

PROMISING VARIATIONS OF THE GLYPHOSATE/STUMP CUP TECHNIQUE FOR REMEDIATION OF OAK WILT: *'Chaser' & 'Half Moon'*

INTRODUCTION:

The Glyphosate/Stump Cup Technique was created by the author more than a decade ago as an alternative to the costly, destructive, and invasive Root Graft Disruption (trenching, vibratory plowing and the rather costly, multiple-year Tree Injection programs for the remediation of Oak Wilt (OW) (Photos 1, 2 & 3). This (Glyphosate) herbicide remediation technique was designed to be used with the Tier Tree Model, which was originally created by the author in the mid-1980s for containment and eradication of Oak Wilt by Root Graft Disruption (RGD). For more background information on the Glyphosate/Stump Cup Technique, the Tier Tree Model, RGD, Tree Injections, and the Glyphosate/Stump Cup Technique, please refer to the three-part series: **Oak Wilt Remediation by The Tier Tree Model Part 1: Root Graft Disruption** (*The Michigan Landscape*, March/April 2020, Pages 39-45); **Oak Wilt Remediation by The Tier Tree Model Part 2: Tree Injections** (*The Michigan Landscape*, July/August 2020, Pages 32-39); and **Oak Wilt Remediation by The Tier Tree Model Part 3: The Glyphosate/Stump Cup Technique** (*The Michigan Landscape*, September/October 2020, Pages 39-45). This three-part series is available upon request in PDF form from the author or the MNLA Editor (Jen Dwyer).



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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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P1

The Glyphosate/Stump Cup has proven to be a highly effective and economical alternative to RGD and Tree Injections over the last 10 years. The technique can be used anywhere but is especially beneficial in adverse terrain where RGD by trenching and vibratory plowing are hazardous if not impossible (Photos 4 & 5), where soil disturbance is not permitted (Critical Dunes, Photo 5), where there are complications with utilities, or where root damage to other species is not acceptable. The author has been experimenting with two variations of the Glyphosate/Stump Cup Technique that may prove to be even more useful for Oak Wilt Remediation. These two variations are called ‘Chaser’ and ‘Half Moon’ by the author. Following is a summary of that preliminary research.

Glyphosate/Stump Cup ‘Chaser’:

In field studies, including practical applications of the Glyphosate/Stump Cup Technique, it has been noted that Glyphosate translocates through roots and root grafts much faster and farther than the Oak Wilt fungus does during a given period. Subsequently, experiments were designed to determine if using the Glyphosate/Stump Cup Technique on *Oak Wilt-infected trees* (as a ‘Chaser’) might be sufficient to ameliorate Oak Wilt in lieu of sacrificing even a tier of healthy trees according to the Tier Tree Model. The hypothesis follows that Glyphosate might “chase” the fungus, pass it, and kill the roots ahead of the advancing fungus, thus preventing the fungus from transmitting through root grafts to nearby healthy Red Oaks. Thus far, the results are quite promising. Two examples follow.



P2



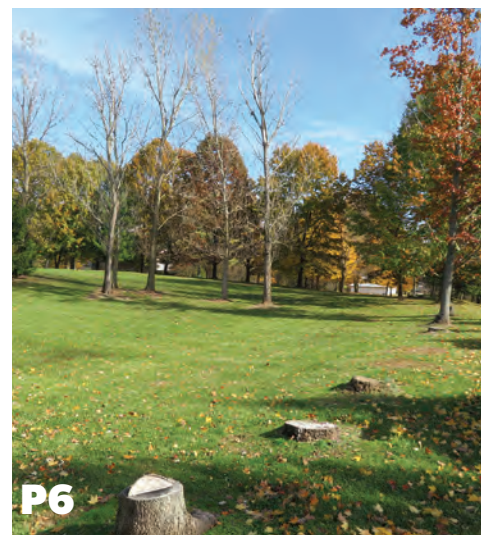
P3



P4



P5



P6

At one location, Oak Wilt had been moving along a roadside line of trees for several years, killing one tree after another (Photo 6). When the next tree in succession became infected and showed the telltale signs of Oak Wilt in 2019, the tree was subjected to the Glyphosate/Stump Cup Technique ‘Chaser’ Technique in the fall of 2019 (Photo 7A). In 2020, slight symptoms of Glyphosate toxicity were revealed in the foliage of the “healthy” adjacent tree (Photo 8), but the Oak Wilt fungus did not transfer to that healthy, but slightly glyphosate-damaged tree in 2020 (Photo 7B). As of late July 2021 (the time of this writing), the subject tree had completely recovered from glyphosate damage symptoms, and the Oak Wilt fungus has still not transferred the relatively short distance of approximately 16 feet between the infected tree and the “healthy” tree.

