



Oak Wilt Interactives:

Matters that May
Be Mistaken for
or Associated with
Oak Wilt



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Dr. Roberts retired from Michigan State University in 2018 after committing four decades to advancing MSU's Land Grant Mission, originally signed into law by President Abraham Lincoln during the midst of the American Civil War. He has published hundreds of articles and has taught hundreds of lectures and workshops.

Dr. Roberts has researched many issues in Michigan's plant industry, including Oak Wilt, Dutch Elm Disease, Diplodia Tip Blight of Pines, along with a variety of cultural problems such as plant nutrition and herbicide toxicity. During his career, he has discovered a variety of new diseases and pests such as Phomopsis Canker of Spruce and the first bacterial wilt disease of turfgrasses in North America.

In the early 2000s, his research on Ash Decline in Southeast Michigan led to the discovery of the invasive Emerald Ash Borer in North America.

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I thought it might be useful to alert arborists, landscapers, and the public to several factors that I have commonly encountered as either mistaken for Oak Wilt or that may be interactive with the disease. These factors are briefly addressed in the following topic headings.

Twig Girdlers/Twig Pruners:

We are all aware that injury to oak trees, especially during the high-risk period of the spring, may induce insects to transmit spores of the Oak Wilt fungus to fresh wounds on injured oaks. How are oaks injured? Typically, oaks are injured via pruning or storms. Ok, but what about woodpeckers? Over the years, I have been asked that question so often! I can see no reason why the activities of woodpeckers such as the Pileated variety couldn't result in infection of an oak tree via Overland Spread. But has anyone proven it? What about tiny ambrosia beetles or other bark beetles (Photo 2A)? It has been documented, for example, that the itty bitsy Walnut Twig Beetle will transmit the Thousand Cankers Disease fungus to *Juglans* (Photo 2B). While there are many

INTRODUCTION:

Oak Wilt is disseminated by two major methods:

- 1) Overland by insects to fresh wounds, and
- 2) Underground by transmission of the Oak Wilt fungus through root grafts (Photo 1). Injuries to Oak trees, especially during the high-risk period but also potentially during other times, attract insects (such as sap beetles) that may carry the deadly fungus from Oak Wilt reproductive structures (Pressure Pads) in diseased trees to injured healthy trees. Some tree species possess a tendency to form root grafts between individual trees; the formation of root grafts results in the sharing of water, nutrients and, unfortunately, diseases, especially vascular-transmitted ones. Members of the Red Oak family, the most susceptible family of oaks in Michigan, tend to form root grafts far more commonly than members of the less susceptible White Oak family. Of course, the Oak Wilt fungus can also be carried "Overland" in Pressure Pad (fungal reproductive structures) guise in firewood where the fungus may be introduced into new areas not formerly affected by the lethal disease.



insects that may harm trees, either through primary, aggressive means to healthy trees or through secondary means to stressed trees, very few are widely recognized to transmit the Oak Wilt fungus. While we can speculate about Oak Wilt Overland transmission, there are many unanswered questions that can only be resolved through research and/or careful observations.

During the last several years, I have encountered a rather strong correlation of Oak Wilt incidence with a group of insects commonly known as Oak Twig Pruners and Twig Girdlers. These insects may be distinguished as follows: twig girdlers attack twigs and branches from the outside and chew towards the inside; in other

P1 A large oak that was pruned became infected by the Oak Wilt fungus by **Overland** Spread to the pruning cuts; to make lemonade out of lemons, the tree was eventually carved into the Bald Eagle and American Flag (left forefront). Unfortunately, remediation efforts using Root Graft Disruption were insufficient due to inadequate trenching depth; the disease continued to spread **Underground** through root grafts at this Houghton Lakefront residence, threatening many other neighbors' oaks (note dying trees in other of the photo).

P2A & 2B Can insects other than sap beetles spread Oak Wilt? For example, can ambrosia beetles or bark beetles carry the Oak Wilt fungus or create open wounds to attract other insects? The answer to this common question is "possibly", but it may be difficult to prove (Photo 2A Credit: Lucas Drews). Certainly, small insect "borers" can transmit diseases; the tiny Walnut Twig Beetle has been proven to transport the lethal Thousand Cankers Disease to *Juglans* sp. (Photo 2B Credit: Dr. Whitney Cranshaw).



