The Plant Doctor's LANDSCAPE TIPS

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OAK WILT MANAGEMENT BY TIER TREE PART 1: ROOT GRAFT DISRUPTION

INTRODUCTION

Oak Wilt, caused by *Bretziella fagacearum*, is a lethal disease of oak trees (Quercus sp.). Members of the red oak family (northern red oak, scarlet oak, black oak, pin oak, etc.) tend to be highly susceptible and die rather quickly (Photo 1) while members of the white oak family (white oak, English oak, Chestnut oak, swamp white oak, etc.) tend to be more tolerant of the disease. As an exception, Burr oak, a member of the white oak family, can be seriously affected by Oak Wilt and may be the most susceptible of the white oak group.

The Oak Wilt fungus spreads by two major methods: 1) "Overland", by sap beetles and possibly other insects usually to fresh wounds on oak trees, and 2) "Underground", through root graft connections between nearby oak trees, most commonly of the same species. Once detected, Oak Wilt is extremely difficult and costly to manage. There seems to be confusion among the arborists/landscapers and the public who desire to try to contain and eradicate the disease from infested properties. Much of that confusion apparently originates from the people giving a wide variety of conflicting and confusing advice.

Over the last few years, the coverage devoted to and importance of Oak Wilt has skyrocketed, thanks largely to higher involvement of various green industry organizations and State of Michigan Departments, such as the Michigan Department of Natural Resources, which have devoted more resources towards publicity, detection, advice on management, etc. Many new individuals have been hired and/or have shown interest in becoming Oak Wilt "experts." Regrettably, sometimes with little experience, many individuals have promoted their understanding of Oak Wilt management and these understandings may not be the best information for Oak Wilt management at various oak wilt sites. The management of Oak Wilt in forest situations differs greatly from management of the disease in urban/suburban settings.

Photo 1: This Oak Wilt outbreak on a golf course in northern Michigan was due to power line (right-of-way) clearance pruning in November several years ago and is proving difficult and expensive to contain and eradicate.

WHAT IS THE TIER TREE MODEL?

Some of the confusion cited above especially involves Root Graft Disruption (RGD), also known as vibratory plowing or trenching by many individuals in our industry. The confusion arises from many "experts" promoting the Forest Management Model (FMM), developed by Dr. Johann Bruhn at Michigan Tech around 1992-93. To many, this is the only RGD model available and has been promoted in natural forests and urban forests alike (Sketches #1 & #2), often to the great detriment of property owners. The FMM was developed strictly for forest situations or areas with trees of relatively low value (Figure 1). It was meant to be the most

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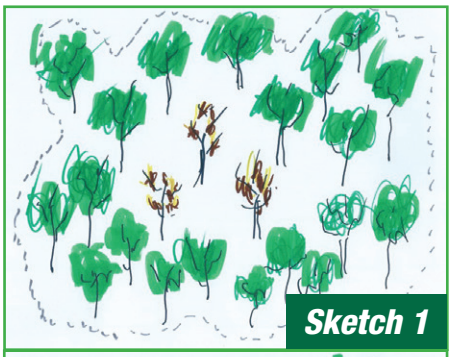
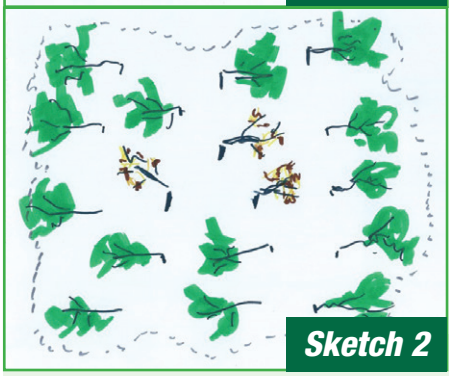
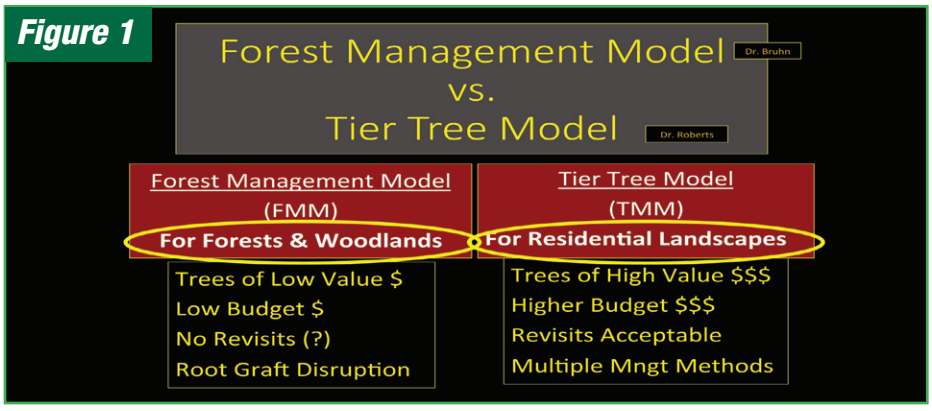




