

Oak Wilt Remediation by The Tier Tree Model

Part 3: The Glyphosate/ Stump Cup Technique



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Dr. Roberts has researched many issues in Michigan's plant industry, including Oak Wilt, Dutch Elm Disease, Diploia 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.

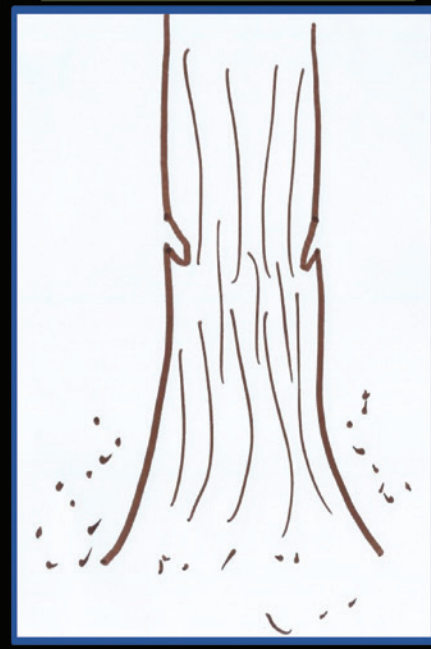
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INTRODUCTION

The Tier Tree Model was originally designed by the author in the mid-1980s as a method to contain and eradicate Oak Wilt (caused by the fungus *Bretziella fagacearum*) from infected sites via use of Root Graft Disruption (RGD); the Tier Tree Model was invented by the author almost a decade before the Forest Management Model (FMM, after Bruhn) of Root Graft Disruption. Oak Wilt (OW) can spread by underground transmission to nearby trees through root connections called "root grafts". Root grafts often form between trees that are genetically related or of the same species (Photo 1). RGD techniques were summarized in "Oak Wilt Management by The Tier Tree Model: Part 1 Root Graft Disruption", *The Michigan Landscape*, March/April 2020, Pages 39-45. In the 1990s and early 2000s, I adapted The Tier Tree Model for use with Tree Injections (please see "Oak Wilt Management by The Tier Tree Model: Part 2 Tree Injections, *The Michigan Landscape*, July/August 2020, Pages 32-39).



F1 Creation of a "Stump Cup"



From the 1950s through the 1970s and later, disrupting root grafts between trees for Dutch Elm Disease and Oak Wilt control was sometimes performed with fumigants. Fumigants are very broad-spectrum biocides that not only kill roots and root grafts of/between trees but will kill virtually every living entity in the soil or environment into which the fumigant is applied. Types of fumigants include chloropicrin (=tear gas), methyl bromide, and hydrogen cyanide. Although inexpensive and less disruptive than trenching, fumigants were very dangerous to the applicator and anyone coming in contact with the gaseous evaporates. Due to environmental concerns, these fumigants have largely been unavailable to many markets and uses, except for some special use situations. The unavailability

P1 In this aerial view of an Oak Wilt epicenter on a golf course near Traverse City, Michigan, the Oak Wilt disease was initiated by overland spread to trees pruned near the power lines by a power company's subcontractor. Subsequently, the Oak Wilt fungus transmitted "underground" through root grafts, dramatically expanding the Oak Wilt epicenter in the next several years. Oak Wilt remediation was accomplished by The Tier Tree Model using RGD, Trunk Injections and the Glyphosate/Stump Cup technique.

P2A These volunteer Silver Maple trees (background) were sprayed with Triclopyr by a professional applicator to eliminate them from this conservation land prairie. The trees were leafless and appeared dead for about one to two years before they "magically" re-leaved. In the industry, we could call this job security for the professional applicator.

P2B A more effective technique to kill the trees on this conservation land was to cut and lay them over in windrows. Stumps were sprayed with concentrated (32%) Glyphosate; the stumps never re-sprouted.

F1 A Stump Cup is accomplished by girdling the target tree with a chain saw approximately one to two inches deep beyond the bark. The chain saw is angled to create a cup that can hold sufficient concentrated Glyphosate to kill the roots of the tree, typically one cup for small trees and two cups for large trees.

of fumigants resulted in a void for Oak Wilt management. Subsequently, RGD was performed primarily by physical means such as trenching and vibratory plowing.

For more than a decade, I have been experimenting with herbicides for Oak Wilt management as an alternative "chemical" approach to the invasive and disruptive physical RGD. This article will review the results of some of that research.