P3A



P3B



P3C



P3D

P3A, 3B, 3C, & 3D Branches affected by the twig pruner can be “large”, in this case over an inch in diameter (Photo 3A and Inset). Typical damage to oak twigs and branches by the twig pruner includes a smooth “cut” surface, as if cut by pruning shears, but with ragged edges (Photo 3B); also note tunneling within the stem as well as ripped bark when the branch broke from the tree (Photo 3B, left). Some property owners lament the number of branches that they must pick up when twig girdlers and twig pruners are infesting their trees. This trailer load of “sticks” was just a few days’ collection of fallen branches during the high-risk period for Overland Spread of Oak Wilt (Photo 3C). In some Oak Wilt situations such as the one exemplified in Photo 3D, the tree died from Oak Wilt amid many healthy oaks with no possibility of Underground root-graft transmission. Plus, there was no evidence of injury from pruning or storms. However, the twig pruner was quite prevalent at this site (Photo 3C).

words, twig girdlers chew inward from the bark to the center of the twig much as a beaver destabilizes a tree to build its “damn dam”. Twig pruners tunnel and chew from the inside out, leaving a nearly flat surface with fringed edges near the bark. Whether twig girdlers or twig pruners, the result is that the structural integrity of twigs and branches is compromised; twigs and branches break in wind and fall to the ground to the consternation of property owners (Photo 3A). Branches that snap from the tree often contain green cambium and green foliage especially from twig pruner damage. The juncture of the break from twig pruners is sometimes very clean, perhaps rivaling some pruning cuts (Photo 3B). When twig pruners are involved, the twigs are usually semi-hollow from the insect’s tunneling impacts (Photo 3B, left). Fairly large twigs or branches (Photo 3A Inset) in significant numbers may snap from trees affected by twig girdlers/pruners (Photo 3C). The reason I have wondered about the involvement of twig girdlers and twig pruners with Oak Wilt is that I sometimes cannot find any evidence of

pruning or storm damage, typically the types of injuries associated with **Overland Spread** of Oak Wilt (Photo 3D). When branches affected by girdlers/pruners break from trees, they often rip the bark, exposing green cambium tissues which could attract sap beetles... not to mention the exposed wound in a clean “girdle” (Photo 3B). Hence, I have become very suspicious of the role that twig girdlers and twig pruners may have with the Oak Wilt disease cycle. When I diagnose Oak Wilt from **Overland Spread**, I always look for wounds that may have attracted sap beetle transmitters. If I can’t find any wounds and there is no chance of Underground Spread, how did the Oak Wilt fungus infect the Oak tree? Perhaps arborists working on Oak Wilt at various sites have also witnessed similar phenomena; if so, I would love to hear from you. I have witnessed twig pruner activity on oak trees all over Michigan, often in conjunction with some Oak Wilt sites. If twig pruners/girdlers are involved in Oak Wilt, it may be very difficult to manage the disease at those sites, especially where these insect populations are elevated (Photo 3C).

Two-Lined Chestnut Borer (TLCB):

Although often considered a secondary pest on stressed trees, the TLCB is sometimes mistaken for Oak Wilt by arborists and laypeople alike (Photo 4A). Both Red Oak family members and White Oak family members may be affected by the TLCB. It may be rather difficult to distinguish between Oak Wilt and TLCB on White Oak Family members because both problems may result in gradual decline of the afflicted oak trees. For Red Oak family members, distinguishing between Oak Wilt and TLCB is rather straightforward. Red Oaks affected by TLCB infestations decline gradually over several years, starting from the tree’s top much like the Emerald Ash Borer – the TLCB’s invasive cousin that attacks ash trees. With TLCB, D-shaped exit holes will be noted in the lower trunk when trees are advanced in decline (Photo 4B). When Red Oaks become infected with the Oak Wilt fungus, the whole tree dies rather quickly, often within a month or two... with accompanying symptoms of wilt and copious leaf drop.