Sketches 1 & 2: The Forest Management Model was developed as a highly effective and economical Root Graft Disruption Model strictly for forest situations and trees of relatively low value. A trench line (dotted-Sketch 1) is installed according to a table that considers trunk diameters (dbh) of diseased and healthy trees. Subsequently, all trees within the trench line are sacrificed (Sketch 2). Stumps are usually treated with an herbicide.



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economical treatment for Oak Wilt sites in natural forest situations where many trees, especially healthy trees are also sacrificed to attain the goals of Oak Wilt containment and eradication with a high degree of confidence.

In 1984, I became Director of MSU's Plant & Pest Diagnostic Clinic (Photo 2). In addition to diagnosing and providing management advice for every potential problem with any plant in Michigan (Nursery, Christmas Trees, Potatoes, Wheat, Fruit Crops, Homeowners' house plants . . . you get the picture), I also had to diagnose and provide "expert" advice on Oak Wilt, a totally new disease to me, that hadn't been taught in any of my Plant Pathology courses. Having worked with and having become very familiar with Dutch Elm Disease (DED), I simply adapted the management techniques of DED to Oak Wilt because both diseases had some similarities: overland spread by insects, root graft transmission, vascular wilts by fungal incitants, etc. The management technique for RGD used in DED generally involved trenching between trees in a "tier" pattern (Photo 3). At that time and through many of the ensuing years, I simply referred to this technique as the DED Model or DED Trenching Model; it was later to become the (Dr. Dave's) Tier Tree Model (TTM). I arrived at the TTM quite independently from other scientists' research and have utilized

Photo 2: In 1984, I (the author) became Director of MSU's Plant and Pest Diagnostic Clinic. I had to become a quick study in the diagnosis of Oak Wilt and its management, years before the Forest Management Model was developed.

it very successfully for 35+ years. I have never utilized the FMM largely because of its destructiveness, which involved sacrificing many healthy, non-infected trees. As far as I know, I am the only person in

Photo 3: This old 35mm slide from the American Phytopathological Society was used to teach Dutch Elm Disease management by trenching between trees in a "tier" pattern. I simply adapted this technique to Oak Wilt Management. It later became known as the Tier Tree Model.

Photo 4: The Oak Wilt fungus typically moves one tier of trees per year. There are occasional exceptions. In this photo, Oak Wilt began at the left on some distant tree and over several years marched down this line of trees towards the right of the picture. For some reason, the disease skipped the "healthy" tree visible on the right lower side of the photo . . . at least for now. (Please ignore the leafless Poplars in the background, due to fall senescence.)

Michigan (until recently) who has promoted the Tier Tree Model, especially for private properties, urban environments and other locations (i.e. parks, nature preserves, etc.) where trees can be far more valuable than in forest situations. (Figure 1, previous page). The Tier Tree Model is based upon the long-standing observation that the Oak Wilt fungus (like the DED fungus) moves fairly slowly "underground" (compared to overland spread of "miles") through root grafts in the trees' root systems . . . approximately one tier of trees per year (Sketch 3). This one-tier movement by the Oak Wilt fungus in the tree's root system occasionally encounters a kerfuffle (Photo 4).