Potential Herbicides for RGD:

A variety of herbicidal chemistries can be employed to kill trees or, specifically, their roots and root grafts. Several of the more common chemicals used in Forestry and Arboriculture are Triclopyr, Imazapyr and Glyphosate. I have not been favorably impressed with the carboxylic acid herbicide group (Imazapyr, Triclopyr, etc.) because of their modes of action, extended time periods to cause death, and due to many observations over the years that trees sometimes recover after treatment (Photos 2A & 2B). Another reason for my concern is that the mode of action of carboxylic acid herbicides is to inhibit cell division in the meristematic tissues of plants. If a sufficient dose of the herbicide is applied, the target plant cannot "replicate" cells to grow and gradually dies. My personal communication with Triclopyr users for Oak Wilt management in Texas reveals their belief that Triclopyr, if applied in enough concentration, will require at least 1.5 to 2 years to kill the roots of trees. If the roots of oaks are still alive during that time period, the Oak Wilt fungus may theoretically be transmitted through the roots and root grafts. Recalling the herbicide Imprelis, another carboxylic acid herbicide released by DuPont in 2010 for broadleaf weed control in lawns before it was thoroughly tested, numerous trees were killed, but numerous trees were drastically affected and then recovered. In the author's experience "on the farm" and elsewhere, Glyphosate, with its much different mode of action, is far more efficacious at killing trees and their root systems, apparently fairly quickly.

The Theory of Oak Wilt RGD with Herbicides:

The utilization of equipment (trenchers, backhoes, mini-excavators, vibratory plows) for physical RGD can not only be

costly and highly disruptive to the landscape, but unwanted damage to non-target trees either in a landscape, woodland or forest can result, not to mention serious complications with utilities in urban areas. If a chemical (herbicide) can be applied in a concentrated dose to kill the root system of the target tree, then theoretically the Oak Wilt fungus will also die with the dying roots; theoretically the Oak Wilt fungus cannot survive without living tissue, essentially categorizing it as an “obligate parasite”. Furthermore, I have hypothesized that necrotic (dead) roots cannot transfer the Oak Wilt fungus. In theory, if a “tier” or two of healthy trees surrounding an Oak Wilt infection site (epicenter) is/are “sacrificed”, the Oak Wilt infection will be contained within that chemical barrier. With Glyphosate translocating through the healthy trees’ roots and killing them, theoretically the Oak Wilt fungus cannot spread through or outside of the sacrificed trees.

The Technique:

A “Stump Cup” (aka “Trunk Cup”) is made with a chain saw at a downward angle 1-2 inches deep beyond the bark into the sapwood (including the xylem and phloem) of the tree to be killed/sacrificed (Figure 1). A “Stump Cup” is analogous to what many foresters refer to in various renditions as a “Frill Cut” or a “Kerf Cut”.

P3 A *level* Stump Cup to hold about a cup (8 Fl. Oz.) of concentrated Glyphosate can be quite challenging to make free hand. The author attempted this stump cup with less than enviable results.

P4 To provide a level Stump Cup, a ribbon wrapped around the tree and leveled by eye usually provides a guide for the chain saw path. Here, Matt Bainbridge, owner of American Arbor, demonstrates with fine technique and PPE the art of making a good Stump Cup. Please note the downward angle of the chain saw to make the “cup”.

P5A Due to the difficulty of applying a cup of concentrated Glyphosate from a measuring container (the liquid tends to spill on the bark once tilted beyond 45 degrees), an inexpensive (\$4.00 to \$5.00) sprayer can be used to apply the herbicide directly into the Stump Cup.

P5B The Glyphosate can be observed pooling in this Stump Cup. If the entire amount of glyphosate cannot be administered at one time, simply wait a few minutes for the tree’s vascular system to absorb some of the herbicide. If Glyphosate leaks out of a lower area in the Stump Cup, the leakage can be stopped with a “soil plug” (arrow). A tube of latex putty might also prove helpful in lieu of a “soil plug”.

A “level” Stump Cup is designed to hold a volume of concentrated liquid herbicide that when poured into the “stump cup” can be absorbed by the tree’s vascular system. A *level* Stump Cup can be quite difficult if attempted “free hand” as I have (Photo 3). Although a string and string level can be used, simply wrapping a piece of ribbon around the tree and adjusting it to level by visual means is generally sufficient (Photo 4), although a torpedo level or other leveling device may help. A concentrated (undiluted) solution of Glyphosate (30-40% or so) is poured or sprayed into the Stump Cup.