At another location, a large Red Oak became infected in 2020 from storm damage and showed typical signs of Oak Wilt within a couple of months of the limb breakage (Oak Wilt was confirmed by two lab tests). The tree was not subjected to the Glyphosate/Stump Cup until the spring of 2021, approximately a whole year after it became infected by Overland Spread. Subsequently, a large, adjacent Red Oak (approximately 12 feet distance) exhibited thinning and leaf distortions of Glyphosate toxicity within 1-2 months of treatment of the infected tree (Photos 9A and 9B), but no transfer of the Oak Wilt fungus has been observed as of late July 2021, at least as determined from the lack of development of Oak Wilt symptoms. Other locations are demonstrating similar results.

As a potential additional benefit of the ‘Chaser’ Technique, diseased (Oak Wilt-infected) trees that are subjected to the Glyphosate/Stump Cup ‘Chaser’ treatment have not been observed to form Pressure Pads (Spore Mats) of the Oak Wilt fungus. It is believed that the Glyphosate kills the vascular system (cambium) of the tree so quickly and dries it out (moisture in the cambium is necessary for Spore Mat production under the bark) that other microbes and critters colonize the tree immediately and may be too competitive for the Oak Wilt fungus to form its reproductive structures (Photo 10A & 10B). If this observation consistently holds true, the ‘Chaser’ Technique could become a major boon to Oak Wilt Remediation in Michigan and elsewhere.



P7A



P7B



P8

P1 Oak Wilt development in residential areas often threatens many adjacent properties and their valuable oak trees. Transmission by root grafts is very common in these environments and the lethal disease can jeopardize property values.

P2 Root Graft Disruption (RGD) by trenching methods or vibratory plowing can be very costly and disruptive, not only harming roots and health of non-target trees but is very challenging in residential areas where various utilities are the norm. Here, a mini excavator is used instead of a vibratory plow to ensure sufficient depth for severing root grafts in sandy soil. The Glyphosate/Stump Cup has proven very useful in such situations; the herbicide remains systemic within treated trees and does not harm other species of trees. And, utilities are never a concern.

P3 While tree injections with propiconazole fungicide may save valuable trees from Underground Transmission of the Oak Wilt fungus via root grafts, multiple-year treatments may prove to be quite costly, with no guarantee of success.

P4 & 5 Some terrains are so rugged that Root Graft Disruption by trenching machines or vibratory plows could be downright dangerous. At this site in western Michigan where an Oak Wilt workshop was held, people could barely stand upright without sliding down the hill (Photo 4). Photo 5 shows a Critical Dune area, which is also quite steep, where soil disturbance is not advised and often not permitted.

P6, 7A, 7B & 8 At this site in southwest Michigan, Oak Wilt marched down this roadside line of trees killing trees in succession over several years (Photo 6: Note stumps of killed and removed trees in foreground). In 2019, the tree (left, Photo 7A) became infected and died from root graft transmission; this tree became a prime candidate to test the Glyphosate/Stump Cup ‘Chaser’ Technique, applied in the fall of 2019. Photo 7B shows the same two trees in 7A but in 2020. In 2020, minor symptoms of Glyphosate toxicity (Photo 8) appeared in the adjacent “healthy tree” (Photo 7A & 7B, right). Interestingly, there were no symptoms of Glyphosate toxicity in the adjacent “healthy” tree in 2021. Almost two years after treatment, the Oak Wilt fungus still has not transferred “Underground” the relatively short distance of approximately 16 feet from the infected tree to the next oak in succession. This experiment shows very promising results for the ‘Chaser’ treatment of infected Red Oaks.



P9A



P9B

P9A & 9B Although Photo 9A may be difficult to discern, we can make out the Oak Wilt affected tree by the “dead” branches (left), which became infected by Overland transmission to a broken branch in 2020. In the spring of 2021, almost a year after the infection in 2020, the tree was treated with the Glyphosate/Stump Cup ‘Chaser’ Technique. Within a couple of months, obvious signs of Glyphosate toxicity appeared in the large tree to the right, only about 15 feet

from the treated Oak Wilt-infected tree (left). The Oak Wilt fungus still has not transferred to the “healthy” tree approximately one and a half years after the injured tree became infected. Photo 9B shows closeup Glyphosate toxicity symptoms of thinning and leaf distortions near the top of the “healthy” tree in Photo 9A (right).