Scientific evidence suggests that the Oak Wilt fungus may move through a trees' root system, through root grafts between trees, approximately 18 feet or so per year in heavy clay soils and as much as 40 feet or so per year in light sandy soils. Even though these measurements may serve as guidelines, they do not necessarily hold true (Photo 5).

When I provide advice on Oak Wilt Management, I employ the Tier Tree Model (TTM). However, for me, the TTM has evolved into something far more comprehensive than RGD (trenching).

Photo 5: Even though we may suggest that the OW fungus moves underground one tier of trees per year, the fungus didn't move 6 feet in two years from the pruned and infected trees (appearing without foliage and dead) to the single unpruned tree on the left. We have noted that the disease tends to move more quickly when diseased trees are moved before remediation efforts are implemented.

Photos 6A, 6B & 6C: Various implements can be used in root graft disruption: vibratory plow, backhoe (6A), mini-excavator (6B) and chain-style trencher (6C). Just make sure to achieve the proper depth of at least 5-6 feet depending on soil type.

In my research and experience, the Tier Tree Model involves the following three possible methods to contain and eradicate Oak Wilt, the ultimate objective of Oak Wilt Management:

1. **Root Graft Disruption:** Severing potential root grafts between nearby trees can stop underground transmission of the OW fungus. In my opinion, trenches or vibratory plows need to sever roots to a depth of at least 5 feet in clay to loam soils and at least 6 feet in sandy to sandy loam soils. If using equipment other than a vibratory plow, such as digging trenches with a backhoe (Photo 6A), mini-excavator (Photo 6B), or chain-style trencher (Photo 6C), the soil can be back-filled immediately.

2. **Tree Injections:** Healthy trees adjacent to OW-diseased trees can be protected from root graft infection by injections of propiconazole (fungicide) at high rates. Injection procedures may vary from micro to macro injections using a variety of implements. I strongly recommend the high rate of 20ml per inch dbh (diameter at breast height) for protection of members of the red oak family from root graft transmission. Although 10ml of propiconazole is on the label for most injection systems, I have witnessed failure with this lower rate across all systems. Injections need to be repeated every other year for at least a total of 6-8 years (3 or 4 total treatments). Red oaks exhibiting symptoms of OW generally cannot be saved, however, some arborists and I are getting some positive results with even higher rates of propiconazole on infected red oaks.

3. **Stump Cup/Glyphosate:** In the last 8-10 years, I have been experimenting with a technique using concentrated glyphosate applied to a "stump cup". This is by far the most cost-effective method of Oak Wilt remediation but may cause significant collateral damage to other oak trees within root graft range. Extreme care must be taken if considering this technique, which I'll discuss in an upcoming article.

These three methods associated with the Oak Wilt remediation can be used singly or in combination with one another depending on the specific requirements of the site. These three techniques will be the subject of several articles, with RGD being the primary subject of the present one.

PRACTICAL EXAMPLES OF ROOT GRAFT DISRUPTION WITH THE TIER TREE MODEL

The Tier Tree Model (TTM) is implemented in Tiers (Sketches 3 & 4). There are several important nuances that need to be determined when implementing the TTM . . . or example, age of the Oak Wilt site. If for example, the OW was detected *this year*, a trench between the diseased and healthy trees *this year* will usually suffice and be effective. For added insurance, a secondary trench can be placed in the next tier, between healthy tiers of trees. If the site is several years old, then, the trench lines may need to be adjusted outward farther from the original infection and adjusted to the trees showing the most recent symptoms of Oak Wilt . . . and perhaps more tiers of trenches need to be added for additional confidence. I'll provide three successful examples of the TTM as follows.

