Can Glyphosate Stop Oak Wilt?

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ABOUT THE AUTHOR

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INTRODUCTION:

Oak Wilt (OW) is a devastating disease that is spreading throughout Michigan (Photos 1A & 1B). Information about OW biology, detection, "horror stories", and management has previously been published in a three part series in *The Michigan Landscape*; Oak Wilt Part 1: Symptoms, Biology & Diagnosis (Jan/Feb 2016); Oak Wilt Part 2: Prevention & Management Strategies (March/April 2016); Oak Wilt Part 3: Tales of Horror (March/April 2017).


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1B


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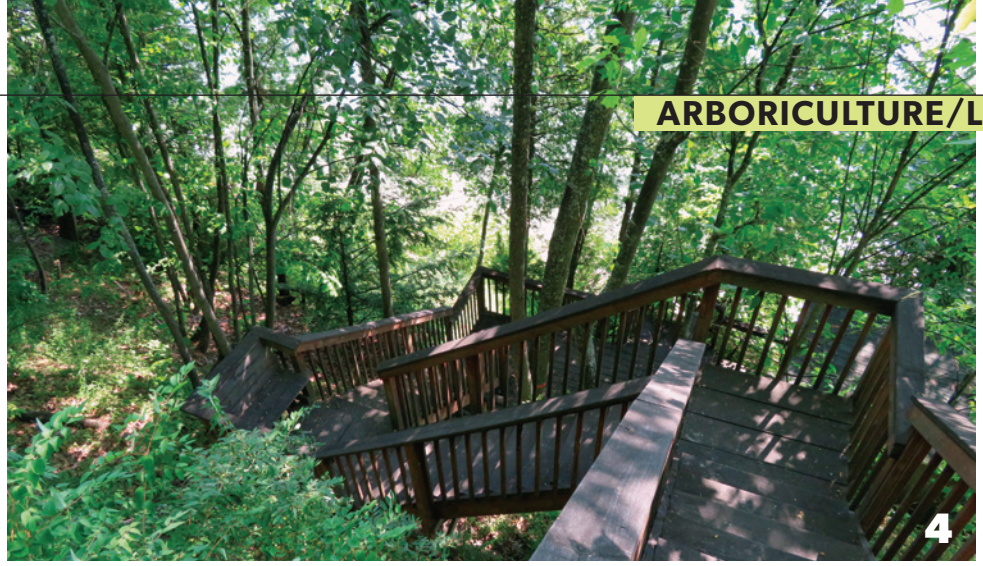
OW is one of the most costly diseases when tree value losses, property value losses and containment and eradication efforts are considered. Two acceptable methods to contain and eradicate the disease from landscapes, woodlands and forests include trunk injections with propiconazole and root graft disruption (RGD) by trenching or vibratory plowing. For forest and possibly woodland situations where fiscal concerns prescribe the most cost effective measures with no or few revisits, RGD followed by destruction of all healthy and diseased trees within the trenched area is usually the preferred method (known as the Bruhn Model or Forest Management Model). For residential landscapes and high value trees, either RGD or Trunk Injections or a combination of the two methods is advised according to the author's Tier Tree Model, which is far less destructive and "sacrificial" than the Forest Management Model (see Oak Wilt Part 2, *The Michigan Landscape*, March/April 2016). In some circumstances, however, such as dense woodlands with diverse tree species or steep, fragile dune areas, RGD is not easily accomplished or necessarily recommended due to potential for severe erosion, damage to the ecosystem (Photos 2, 3, 4, & 5) and collateral damage to other species of trees. And trunk injections, which must be applied for at least six years, may be cost-prohibitive. In previous decades, very toxic chemicals (fumigants, biocides) could create "chemical trenches" by killing the root systems of trees, thereby preventing the translocation of the OW fungus through root grafts; these chemicals are no longer available on the market for such uses. In theory, a herbicide could be employed to create a root-graft barrier to thwart the underground transmission of the OW fungus. To clarify, the translocation of a systemic herbicide through the roots, exactly in the same tissues and manner that the OW fungus is transmitted, might prevent the spread of the OW fungus. The OW causal fungus, *Bretziella fagacearum* (formerly known as *Ceratocystis fagacearum*), is largely considered to be an obligate parasite by most scientists, meaning it cannot survive without live plant tissue for very long. The fungus does not survive very well in above ground tissues (trunk cambium), but may survive in root tissues for several years. Hence, killing the roots of infected oaks trees should negatively impact the survival of the OW fungus and theoretically hasten its death.

The author has been working on a technique using glyphosate that has shown some promise for very economical and effective management of OW. The research and results are summarized in this article.