Glyphosate/Stump Cup ‘Half Moon’:

This variation of the standard Glyphosate/Stump Cup treatment involves application of Glyphosate to a half Stump Cup, facing in the direction of the advancing Oak Wilt Epicenter. The hypothesis behind the ‘Half Moon’ is to direct the Glyphosate in the direction of the advancing Oak Wilt and away from trees that are destined for preservation. Whether this technique will actually work to contain and eradicate Oak Wilt remains to be seen, but experiments are underway. Nevertheless, an interesting application of the ‘Half Moon’ Technique proved some very important results regarding herbicide efficacy and Oak Wilt remediation as the following experiment demonstrates.

Superiority of the Glyphosate/Stump Cup Technique over the Garlon 4/ Double Girdle Technique: An Experiment using the ‘Half Moon’ Variation of the Glyphosate/Stump Cup Technique.

Two herbicides are currently used in Michigan for the remediation of Oak Wilt: Glyphosate and Garlon 4. An objective of the present research was to test the efficacy of Glyphosate and Garlon 4 herbicides in their ability to kill trees to prevent transmission of the Oak Wilt fungus through root grafts. The design of this replicated experiment is very simple. For one treatment, a ‘Half Moon’ Stump Cup was created in healthy Red Oaks, and Glyphosate was administered to the half girdle (Half Stump Cup, Photo 11). As another treatment, Garlon 4 was administered to ‘Half Moon’ Double Girdles in healthy Red Oaks (Photo 12). Rates (volume) of herbicides were administered similarly to what would be applied to full girdles for each method. For example, the ‘Half Moon’ Double Girdle was sprayed twice to expose the treated trees to the same amount of herbicide (Garlon 4) that trees would normally receive with a *full* Double Girdle treatment. Replicate treatments were spaced in a woodland with sufficient distance between trees to avoid any possibility of cross contamination of herbicides between treatments and treated trees. Treatments were initiated in the fall of 2020; data was collected in June 2021.

Results and Discussion: Results within replicate treatments were 100% consistent. ‘Half Moon’ Glyphosate/Stump Cup trees could best be described as “Stone Cold Dead” (excuse the non-scientific terminology) in June 2021 (Photo 13). There was no evidence of life in any of the treated trees (no bud swell, no foliage emergence, etc.). In contrast, all trees that received the ‘Half Moon’ Garlon 4/Double Girdle leafed-out with full foliage (Photo 14). The foliage exhibited normal color and structure. There was not even a hint of Garlon 4 herbicide toxicity symptoms on the foliage.

There are several important factors that we know about trees and their biology:

- 1) **Girdling Trees by Stump Cup or Double Girdle will kill Trees above the Girdle.**
- 2) **The Root Systems of Gridled Trees may remain alive for years.**
- 3) **The Root Systems of Girdled Trees may remain alive indefinitely if they are root-grafted to live trees, which may use the Girdled Trees’ roots as extensions of their own root systems.**
- 4) **Half Girdles (‘Half Moon’) will not kill trees.**
- 5) **If we are to stop Root Graft transmission of the Oak Wilt fungus, we must kill the roots of Oak Trees.**

The results of this experiment were quite revealing. Because the ‘Half Moon’ treatment of oak trees by either girdle method (Stump Cup or Double Gridle) will not kill them, the application of either herbicide to the ‘Half Moon’ girdle should be a true test of that herbicide’s impact on oak trees. The results indicate that Glyphosate is highly effectual for killing oak trees while Garlon 4 had no verifiable impac .

The Garlon 4 Addiction: Garlon 4 is a trade name for Triclopyr, manufactured by Dow Chemical. This herbicide has been used extensively in forestry and logging operations for decades. The chemical’s primary usage is for invasive plant management, suppressing sprouting in stumps from harvested trees, and maintaining



P10A

Note: The author is looking for more Oak Wilt sites to expand research on the Glyphosate/Stump Cup Technique and its variations, the ‘Half Moon’ and ‘Chaser’ Techniques.