The Glyphosate/Stump Cup technique is engineered and implemented according to the Tier Tree Model (Figure 2). The first Tier (or two) of *healthy* Oaks of the **same** species (or family) out from the epicenter of infected trees are treated with this technique. An option is to treat the infected oak tree(s) *after* treating the healthy tier(s) of sacrificial trees. The next step, perhaps the hardest, is to wait and be patient. It is



advised to allow at least 2-4 weeks for the Glyphosate to be absorbed and transported through the tree's root system.

Why Glyphosate?

In the author's experience, Glyphosate is far more effective at killing the roots of trees than many other herbicides. And Glyphosate appears to kill the roots of trees faster than most other herbicides. As we are aware, there is controversy surrounding Glyphosate. In the author's opinion, if Glyphosate is used according to its label and the directions and as outlined in this article, it should be relatively safe for the applicator and environment. The Glyphosate application to a Stump Cup keeps the fungicide (systemically) within the tree and does not affect the surrounding environment. The controversy surrounding Glyphosate at the time of this writing is primarily associated with applicators' use of sprays, and not necessarily to the millions of acres of food crops to which the chemical is being applied. Glyphosate has been determined

to be relatively safe by the vast majority of health organizations around the planet. Because Glyphosate is the most widely used herbicide/pesticide in the world, it is a natural target for controversy. If anyone is sincerely concerned about using Glyphosate, they should probably not use it. Please consider reviewing the article, "Roundup®: The Controversy Continues", *The Michigan Landscape*, September/October 2019, Pages 39-46. Other commonly used herbicides such as Triclopyr and Imazapyr are actually more persistent than Glyphosate as active herbicides but they may move from the area of application, sometimes leaching through soil or moving in water and kill other plants. The beauty of Glyphosate and the Stump Cup technique is that its application should not harm other species of trees or other plants if used according to the directions in this document. **Be sure to use only the pure Glyphosate formulations. Formulations of Glyphosate mixed with other herbicide such as Imazapyr will likely result in detrimental impacts to other trees.**

Why a Stump Cup? The Stump Cup theoretically provides for application of enough herbicide to kill the root systems of trees. The "*Prime Objective*" is to apply a sufficient chemical dose to kill the root systems of trees. Killing the entire root systems of trees should, theoretically, prevent the transmission of the Oak Wilt fungus through roots and root grafts, thereby inhibiting the spread of Oak Wilt. The one-cup application for smaller trees (10-16" or less dbh) and two-cup application for larger trees seem to accomplish the goals. I have considered recommending one cup per each 12" dbh to be more precise. Foresters, loggers and lumberpersons have traditionally applied Triclopyr (Garlon) to stump surfaces of removed trees to prevent sprouting (Photo 6); this application is probably not effective at stopping Oak Wilt transmission through root grafts because I believe that insufficient material is being applied to kill the large root systems of trees.

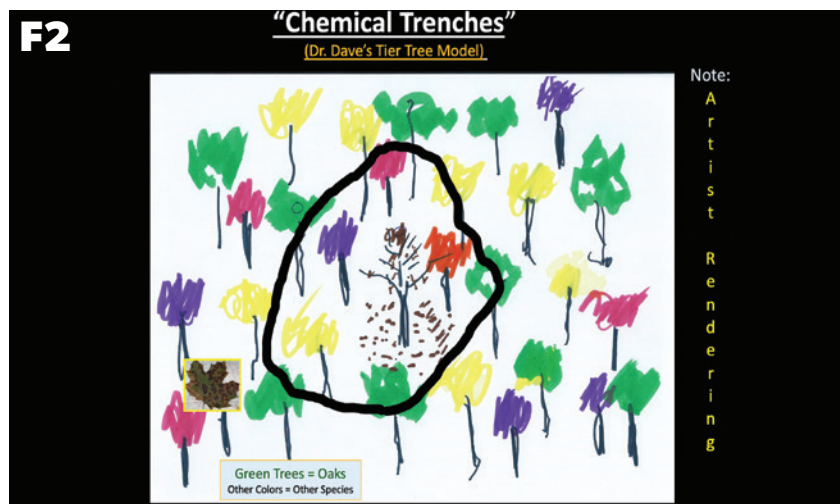
A Word of Caution!!!!!!