Example 1: I was called into this site near Brighton rather late in the year a number of years ago. Two red oaks (yellow arrows) had been pruned in the spring and died in the summer (Photo 7). I proposed two trenches be installed according to

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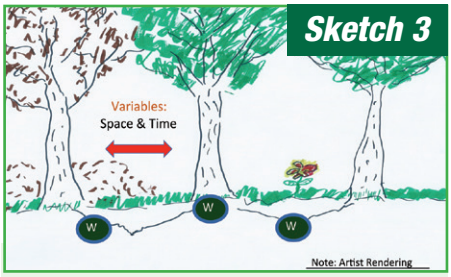

Sketch 3: This schematic shows the movement of the Oak Wilt fungus (Circle W) underground by such variables as space and time. In reality, the fungus tends to move one tier of trees per year.

Sketch 4: In an urban setting (compare to forest situation Sketch #1 & 2), properties are often very close together. According to the Tier Tree Model, trench lines are installed in tiers - the primary between diseased and healthy and secondary between healthy trees (dotted lines) using the foundations of homes as "natural barriers" to root graft transmission. If desired, depending on age of the site, tertiary or more trench lines can be installed for greater insurance.

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the white lines in Photo 7. Although the distances between the diseased trees and the next tier of healthy trees was significant, more in line with the FMM, I still consider this to be the TTM, the next tier of trees. Trenches (alone, with no other remediation technique) were installed in December and were a complete success. What was interesting at the site was the variability of root depth. In one trench, most the roots were within the top two feet of the soil. In the other trench, many roots were measured to be around 5 feet deep (Photo 8 and Inset).

Photo 7: At this site, the trees with yellow arrows had been pruned in the spring and died in the summer. I wasn't contacted until late in the year. Because the disease had infected the two trees by overland spread and because remediation was within the same year, I suggested two trench lines (white) be installed: one trench extending from the foundation of the house (using the foundation as a root barrier) into a wetland to the right and the second trench installed along the drive (left). Even though the distance between the diseased trees and the next tier of healthy trees was significant, perhaps more closely in line with the FMM, I still refer to this as the Tier Tree Model.

Photo 8 & Inset: A backhoe was used to trench the site in Photo 7. In this photo of the trench along the drive, some of the roots of trees were within the top couple feet of soil. However, many of the roots were found to be around 4-5 feet deep (Inset).

Example 2: At this site near Grand Rapids, MI, which is typical of many locations around Michigan, most oak trees in the landscape were pruned (Sketch 5 and Photo 9A), and most of the trees started to die immediately. An anomaly did occur here, however; the two trees in the center of the yard were also pruned but somehow escaped infection (Photo 9A)! Because the two "escape" (apparently healthy) trees were not showing symptoms at the time of the remediation efforts the following fall and because they were too close to the diseased trees for trenching/RGD, the arborist and I agreed those two trees should be injected with the high rate of propiconazole fungicide (trunk injections were performed every two years). Additional remediation efforts using the Tier Tree Model included placing one trench line along the property boundary on either side of the property. Because diseased trees were directly adjacent to the property lines and neighbor's healthy trees in both directions, implementation of the Forest Management Model would have necessitated the destruction of many neighbors' trees on their properties; the Tier Tree Model didn't require the removal of any healthy trees to prevent Oak Wilt transmission! Photo 9B was taken about 5 years after the Oak Wilt infection by overland pruning and shows a completely stabilized site with no further evidence of Oak Wilt.

Sketch 5: In urban environments, usually one property owner has his/her trees in the landscape pruned; if Oak Wilt develops, it directly threatens the neighbors' trees on either side. See Photo 9A for the dose of reality.

Photo 9A: The oaks on this property near Grand Rapids were pruned in the spring and exhibited decline towards death within weeks. Uncommon with most Oak Wilt sites is that two trees (center) apparently escaped infection despite being pruned. Even though diseased trees were within feet of property lines, single trenches were placed near the property line on both sides of the property, according to the Tier Tree Model. Because diseased trees were so close to the two escaped "healthy trees" (center), no trench lines were installed between them; rather these two escaped healthy trees have been injected every two years.

Photo 9B: The same site as in Photo 9A five years after the trees on the property were affected by Oak Wilt. The site has been successfully remediated using two techniques with the Tier Tree Model design: Root Graft Disruption (Trenching) and Tree Injections. Note that property is now "For Sale."