1 Oak Wilt outbreaks seem to be occurring more frequently around Michigan. New epicenters of OW are usually caused by pruning, storm damage or other injuries to oaks that predispose trees to infections by overland transmission of the fungus by insects to fresh wounds. (Photo 1A) At this site in Traverse City, Michigan in 2017, the epicenter apparently began from line clearing operations (pruning in November, 2014). Photo 1B is an aerial view of 1A (ground view photo).

2 Herbicide treatments have the potential to be used in situations where traditional root graft disruption and/or trunk injections may not be feasible or economical. In this aerial view in Northern Michigan, note the Oak Wilt epicenter near the photo's center. Not readily apparent is a very steep cliff extending from the landscape (yard) down to the lake, about 80-100 feet in distance. Trenching (insufficient depth) by an irrigation company did not stop the disease from advancing to oak trees residing on the cliff (see Photos 3 & 4).

3 This is a ground view of the advancement of Oak Wilt (OW) from the landscape area in Photo 2 over into the oak trees located on the cliff. Due to angle (steepness), diversity of plant/tree life and the potential for cliff destabilization, trenching (root graft disruption) would not usually be practical. Under consideration for trenching, the MDNR would not grant a permit to the residents. Glyphosate treatments to stump cups (as described in this article), which may be very useful for such situations to contain and eradicate OW, were initially planned at this site.



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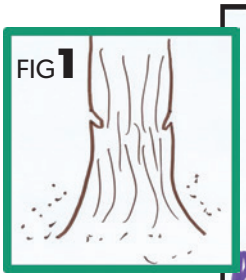

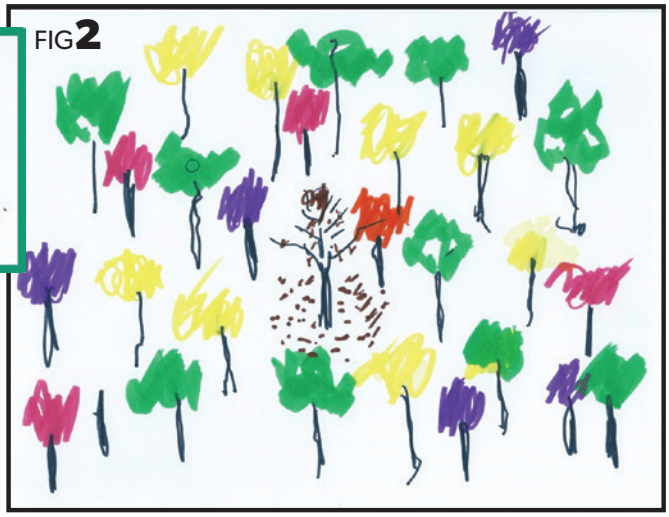

Figure 1: A "stump cup" or "trunk cup" is made by girdling an oak tree around its entire circumference with the aid of a chain saw at a downward angle. Concentrated glyphosate is poured into this "stump cup". Hopefully, the root system of the tree should be killed by the herbicide, creating an effective barrier for Oak Wilt fungal transmission through root grafts.

Figure 2: In this diagram showing a diversity of tree species, assume that the "green" trees are oaks surrounding and adjacent to the dead Oak Wilt-affected tree in the middle of the diagram. The other colors of trees depict different species of trees. A tier or two of healthy oaks (green) around the OW-infected tree are girdled and treated with glyphosate. Hopefully, the OW fungus should be contained within this herbicide barrier and eventually die out as roots succumb to the herbicide treatment. Can you find the maple in this artist rendering of a wooded area?

4 In this elevated view, looking down toward the lake from the top of the cliff, we can see the steepness of the terrain and the diversity of plant life, which helps to stabilize this fragile slope in Photos 2 & 3.

5 At this property near Hartland, Michigan, the tree in the center of the photo was predisposed to OW infection by overland transmission from an arborist's pruning cuts in the spring of 2015. Judy, the owner of the property, protected her landscape trees (not pruned) with trenching and trunk injections, but was reluctant to use these same procedures in her adjoining woodland due to expense, density of the trees, diversity of tree species and potential for collateral damage (from trenching) to other species of trees.

6 Judy and her neighbor, Bob, elected to try the glyphosate/girdling stump cup method according to the procedures disclosed in this article. They applied the procedure to one tier of healthy trees around the OW-affected tree in Photo 5 and administered concentrated glyphosate into the "stump cups" in the fall of 2015. Please note the several girdled oaks and the non-girdled cherry tree in the background. Glyphosate-treated oak trees began to exhibit leaf shriveling, shedding and death within days of treatment.