P4A & 4B The Two-Lined Chestnut Borer (TLCB) is known to attack oak trees, especially those under stress, and is often misdiagnosed as Oak Wilt. TLCB induces a gradual decline in both Red Oak and White Oak family members. This Red Oak is showing decline symptoms typical of TLCB infestations (Photo 4A); many other oaks are also affected in this 60+ acre woodland. In advanced cases of decline, “D-shaped” emergence holes can be found on the lower trunks of trees affected by TLCB (Photo 4B yellow arrow, plus adult Inset). Oak Wilt, which kills trees very quickly, was also confirmed elsewhere on this property. (Adult Inset Photo Credit: Dr. Robert Haack)

In some landscapes/woodlands/forests, the TLCB may build up in populations, attacking more and more trees (Photo 4A). Valuable oaks affected by the TLCB can easily be reversed in decline by tree injections with emamectin benzoate or soil drenches/trunk washes with other insecticides, if the decline is not too advanced. In woodland areas where Red Oaks (or White Oaks) are infested by the TLCB, I have urged the novel use of the Glyphosate/Stump Cup technique to quickly kill oak trees. Quickly killing oak trees declining from TLCB infestations with glyphosate will likely trap larvae in trees and inhibit their metamorphosis into

adults, lessening the TLCB populations and their dissemination to other oak trees in the area.

Emerald Ash Borer (EAB):

Throughout Michigan, the EAB has killed most ash trees. Many of the ash trees that have been killed by the EAB have also toppled (Photo 5A). When ash trees (or other dead trees or their limbs) fall, they may injure oak trees, predisposing them to Oak Wilt infections, especially during the high-risk period of the spring and early summer (Photos 5B & 5C). The author has encountered several sites where

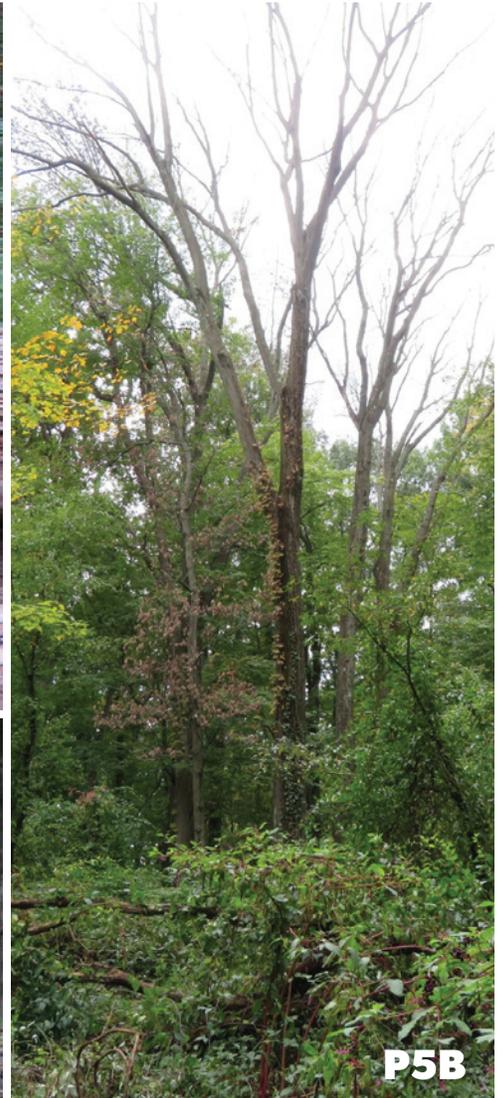
fallen ash trees or other fallen species injured oaks and likely caused Oak Wilt epicenters to develop from Overland Spread.

Herbicide and Oak Wilt:

By far the most common misdiagnosis of Oak Wilt has occurred at sites where herbicide applications have damaged oak trees (Photo 6A). One of the most common herbicides involved is Imazapyr/Imazapic, found in commonly marketed products such as Ortho® GroundClear®, Bayer's Roundup® Extended Control and Roundup® 365, Ragan & Massey's RM-43,



P5A



P5B



P5C

P5A, 5B & 5C This large ash fell after being killed by the Emerald Ash Borer (Photo 5A). When the ash tree fell, it injured several large Red Oaks, inducing an Oak Wilt epicenter (Photo 5B) which threatens many old, large oak trees typically measuring 35" dbh and above at this University-owned natural research station site (Photo 5C).

and Gordon's Barrier, among many others. It is relatively easy to distinguish between herbicide damage and Oak Wilt if we know what to look for. First, trees afflicted by Oak Wilt will usually show the typical leaf wilt and shedding associated with infections (Photo 1). With Imazapyr herbicide damage, leaves will likely not even emerge the year after herbicide application in severe exposures or sparsely in less herbicide dosages (Photo 6A). If oak leaves do emerge, they will likely be sparse (depending on the herbicide exposure level), deformed, and stunted.