Glyphosate is a systemic herbicide; it will translocate through the root system and through root grafts to nearby trees in the tree's vascular system in the same manner as the Oak Wilt fungus. Because of its systemic activity, Glyphosate can harm or even kill non-target trees. If anyone is considering using this technique in the vicinity of desirable oaks to be maintained but is uncertain about what this technique with Glyphosate can do, please contact the author for advice/assistance. I strongly advise that assistance be sought until the Oak Wilt Remediator Expert becomes confident with the expected outcomes.

Expected Results: If the treatment is applied to healthy trees within the growing season, oak trees will generally collapse within a few days to a week or two. By "collapse", it is meant that leaves will turn lethargic, begin dropping and/or turn tan or different shades of color. The impact of the herbicide on treated trees may resemble symptoms of Oak Wilt on Oak Trees.

Specific Examples of the Glyphosate/Stump Cup Technique:

Hartland, Michigan: An "arborist" stopped by Judy's home one day to ask if he could prune her trees. Luckily, Judy didn't think her landscape trees needed



pruning, but, perhaps feeling sympathy for the tree trimmer, Judy suggested he could prune some of her woodland trees; then, she would pay him. Each of the woodland Oak Trees he pruned became infected with Oak Wilt from overland spread (Photo 7A). Judy was horrified. She had a dense, lovely woodland of mixed species of trees adjacent to her landscape. She knew enough about trees to understand that physical RGD could be extremely harmful to other species, possibly even killing some of her desirable trees like maple, cherry, hickory, sassafras, etc. And she was not warming to the notion of injecting all of her woodland oak trees with a fungicide for six to eight years. Judy was desperate and asked me for assistance. After carefully reviewing the traditional methods, as a last resort I suggested she try my Glyphosate/Stump Cup technique, warning her that the technique had its advantages and some potentially dangerous disadvantages. Feeling exasperated with her predicament after trying to help the tree trimmer, she decided to try the Glyphosate/Stump Cup technique. Her neighbor Bob had a chain saw, and Judy had a measuring cup. She would buy the concentrated Glyphosate at her local farm store. Results? The technique worked beautifully (Photos 7B and 7C). Both Bob and Judy were in their 70s. With minimal effort and investment, the Oak Wilt was efficiently and easily contained and eradicated from Judy's property. And as expected there was no

harm to any of the other species of her woodland trees. I have monitored the property for the past six years, and there has been no resurgence of Oak Wilt after this treatment.

Oakland County: At an Oakland County golf course, several Oak Wilt outbreaks occurred from pruning during the high-risk period (spring through early summer) and from storm injury. At one location, tree injections and RGD were implemented...and failed because of insufficient RGD depth and length (Photo 8). At another location on the golf course, the



F2 In this schematic of a mixed-species woodland, the oak tree killed by overland spread of the Oak Wilt fungus is obvious. Now comes the challenge of stopping the Oak Wilt from transmitting underground via root grafts, which tends to occur within the same species of trees. For reference in this schematic, the green trees are oaks. The other colors represent other species: for example, the red trees could be Cherry Trees, the yellow trees could be Yellow Poplar (aka Tulip Poplar), etc. The Norway Maple tree affected by Tar Spot is in the lower left. The first tier of oak trees outlined by the black circle represents the trees to be sacrificed to contain and eradicate Oak Wilt.

P6 Many foresters traditionally use Triclopyr to inhibit sprouting of stumps after forest trees are harvested for lumber. At this Oak Wilt site near Suttons Bay, Michigan, a government representative recommended a Triclopyr dressing to the stump from a tree that was cut down rather than employ the Glyphosate/Stump Cup technique to inhibit underground spread of the Oak Wilt fungus. Note that the stump is sprouting within several weeks after herbicide application, indicating that Triclopyr was not effective at killing the roots of the tree.

P7A The tan/brown colored tree at the center of this photo contracted Oak Wilt by overland spread when the tree was pruned by a tree trimmer at Judy's residence near Hartland, Michigan. In consideration of the mixed species of her woodland adjacent to her landscape, Judy was reluctant to trench through the woodland to isolate Oak Wilt for fear of injuring other species. She was also hesitant to fund costly tree injections to protect so many other Oaks in her woodland.