Procedure:

A girdling chain saw cut is made at a downward angle in a continuous trunk-circling fashion, 1-2 inches deep (beyond the bark, Figure 1 & Photo 6). With this girdling, a circular "stump cup" or "trunk cup" is created continuously around the lower trunk of the tree. Concentrated glyphosate (30-50 % active ingredient) is poured into this "stump cup". For small trees, at least ½-1 one cup (4-8 fl. oz.) is recommended while at least 1-2 cups (8-16 fl. oz.) is recommended for larger trees. The exact amount has not been extensively investigated (thus far, the 1-2 cup range of treatment has worked very well, with rapid tree death and no recovery).

Order of Implementation:

Taking into account tree biology, anatomy and physiology, the following order of technique implementation was devised. Preferably, the treatments should be administered in the early fall to promote downward translocation of the glyphosate.

Step #1-Treat Healthy Trees First: Using the author's Tier Tree Model (see *The Michigan Landscape*, March/April 2016) a tier or two (or three) of **healthy trees** are located around the OW-diseased oak trees according to the diagram, Figure 2. Or, similarly, a tier or two of healthy trees are located between the diseased trees and the population of trees that are to be protected from OW (Photos 2-4). The girdling "stump cups" are crafted on the healthy trees; glyphosate is administered simply by pouring the concentrated chemical into the stump cup of these trees, ***first***. The rationale behind this Step #1 is retrieved from field observations where cutting into the diseased trees (first) may cause a rapid transfer of the OW fungus to nearby healthy trees from "transpirational pull" from the healthy trees. Girdling the healthy trees ***first*** should inhibit sap pull on diseased trees by healthy trees.

Step #2-Treat OW Diseased Trees Last (or not at all): Girdle and create the "stump cups" in the OW-diseased trees so that the

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glyphosate is administered in a similar manner as for the tier or two of healthy trees. Small trees that are too small to girdle can simply be cut so that the exposed stump is level (horizontal); glyphosate is subsequently poured over the exposed stump. Sprouting stumps left from previously removed trees should be treated as though the whole tree is still present, which is to create the stump cup, etc...

Step #3-Tree Removal: Trees that have been administered the girdling/glyphosate treatment can be removed several weeks after the treatment or, preferably, the following year, depending on concern for structural integrity issues.

What To Expect:

Oak trees treated in the prescribed manner will literally collapse within a few days of treatment; the foliage will likely turn brown, shrivel up and begin dropping soon after treatment. The response of the healthy trees affected by the herbicide may mimic symptoms of Oak Wilt and cause alarm from some property owners. If the procedure is performed correctly, there will be no re-emergence of foliage or evidence of viability within these previously girdled and treated healthy oak trees the following spring (Photo 7).

We can possibly expect some collateral damage to healthy (non-target) trees within root graft range of the girdled and herbicide-treated trees (Photo 8). Depending on extent of root grafting between healthy, non-target trees and the girdled/herbicide-treated "healthy, non-OW-affected" trees, some non-target trees may be killed…although the author has yet to witness such an event. Trees exhibiting non-lethal collateral damage may recover (Photo 8). We need to remember that the stump cup/glyphosate treatments are designed to stop the progression of OW; hence, some healthy trees (targeted and/or non-targeted) will be sacrificed in this process. It is important to consider that these sacrificial trees would normally die from unrestricted OW advancement anyway.

The combination of trenching and glyphosate treatments may be feasible in some locations to prevent collateral damage and/or for other special circumstances for Oak Wilt containment and eradication. For example, the combination of RGD and glyphosate treatments are planned at the site in Traverse City (Photos 1A & 1B); the RGD would protect adjacent large, valuable trees on level ground from glyphosate toxicity whereas smaller, undesirable trees on the steep slope (where RGD is not possible) will be killed by glyphosate, thus preventing transmission of the OW fungus around the RGD effort on the level ground.

7 Approximately one year later (2016), this group of dead oak trees near Judy's Hartland home represents the remnants of their girdled/glyphosate-treatments (the original OW-infected tree was removed the previous fall). The untreated cherry tree displays prominently in the photo's center. To date, no further OW has been noted. It is anticipated that the original OW infection center will have been contained and eradicated by the "chemical barrier" of killed roots, preventing further root graft transmission.

8 At Judy's treatment site (Photos 5-7), this oak tree is within a few feet of the original OW-affected tree and the glyphosate-treated oak trees. Collateral damage from glyphosate is evidenced by sparse, stunted foliage (also note normal foliage). Despite root graft transmission of glyphosate, this tree has survived and is expected to make a full recovery with time. As expected, no collateral damage was observed on other species of trees, shrubs or plant life. As with any site receiving the glyphosate/girdling treatment described in this publication, Judy's landscape and woodland will be monitored for evidence of further OW outbreaks for the next several years.