Of most importance in distinguishing between Oak Wilt infections and herbicide damage on oak is that other species of trees and shrubs will not be affected by Oak Wilt but will exhibit symptoms of stunted, inhibited growth due to herbicide exposure (Photos 6B & 6C). Both herbicide damage and Oak Wilt may result in the death of oak trees. Members of the Red Oak family are especially sensitive to Imazapyr, almost as deadly as Oak Wilt, while members of the White Oak family are less sensitive to this class of herbicide (Photo 6D).



P6A, 6B, 6C, & 6D More than a dozen oak trees were killed or severely damaged by application of an herbicide containing Imazapyr to the landscape areas bordering the drive at this property in Western Michigan (Photo 6A). Arborists were conflicted over the cause of death; some believed the problem was Oak Wilt. When distinguishing between Imazapyr (or other herbicides) and Oak Wilt, it is always advisable to examine other species of plants. The Kousa Dogwood in Photo 6B appears dead, but close examination (Inset) reveals stunted foliage trying to emerge, typical of Imazapyr impacts on many plants; the tree has the potential to recover with time. The spruce tree in Photo 6C exhibits the telltale signs of Imazapyr exposure at this site; note stunted foliage and shoots. At another site, Imazapyr killed the two Red Oaks straddling the drive (forefront) but had no impact whatsoever on the White Oak in the background, indicating differential impacts of Imazapyr on various oak species (Photo 6D).

Scorch – Environmental and Physiological:

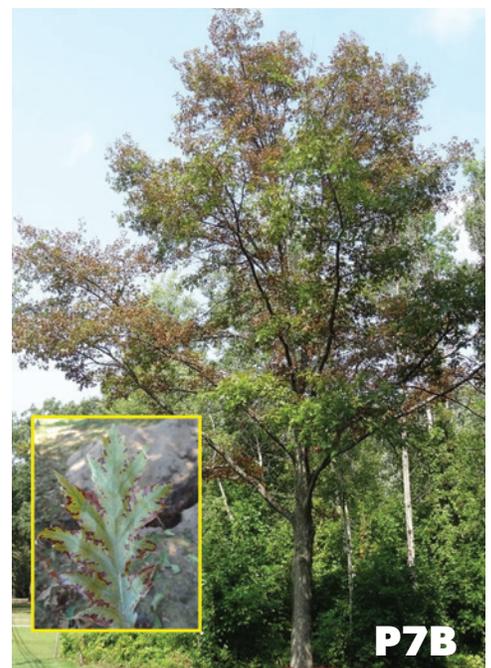
As with most tree species, oak trees may encounter various problems related to the environment or local interactive soil conditions/irregularities. “Scorch” is a general term used to describe certain leaf maladies affecting trees. In my definition, there are different types of “Scorch”. Environmental Scorch is one issue that is often mistaken for Oak Wilt (Photo 7A). Environmental Scorch is usually related to environmental factors such as drought and heat. When oak trees are affected by heat and/or drought, they often react by dropping foliage, which we may easily but

erroneously conclude is representative of Oak Wilt leaf fall. Foliage impacted by Environmental Scorch often exhibits lightened interveinal areas and green veins (Photo 7A Inset).

Physiological Scorch is especially common on Red Oak family members and may be related to soil factors combined with nutritional and water imbalances within the tree. Afflicted trees often exhibit a reddish cast, which many people surmise as tree death from Oak Wilt (Photo 7B). Symptoms on leaves include reddish/brown interveinal necrosis (death) and green veins. In general, trees affected by physiological scorch survive just fine

but may develop similar symptoms year after year. In some instances, Physiological Scorch affects only certain branches on a tree and the balance of the tree appears normal in coloration and health.

It is perfectly understandable that we may confuse “Scorch” with Oak Wilt. While leaf drop from trees infected with Oak Wilt is common, the abundant, cascading leaves range in coloration from tan to brown to olive green to normal green (Photo 7C). If we understand the different symptoms of these maladies on oak, we can usually make a relatively definitive, accurate diagnosis in the field.