P10B



P11



P12



P13



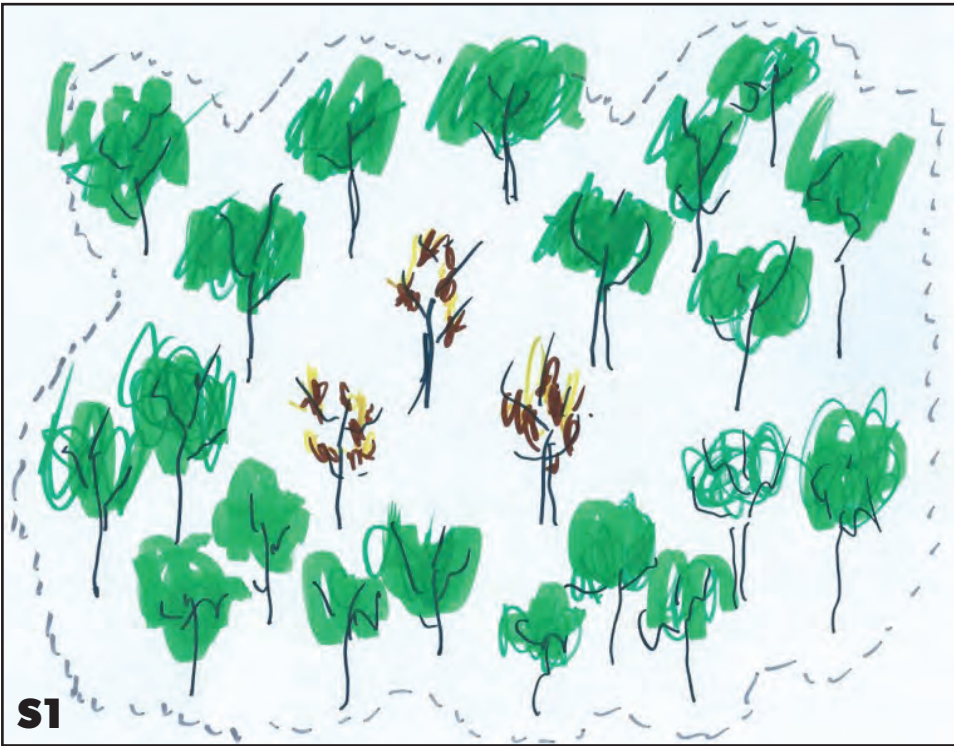
P14

P10A & 10B Thus far in our observations of infected Red Oaks subjected to the Glyphosate/Stump Cup ‘Chaser’ Technique, spore mats (=Pressure Pads) of the Oak Wilt fungus do not develop, likely due to the rapid drying and death caused by Glyphosate and the prompt colonization of the tree, particularly the vascular system beneath the bark, by other microbes and critters. Photo 10A shows the inhospitable environment for pressure pad formation in a ‘Chaser’ tree versus pressure pad formation in a normal, infected tree (non-‘Chaser’) in Photo 10B.

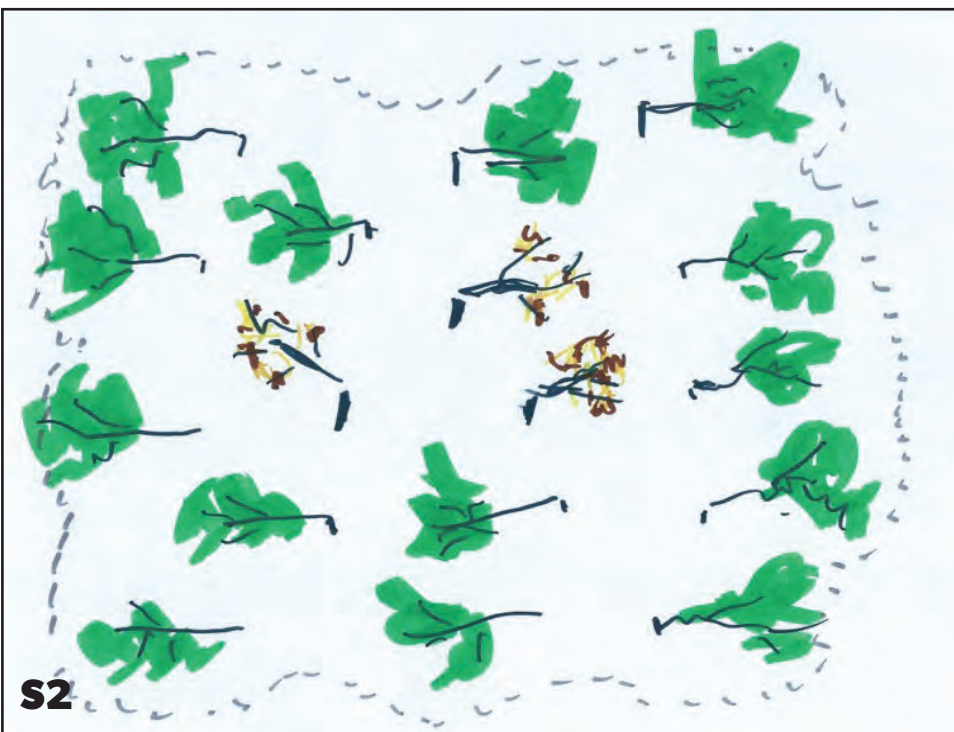
P11 For the Glyphosate/Stump Cup ‘Half Moon’ experiment to test the impacts of the herbicide on oak trees, Glyphosate was administered to a half girdle (= ‘Half Moon’ Stump Cup) of healthy Red Oaks in the fall of 2020.