9 Not typically visible to the public, scientists or arborists is the massive root system of trees. In order to effectively prevent OW transmission through roots, the roots must be killed, the reason for the stump cup and concentrated glyphosate.

10 As a common practice, foresters commonly apply triclopyr to stumps to prevent sprouting. Rather than use the stump cup/glyphosate treatment as described in this article at the Northern Michigan site shown in Photos 1A & 1B, government officials changed the protocol for treatment of the Northern Michigan cliff site (Photos 2-4) at the last minute to treatment of flat stumps (no cup) with triclopyr (as mandated by a cost sharing government grant). This stump is sprouting several months after the triclopyr treatment… not only indicating that the treatment was not effective, but that survival of live roots will probably permit transmission of the oak wilt fungus. Again, our prime objective is to kill all roots of a tier or two of healthy oaks to prevent transmission of the OW fungus from diseased trees through root grafts.


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Discussion & Conclusions:

The application of herbicides for creating "chemical barriers" exhibits good potential for containing and eradicating OW….particularly in areas where Root Graft Disruption (vibratory plowing, trenching) is not feasible, such as on steep slopes, in critical dune areas and in dense stands of mixed species of trees (woodlands, forests). The use of herbicides also exhibits significant economic advantages compared to trunk injecting low value trees with propiconazole in similar areas of low value oak trees, but where containment and eradication of OW is desirable.

The procedure described herein was developed because personal communications with individuals who have tried applying herbicides to girdled OW-infected trees has not stopped the disease.

Why a Stump Cup? A stump cup or trunk cup is created to hold sufficient concentrated herbicide to hopefully kill the entire root system of the tree to be treated. Trees have a massive root system (Photo 9) and in order for this "chemical barrier" to be effective, all roots need to be killed so that the OW fungus cannot be transmitted between trees.

Why Glyphosate? In the author's opinion, glyphosate "stays put" and is highly effective. Triclopyr is commonly used by foresters to inhibit sprouting of stumps (Photo 10); however, for inhibiting OW transmission through root grafts, we are interested in killing roots, not just inhibiting stump sprouting. Furthermore, in the author's observations, professional treatment of trees and brush in township or county drainage ditches and other right of way areas often results in woody plant recovery one to two years after treatment, even though the treated plants appeared dead during that one to two years after the treatment period. In addition, members of the carboxylic acid herbicides such as triclopyr and imazapyr tend to be soluble in water and may leach to other locations, killing non-target plants. Furthermore, herbicides such as imazapyr and picloram tend to exhibit a long residual, a good attribute for broad spectrum vegetation management in right of ways and elsewhere, but not necessarily a good attribute for an OW containment and eradication site. Glyphosate mixed with other herbicides such as imazapyr, one of the most common duos marketed today under various trade names, exhibits the negative aspects expressed above. Concentrated glyphosate tends to be highly effective as a stump/root killer, relatively inexpensive, and far less likely to move with water and cause harm to other types of plants. In the author's opinion and experience, a large, concentrated dose of glyphosate is more likely to accomplish **our prime objective of killing Oak trees' roots fairly quickly.**

The girdling of oak trees via stump cup and treatment with glyphosate of a **healthy tier or two of oaks** around OW-diseased trees will, in theory, keep OW contained to the treated area; if accomplished, this procedure should cause the OW fungus to die out. A person with a chain saw and a gallon of glyphosate can treat an OW epicenter relatively quickly and very economically. Its ease of application, the lack of soil disturbance, and its comparatively low cost for labor and herbicide may make root graft disruption (trenching, vibratory plowing) and costly trunk injections things of the past for some delicate forest and woodland situations, provided some property owners are willing to sacrifice some oak trees to stop the spread of the deadly OW disease (trees that would succumb anyway if OW was unchecked). At several locations, this technique has proven to be 100% effective in containing Oak Wilt... but more locations are needed to gain additional knowledge about this procedure.

DISCLAIMER: Research with glyphosate and other herbicides to manage Oak Wilt is in its infancy and/or is met with a diversity of views. Therefore, and due to the dangerous impacts of herbicides on plant life and ecosystems, precautions must be contemplated before attempting the control of Oak Wilt with glyphosate or any other herbicide. The author offers no definite claims and cannot guarantee any specific outcomes in regards to safety or the control of Oak Wilt by herbicides. Questions or comments? Please feel free to contact the author at robertsd@msu.edu or (248) 320-7124.