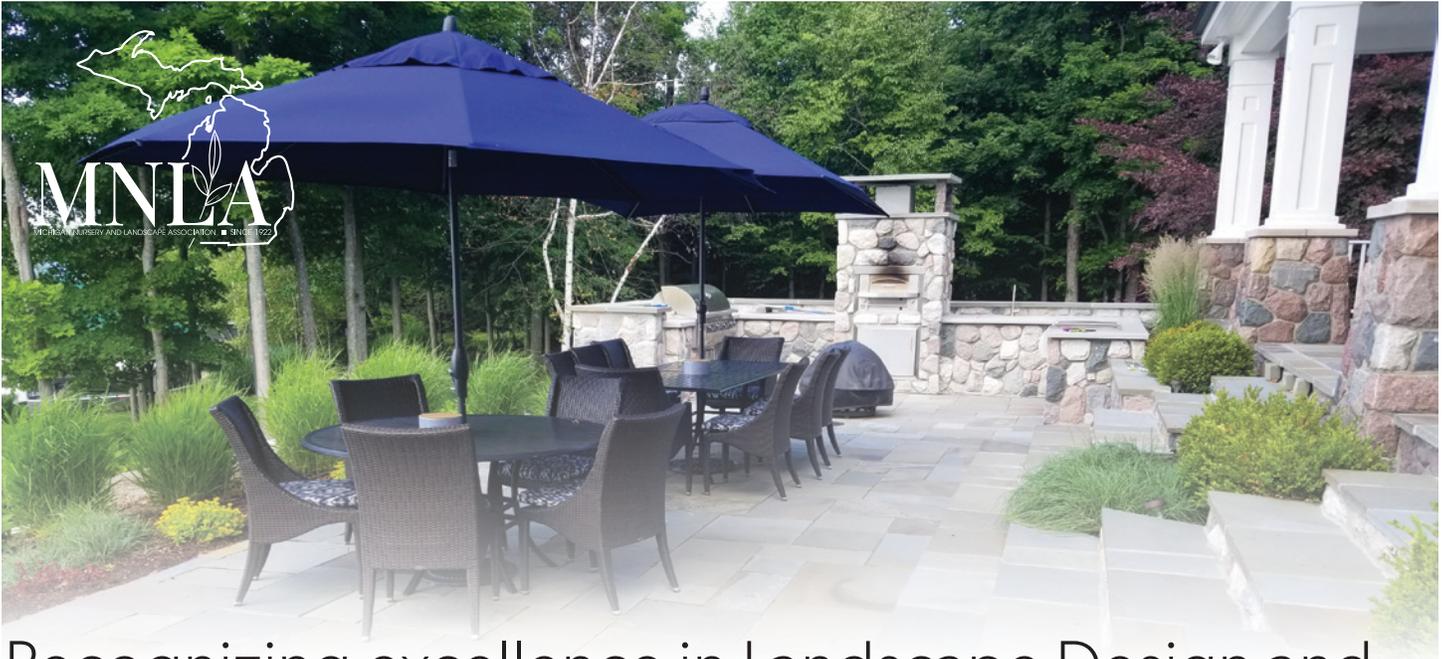
P7A, 7B & 7C, Various symptoms of “Scorch” are often confused with Oak Wilt. Environmental Scorch is caused by adverse environmental conditions such as drought and/or heat. The response of oak trees to Environmental Scorch is often leaf drop, similar to Oak Wilt infections, except fallen leaves reveal water stress symptoms between the veins while veins usually remain green. A property owner and his arborist became alarmed when his tree began dropping foliage in high temperatures and drought conditions (Photo 7A and Inset). Note the thinning in the tree’s canopy. Trenching in the soil for utility installation several years previous to this may have exacerbated the stress. In contrast, Physiological Scorch may also be confused with Oak Wilt except interveinal areas exhibit reddish-brown necrosis (Photo 7B Inset). Severely impacted trees may present an overall reddish-brown cast as if they are dying (Photo 7B). Such trees usually survive just fine even if they exhibit similar symptoms from year to year. By comparison, the leaves of Red Oak family members with Oak Wilt infections cascade in droves to the ground in colors ranging from tan to normal green (Photo 7C).

Summary:

The above topics are some of the more common issues I have often seen associated with Oak Wilt or that may be mistaken for Oak Wilt infections. It is vital that we diagnose cases of Oak Wilt accurately because failure to do so may result in substantial harm to Michigan residents and Michigan forests, whether natural or

urban. For example, in the case of Imazapyr herbicide injury as encountered in Photos 6A through 6C, several arborists had identified this malady as Oak Wilt. Some remediation recommendations for this site included application of the Bruhn Model for Root Graft Disruption (RGD), which would have been a literal disaster for the property owners and their neighbors if this remediation effort had

been pursued. Oak Wilt can be difficult to diagnose and/or may be confused with other factors. Due to the importance of differentiating Oak Wilt from other oak maladies, I would be happy to assist arborists and property owners if desired.



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