P12 For the Garlon 4/Double Gridle portion of the experiment, Garlon 4 was sprayed into ‘Half Moon’ double girdles of healthy Red Oaks in the fall of 2020, according to protocol.

P13 & 14 By June of 2021, trees treated with the Glyphosate/Stump Cup ‘Half Moon’ Technique the previous fall were dead and exhibited no life whatsoever (Photo 13). In contrast, trees treated with the Garlon 4/Double Girdle ‘Half Moon’ all leafed out just fine with no symptoms of herbicide toxicity. This experiment proves the superiority of Glyphosate over Garlon 4 (Triclopyr) for the potential remediation of Oak Wilt. To stop Underground transmission of Oak Wilt, we must kill the root systems of oak trees. The chemistry and the amount of applied Garlon 4 does not provide the mechanism for root death compared to Glyphosate.



right-of-ways by “killing” brush and trees from/near power lines, railroads, and county drains, etc. Foresters and loggers usually consider Garlon 4 and various generic labeled products as the go-to herbicide. In fact, an arborist friend informed me that “chat” on Facebook and other social media among foresters and/or arborists and/or loggers discloses that Glyphosate is not considered to be capable of killing trees. I think that notion is the reason that the DNR, many foresters, and loggers reach for Triclopyr when forestry work is performed. It is a mindset that might be difficult for many to overcome when considering the remediation of Oak Wilt, where we need to *kill the entire root system of trees and their root grafts* as quickly as possible... and not just suppress sprouting of stumps. This research demonstrates that not only is Glyphosate superb at killing trees and their root systems but that Triclopyr is not effective for killing trees and their roots systems, at least with reference to the two methods used in this research (Glyphosate/Stump Cup vs. Garlon 4/Double Girdle).



Glyphosate/Stump Cup/Tier Tree vs. Garlon 4/Double Girdle/Bruhn:
 According to a Michigan Department of Natural Resources (DNR) representative, the Garlon 4/Double Girdle Technique (my terminology) was adopted from American Indians who were trying to use this method to control Oak Wilt in other states. Apparently, the Garlon 4/Double Girdle Technique was employed and has been used for years without verification of its efficacy, likely because of the great sacrifice of so many tiers of trees via the Bruhn Model. The Garlon 4/Double Girdle Technique is implemented with the Bruhn Model for RGD but in lieu of RGD. The Bruhn Model, which I also call the Forest Management Model (FMM), was created by Dr. Johann Bruhn at Michigan Tech in the 1990s. The Bruhn model possesses some advantages (perhaps) for “quick and dirty” remediation of Oak Wilt, especially if one has access to a vibratory plow and other equipment that may not be readily available to many landscapers and arborists. Sketches 1 and 2 provide

S1 & 2 The Bruhn Model for Root Graft Disruption (RGD) is implemented according to the following two sketches. An RGD line is placed according to a table at quite a distance from infected trees (Sketch 1, dotted line) and all trees within the RGD line are sacrificed whether diseased or healthy (Sketch 2). The Michigan DNR uses the Garlon 4/Double Girdle Technique in lieu of RGD, still sacrificing many healthy trees.

