure 3. Tuliptree aphids (leaf on left) produced honeydew that turned black with sooty mold (right leaf) (Photo by J. Obermeyer)

Figure 4. Brown and orange tuliptree scales on this twig excreted liquid honeydew that became infested with black sooty mold. (Photo by C. Sadof)

Figure 5. This black and orange lady beetle larva is attracted to the honeydew and feeds on aphids and scale insects. (Photo by C. Sadof)

Despite the many natural enemies like lady beetles, lacewings and parasitic wasps that attack honeydew producing insects, controls are often needed to reduce nuisance problems in the landscape.

Unfortunately, it is often difficult to control honeydew producing insects on trees with insecticides. Foliar sprays like insecticidal soap, horticultural oil, or insect growth regulators like pyriproxyfen or buprofezin, can be quite effective, but it is often difficult to get effective spray coverage unless you hire a professional. Soil applied systemic insecticides (acephate, imidacloprid, dinotefuran) can be quite effective against aphids and soft scales, but they can kill pollinators attracted to the flowers. New research has shown that when applied to the soil, sucking insects can excrete enough insecticides in the honeydew insecticide to kill beneficial insects.

Probably the best way to avoid problems with honeydew producing insects is by not planting trees with a "High" likelihood of having these pests near parked cars, picnic tables or highly trafficked areas. Use the following table of common street trees to help guide your tree selection. I have compiled this list based on informal notes I have taken on sucking insect problems I have encountered over the last 3 decades. Select plants with a "Low" or very likelihood of being infested with honeydew producers when selecting trees near sensitive areas. As I have yet to see any sucking insects in person or in the literature on a Kentucky coffee tree, I ranked it as "Very low". Even though Callery pear has a low likelihood of problems with sucking insects, you should avoid planting it because it is an invasive plant that is choking our native forests.

In contrast, trees like honeylocust and several species of oaks are on the top of my list of most likely to have honeydew problems. Although the soft scales attacking honeylocust rarely will kill a tree, they have caused enough of a nuisance in some communities to have residents remove their honeylocust trees. Similarly, reports in the Indianapolis Star note persistent problems of honeydew rain in some communities with a rich oak urban forest. This is caused by both a soft scale and an aphid. Problems with kermes scale on oaks have been documented in an earlier issue of the Purdue Landscape report. Tuliptree poplar is another tree that dependably gets coated with honeydew by and aphid or soft scale somewhere in the state every year. The last tree on the high list is the tree of heaven. This is another invasive plant that is also attacked by the spotted lanternfly, the latest exotic pest to enter Indiana. As you can see from Figure 1 it produces copious amounts of honeydew.

Trees ranked in the "Moderately High" category will occasionally become heavily infested with honeydew producers. These problems tend to be more common in parking lots or on city streets where warm temperatures and water stress make sucking insects grow more quickly and produce more offspring. Trees ranked in the Moderate category less dependably infested with sucking insects, or the trees are too small to drip honeydew on to parked cars or picnic tables.

Diagnosing Sucking Insect Problems.

Use the Purdue Plant Doctor Apps, or the Purdue Plant Doctor Website (available after August 15, 2022) to identify and get management advice sucking insects as well as many other pests and diseases.

Table 1. Some Common Street Trees and Likelihood of Problems with Honeydew in Indiana

	Likelihood	Soft Scales and Mealybugs	Other suckers
Honeylocust	High	European fruit tree lecanium, Calico scale	
Oaks	High	Oak leaf aphids, Oak lecanium scale, Oak kermes scale (mostly northern red oak)	Oak leaf aphid
Tuliptree poplar	High	Tuliptree scale	Tuliptree aphid
Tree of heaven*	High		Spotted lanternfly**
Elm, Zelkova	Mod- High	European elm scale, Calico scale, European fruit lecanium scale	Woolly elm aphid
Hawthorn	Mod- High	Hawthorn mealybug, Calico scale, European fruit, cottony maple scale	Green apple aphid, Woolly apple aphid, Rosy apple aphid
Maples	Moderate	Calico scale (sugar maples mostly) Cottony maple scales (red, silver and some hybrids)	Woolly maple aphid
Crabapple	Moderate	Calico, European fruit tree lecanium	Green apple aphid, Woolly apple aphid, Rosy apple aphid
Flowering cherry	Moderate	European fruit tree lecanium	Green peach aphid
Serviceberry	Moderate	Calico scale, European fruit lecanium	Green apple aphid, Woolly apple aphid, Rosy apple aphid
Birch	Low	Oak lecanium	
Callery Pear*	Low	European fruit tree lecanium	
Hackberry	Low	Calico scale	Mulberry whitefly
Hickory	Low	Hickory lecanium	
Linden	Low	European fruit lecanium	Linden aphid
Sweetgum	Low		Mulberry whitefly
Kentucky Coffeetree	Very low		

* Invasive tree, do not plant, and remove if possible.

** Invasive pest, not yet widespread in Indiana.

More resources

How to Fix Problems with Scale Insects – Purdue Landscape Report

Insecticide can be excreted in the honeydew of sucking insects

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