Photo 10: At this site near Onekama, MI, the Tier Tree Model using Root Graft Disruption is shown to great advantage in this photo - note two trenches in "tiers" of trees. The primary line (left) separates the diseased trees (left, out of view of photo) from the next tier of symptomless trees (left, in view of photo). The secondary line (right) was placed between two tiers of healthy (symptomless) trees.

Example 3: In this example near Onekama, MI, the Tier Tree Model was used using two trench lines, a primary and secondary (Photo 10). The primary line (my terminology) was placed between the Oak Wilt-diseased trees and adjacent healthy tier of trees. For added insurance, partly because remediation efforts began several years after initial Oak Wilt infections, a secondary trench was placed between the next tier of healthy trees. As a further measure, the property owner wanted to bid good riddance to Oak Wilt and increase the odds of salvation of as many trees as possible, so tree injections were performed. Remediation of Oak Wilt at this site has been very successful.

A major challenge of the Tier Tree Model for Root Graft Disruption (RGD), especially in urban situations, is the presence of utilities (Photos 11A & 11B). Trenching in the vicinity of utilities may prove difficult; however, resorting to high speed compressed air (examples: Air Spade & Air Knife) in the vicinity of utilities may be helpful, to avoid damaging the utilities. When trenching in highly maintained landscapes, irrigation systems will always be damaged and need repair. In some situations, it may be best to utilize tree injections in lieu of RDG.

TIER TREE MODEL FAILURES

If the Tier Tree Model fails, it is generally due to failure in its proper implementation. At this site near Houghton Lake, the property owners lost many trees to Oak Wilt due to an arborist's "deadwooding" (Photo 12). Not to be totally discouraged the property owner made lemonade out of lemons by having this large tree

Photo 11A: One of the major challenges in Oak Wilt Management by Root Graft Disruption in urban areas is utilities. The single tree near the front door of this house near Grand Rapids was pruned by the property owner for better mower clearance - it contracted Oak Wilt. Initial design of trench lines (yellow) seemed reasonable to protect oak trees in either direction (right or left), with long lines to prevent "end runs" around the trenches. Once utilities were revealed (blue lines), trenching would have been very difficult. Back to the drawing board.

Photo 11B: If the Tier Tree Model is to hold true, the simple trench line from the foundation of the house (left) around the tree to the foundation of the house (right) should work. Performed the same year as infection (2019), we will monitor the site for several years to come to ensure the TTM is performing satisfactorily.

carved (Photo 12 Inset). Regrettably, over the ensuing years, the OW continued to advance after trenches were installed, even into the neighbor's property. Even though I provided advice on this site near Houghton Lake, I was not present for the actual trenching effort. Several years later, with continuing advancement of OW, I asked the property owner if she had taken pictures the day of the trenching (several years previously). She produced Photo 13, demonstrating my suspicions that the trencher didn't sever roots nearly deep enough. L

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Photo 12: Oak Wilt infected many trees at this site near Houghton Lake, Michigan after an "arborist" who insisted he knew what he was doing "dead-wooded" Gail's trees. Every dead-wooded tree became infected with the Oak Wilt fungus by overland transmission. The most valuable oak affected by Oak Wilt is this very large tree in the center of the picture. Incidentally, the "arborist" disappeared and could not be located.

Photo 12 Inset: Despite being very saddened by the loss of so many trees, Gail and her husband made the most out their loss, making lemonade out of lemons, so to speak. They had the large tree in 11A carved into a beautiful American Bald Eagle.

Photo 13: The Tier Tree Model was advised by me at this site, utilizing both Root Graft Disruption and Tree Injections, but I could not be present for their implementation. Several years later, as the Oak Wilt continued to spread on the property . . . and eventually into trees on neighboring properties, I was perplexed at the TTM failure. I asked Gail if she had any photos of the trenching performed several years back. She produced this photo proving that the trench depth was not nearly deep enough to prevent Oak Wilt transmission through root grafts.