P7B Judy decided to try my Glyphosate/Stump Cup technique. Bob, Judy's neighbor, had a chain saw and made some enviable stump cups "free hand" (Inset, also note untreated Cherry, left background). This photo was snapped the year after treatment; the infected oak had been removed during the previous winter. Note the first tier of dead oak trees that had been treated with Glyphosate. Please also note that several healthy conifers and a cherry tree (center) are interspersed within the dead zone of oaks killed by Glyphosate, demonstrating that Glyphosate is systemic and will only affect the tree species that have been treated.

P7C We often benefit by learning from our mistakes. The Oak Tree featured in this photo was in the first tier that should have received the Glyphosate/Stump Cup treatment. Unfortunately, or fortunately for us in our learning by experience, Judy and Bob forgot to girdle and treat this tree. The tree showed symptoms of Glyphosate (note sparse foliage) the following year from root graft transmission of the herbicide from its neighboring oaks that were sacrificed. The tree has leafed-out every year for the past five to six years, improving in health each year. This mistake indicates that the Glyphosate from other nearby treated trees in the first tier protected it from root graft transmission of the Oak Wilt fungus from the original diseased tree.

P8 At this golf course in Oakland County, several Oak Wilt epicenters developed in different wooded areas from pruning during the high-risk period and from storm damage. In this photo, the three oaks had died from overland spread of Oak Wilt to recent pruning injuries. A trench line was placed to the left of the left-most infected tree; the trench failed to contain Oak Wilt due to inadequate extension into the fairway. In other words, the Oak Wilt fungus likely did an end-run around the trench line.



P9A



P9B

P9A At another location at the same Oakland County golf course (as in Photo 8), the tree in the center of the photo developed Oak Wilt from overland spread to a storm-injured branch. The golf course managers decided to try the Glyphosate/Stump Cup technique.

P9B This photo of the Oak Wilt epicenter in Photo 9A was snapped the year after implementation of the Glyphosate/Stump Cup technique. The infected tree had been removed during the winter, but the two sacrificial and formerly healthy trees are readily visible. Again, Oak Wilt remediation was successful at this wooded location on this golf course.

P10A&10B At a property near Jackson, Michigan, a professional arborist decided to attempt remediation of a large Oak Wilt infection site with the Glyphosate/Stump Cup technique. The barely visible dead trees in the distance (right) had been previously treated with the Glyphosate/Stump Cup technique; the Glyphosate translocated through the root systems and root grafts approximately 80-100 feet **under a 4.5 foot deep trench** and killed the tree in the foreground (Photo 10A). Initially distraught with these results, the arborist and I realized his trench was not deep enough. The Glyphosate had traveled exactly where the Oak Wilt fungus would have moved if the herbicide technique had not been used. In spite of the collateral damage to the trees he had

Glyphosate/Stump Cup was implemented and worked perfectly (Photos 9A & 9B).

Jackson, Michigan: At his private property near Jackson, Michigan, a professional arborist with an enviable log home and extensive woodland property was challenged with a severe Oak Wilt outbreak after storms injured several of his trees. He initially trenched around a large area to contain the expanding Oak Wilt disease from several epicenters and performed tree injections on selected trees within the trenched area to try to save them. Becoming frustrated with less than desirable results, he contacted me for some discussion about remediation effort options. I recommended that he try the Glyphosate/Stump Cup technique. He treated several trees within the trenched area as an experimental study to observe what would happen. Within several months, catastrophe struck! The Glyphosate had transmitted through the root systems of his sacrificial oaks approximately 80-100 feet **under his trench line** and killed/injured several trees on the opposite side of the trench line (Photos 10A & 10B). The arborist and I were initially very discouraged with the results. But then, we both realized that his RGD trench line was not nearly deep enough (4.5 feet) to prevent Oak Wilt transmission and that eventually the Oak Wilt fungus would

hoped to save, the Glyphosate actually prevented many of his trees on the other side of the trench line from becoming infected by the Oak Wilt fungus. Photo 10B and Inset shows some non-lethal collateral damage to oaks on the opposite side of the trench line from the Glyphosate treatment.

P11 This 2.5-gallon container of Glyphosate costs about \$30 and prescribes for killing trees on the label. Calculating the number of doses in the container for the Glyphosate/Stump Cup technique, the treatment costs per tree amount to about \$1.00! We cannot visualize a less expensive treatment for Oak Wilt than that!! Standard Oak Wilt remediation efforts involving trenching and tree injections often cost in the \$1,000s to \$10,000s. (Note: The author does not endorse any particular brand of Glyphosate.)