S3 & 4 The Tier Tree Model is implemented in the same manner as the Oak Wilt fungus tends to move, one tier of trees per year (Sketch 3). Sketch 4 shows where RGD lines (dotted lines) may be placed in a residential area, saving many trees

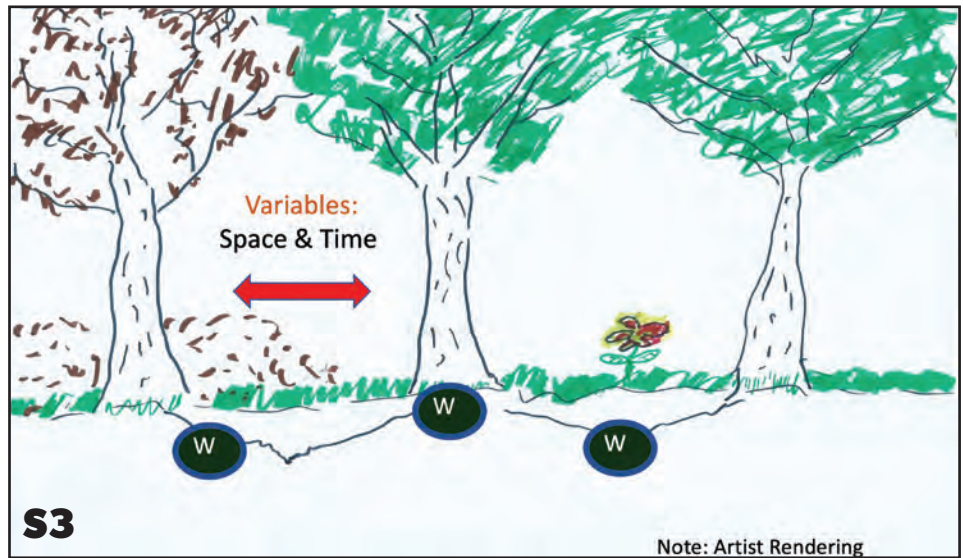
that would normally be sacrificed with the Bruhn Model. The Glyphosate/Stump Cup Technique is utilized in place of RGD. The new ‘Chaser’ Technique may save even more trees from sacrifice than the original Tier Tree RGD Model. The ‘Half Moon’ variation could potentially direct the Glyphosate herbicide towards the advancing Oak Wilt while protecting other trees that are destined for preservation.

P15 The Garlon 4/Double Girdle Technique was applied with the Bruhn Model at this site where state land and private property intersect. It is doubtful that Garlon 4 will provide sufficient root death to stop Oak Wilt in this critical dune area.

illustrations of how the Bruhn Model is implemented. In my opinion, the Bruhn Model has several important deficiencies it does not consider when trees became infected, and it is needlessly sacrificial and destructive of healthy, uninfected trees, especially valuable trees in landscapes and woodlands. My present 'Half Moon' study essentially confirms my prior observations at established sites of Garlon 4/Double Girdle Technique failures at not only killing Oak trees but at containing and eradicating Oak Wilt.

By comparison, the Tier Tree Model was created by the author (Dr. David L. Roberts) in the mid-1980s, years before the inception of the Bruhn model. The Tier Tree Model considers two primary objectives: 1) the containment and eradication of Oak Wilt, and 2) the preservation of as many trees as possible. The Tier Tree Model is implemented in the same manner that the Oak Wilt fungus tends to move Underground through root grafts, typically one tier of trees per year (Sketches 3 & 4). Application of the Glyphosate/Stump Cup Technique with the Tier Tree Model has been highly efficacious at many sites around Michigan without the need for sacrifice of so many valuable Oak trees.

A property owner informed me that the Michigan Department of Natural Resources (DNR) promoted and implemented the Garlon 4/Double Girdle Technique in 2020 along her property line and state land to prevent Oak Wilt from advancing into her property and other private properties in a critical dune area (Photo 15). Based on my research, I am skeptical that this procedure will work. It should be obvious that we need to kill the root systems of Oak Trees if we are to effectively stop root-graft transmission of the Oak Wilt fungus. Hence, I think the present research lends further evidence that the Garlon 4/Double Girdle Technique will not likely be effective in remediating Oak Wilt compared to the highly efficacious Glyphosate/Stump Cup Technique.



Dave Roberts is a Presenter at GLTE 2022 - In-person at the Lansing Center in Lansing, MI, January 24-26th.