P12 At this residential location near Grand Rapids, Michigan, a single oak tree (arrow) was infected by overland transmission when the property owner pruned a single branch for better mower clearance. The Tier Tree Model specified the RGD trench line (yellow), and trees outside of the trench line were injected with propiconazole for added insurance of protection from underground Oak Wilt transmission. In many situations, the author would now also recommend the Glyphosate/Stump Cup treatment **on the diseased tree (arrow) after trenching** to ensure that no root grafts escaped the physical RGD trench.

have moved beyond his enclosed trenched area anyway. Incidentally, he indicated he may have used too much Glyphosate. The interesting aspect about these unexpected results from the Glyphosate/Stump Cup treatment at this location was that the “fast and furious” movement of the Glyphosate was a valuable lesson in the name of research. As a “nonliving” chemical, whatever impact the Glyphosate caused on the trees outside of the trenched area was **finished**; it would not continue to spread as the biological living Oak Wilt fungus would have; the Oak Wilt fungus would have moved into new areas of his woodland property, and kept moving. Despite the collateral damage, the Glyphosate **prevented** the Oak Wilt fungus from transmitting under his trench to infect other trees that he was trying to save.

I could cite many other locations where the Glyphosate/Stump Cup has been employed with great success, but the above three examples span the expected outcomes I have witnessed. Many arborists, landscapers and foresters have tried the Glyphosate/Stump Cup technique with reported successes.

Summary:

The Glyphosate/Stump Cup technique has demonstrated to be a highly effective and useful tool for Oak Wilt containment and eradication. It can be far less destructive than the Forest Management Model (after Bruhn) for RGD. The Glyphosate/Stump Cup can also be more effective. I have never witnessed the Oak Wilt fungus escaping from or overcoming a One-Tier tree treatment with the Glyphosate/Stump Cup method. There are reports of physical RGD failures. Because Glyphosate is a systemic chemical within plants, it remains within the treated tree(s), only affecting the species of trees that have been treated and no other tree species in mixed landscape/woodland/forest stands. At the dose recommended in this article’s protocol, treated trees are killed, and there has never been any recovery of those treated trees whatsoever. I have also never encountered a failure of this method to contain and eradicate Oak Wilt if used according to the instructions in this article. Of considerable benefit, compared to most other Oak Wilt treatment techniques, the Glyphosate/Stump Cup technique is the most cost-effective treatment for the management of

Oak Wilt. The retail cost of a 2.5 gallon jug of Glyphosate (Photo 11, approximately \$30) calculates that the investment to control Oak Wilt amounts to about \$1.00 per tree, plus some chain saw activity. The time investment of creating the Stump Cup and application of the Glyphosate is also minimal, perhaps estimated at approximately 10 minutes per tree. Hence, a person with a chain saw and a container of Glyphosate can contain and eradicate an Oak Wilt infection epicenter with minimal investment of time and money.

Potential downsides exist with this technique, perhaps, most likely due to misunderstandings about Glyphosate and the technique. For example, many laypeople and even some professional arborists and landscapers do not realize that Glyphosate is systemic within trees. Hence, some have proposed treating some trees directly adjacent to trees deemed to be preserved; this could be disastrous. And even though in my experiences the technique has been 100% effective in stopping Oak Wilt, there are some potential detrimental impacts on non-target Oak Trees ranging from no impact to death. If anyone is unsure about how and where to use the Glyphosate/Stump Cup technique, be sure to contact the author for more information, discussion, and assistance.

The Glyphosate/Stump Cup technique possesses great potential for highly efficacious and economical containment/eradication of Oak Wilt. In the author's opinion, it could easily replace the Forest Management Model (Bruhn) RGD for forests and woodlands with much less effort and far less expense than standard vibratory plowing, if dedicated applicators of the FMM were to think "outside the box". The technique is particularly effective *and safe* in regard to mixed stands of trees, causing no collateral damage to other species of trees compared to trenching models. This Glyphosate/Stump Cup technique could also be highly beneficial in sensitive environments such as critical dune areas where soil profile disruption is not advisable due to destabilization of the terrain. And it can be useful in residential woodlands and landscapes if Glyphosate's activity is carefully thought out to thwart unwanted consequences. Glyphosate seems to move faster and farther through root systems than the Oak Wilt fungus. Experimentation with Glyphosate as a



P10A

"Chaser" treatment on infected oaks has been initiated. The author will keep interested individuals apprised as new revelations are generated.

A Comprehensive Tier Tree Model:

With the invention and utilization of the author's Tier Tree Model for RGD in the mid-1980s, "The Model" has evolved into three major Oak Wilt remediation techniques: 1) Physical Root Graft Disruption (RGD), 2) Tree Injections with the fungicide Propiconazole, and 3) The Glyphosate/Stump Cup technique for chemical RGD. These three Tier Tree Model techniques can be used separately or in conjunction with one another, depending on the unique characteristics of every Oak Wilt site. In some Oak Wilt situations, the author has recommended all three techniques. As an example, at a site near Grand Rapids, Michigan, a Tier Tree Model RGD trench was installed and trees outside the trench line were injected with propiconazole for additional insurance (Photo 12). After the trench line was in place and healthy trees were protected with tree injections, I recommended that the Glyphosate/Stump Cup method be applied to the lone infected tree; this application would likely ensure that any root grafts that escaped RGD by trenching would be destroyed by the Glyphosate, providing yet another measure of assurance of the containment and eradication of Oak Wilt. There are other permutations of these three Tier Tree Model techniques that can be applied at other locations.



P10B



P11



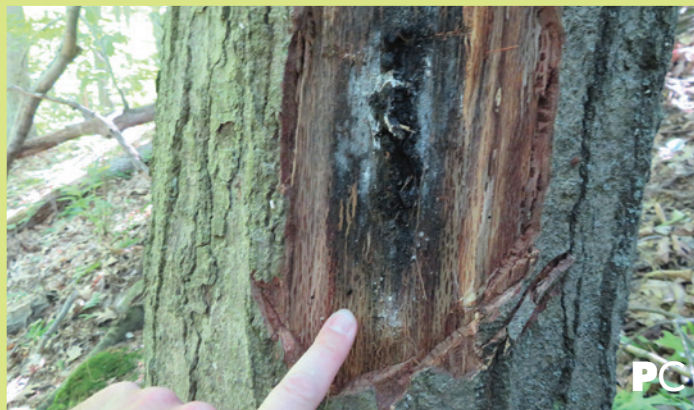
P12

Glyphosate/Stump Cup vs. Triclopyr/Double Girdle

I would be remiss if I did not acknowledge another herbicide technique used by some individuals and entities for the containment and eradication of Oak Wilt. Because I know of no formal name for this other technique, I will refer to it as the Triclopyr/Double Girdle technique. As the name implies, two girdling cuts spaced several inches apart are made perpendicular to the vertical tree trunk (Photo A). Triclopyr (Garlon) is sprayed into (onto) the two girdling cuts. The Double Girdle/Triclopyr technique is administered according to the Forest Management Model (FMM by Bruhn) in lieu of vibratory plowing or trenching. I recently had the opportunity to visit a site where the Triclopyr/Double Girdle technique was initiated four years previous (2016) to contain and eradicate an Oak Wilt infection. Note that after four years the vascular system had not been effectively girdled on this tree and that a vein of healing callus had formed over the girdling cuts (Photo A, arrow); in other words, the tree had recovered from the Triclopyr/Double Girdle technique. A full canopy of a tree that had recovered from the Triclopyr/Double Girdle technique is shown in Photo B. Double Girdle cuts, if performed properly, should kill a tree in, of, and by themselves. Apparently, even if the double girdle was not implemented properly to kill the tree, the herbicide application should have killed the tree, but application of the Triclopyr herbicide failed to kill the tree as well. A person who had worked on a contractual basis with a state department claimed that most of the Triclopyr flowed out of the flat girdling cuts and ran down the trunk of the tree and onto the ground. Photo C shows a tree on the edge of one of these Triclopyr/Double Girdle/FMM Oak Wilt remediation efforts that likely became infected from underground transmission of the fungus through root grafts *through* the Triclopyr/Double Girdle-treated trees. As discussed elsewhere in this article, I do not believe Triclopyr possesses the correct chemistry/mode of action to kill roots quickly; nor is

Triclopyr being applied in sufficient quantity to effect root death. Nevertheless, some individuals and entities swear by the Triclopyr/Double Girdle technique.

Again, I have never witnessed the recovery of an Oak tree when treated with the Glyphosate/Stump Cup technique according to the protocol in this publication. Nor have I ever witnessed a failure to contain and eradicate Oak Wilt with the Glyphosate/Stump Cup method.



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