Protection from

Dutch Elm Disease

with MACRO-INFUSION™

- **Macro-Infusion™ with Arbotect® 20-S for Dutch Elm Disease preventiion is 99.5% effective for 3 seasons.**
- **Recommended by most major university's such as the University of Minnesota, University of Michigan, Kansas State University, University of Wisconsin and other major universities.**
- **Backed by 20 years of field use and research**
- **Used by leading arborist companies such as Davey Tree, Bartlett Tree Experts and The Care of Trees.**

Arbotect® 20-S
is a systemic fungicide used in the treatment of Dutch Elm Disease and Sycamore Anthracnose by trained arborists and others trained in Macro-Infusion™ techniques.

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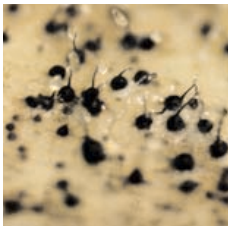
Dutch Elm Disease

Technical Description

What is Dutch Elm Disease?

Dutch Elm Disease is a fungus called *Ophiostoma Novo-ulmi*. This fungus grows only in elms. Most species of elms are susceptible including, American, Slippery (red), English, European, and Winged. Less susceptible species include Siberian, Chinese, and Cedar elms. The disease is spread from infected trees to healthy trees most commonly on the elm bark beetle *Scolytus multistriatus*. It can also pass from one tree to another through root grafts, a situation where a tree's roots fuse underground with another tree of the same species.

Tracing can save elms if done in the initial stages of disease.



The fungus *Ophiostoma Novo-ulmi* causes Dutch Elm disease. It is in the same fungus family as bread mold

Photo courtesy of University of Minnesota

Fungal Growth Inside The Elm

The fungus that causes Dutch Elm Disease is not a blight or a wood decaying organism. Instead it lives inside the xylem of a susceptible elm. Understanding the fungus growth pattern is important to knowing if a infected elm can be saved and understanding the process of tracing, a method where an arborist creates a physical separation of the fungus from the elm.

Beetle infections generally start in the 2 - 4 year old twigs. This is where the beetle feeds and mates. The fungus rubs off the beetle and begins to grow in the tree. The fungus grows in a very predictable pattern. Usually it stays narrow in width and grows down the branch. It will enter the stem of the tree and grow in this narrow line to the roots. Once the fungus enters the root flares, the fungus will grow sideways and back up the tree in many places. Tracing can save elms if the initial infection is caught before entering the roots.

A characteristic stain on the xylem of an elm infected with Dutch Elm Disease is caused by the tree producing gum like substances called tyloses in an attempt to stop the spread of the disease. These tyloses actually are what cause the tree to wilt and die as they block the xylem and prevent water transport to the top of the tree. So in effect the fungus stimulates the elm to kill itself.

Macro-Infusion of Arbotect® protects healthy Elms for 3 growing seasons and is 99.5% effective.

Dutch Elm Disease

Technical Description

The Beetle That Spreads Dutch Elm Disease

An elm bark beetle's life revolves around elm trees. It breeds in dead and dying elms, and depends exclusively on elm tissue for food, this creates a devastating cycle for elms, when the Dutch elm disease fungus *Ophiostoma nova ulmi* becomes part of the cycle. Thousands of eggs can be laid by the adult females in one piece of wood the size of a fireplace log. If the tree died from Dutch Elm Disease every beetle that hatches and emerges as an adult from that wood may be carrying the fungus. They will be looking for a healthy elm on which to feed and will inadvertently inoculate the tree with Dutch Elm Disease via the spores carried on their bodies. The majority of new infections, and the bulk of the losses to Dutch Elm Disease, are due to this method of transmission. That is why prompt detection, removal, and destruction of dying elms is so critically important.

This wound on this small 4 year old twig was caused by a beetle that introduced Dutch Elm disease to this tree.

Photo courtesy of University of Minnesota

The Beetle *Scolytus multistriatus* spreads the disease from infected to healthy Elms.

Root grafts can also spread the disease from sick to neighboring healthy elms

Photo courtesy of University of Minnesota

Root Graft Spread of Dutch Elm Disease

The other method of disease transmission between elms is through grafted roots. When elms are growing near each other their roots come in contact in the soil and graft together. In the absence of a vascular wilt disease, such as Dutch Elm Disease, this is an advantage for the trees. The Dutch elm disease fungus however can pass from diseased to healthy trees through these grafted roots and continue to spread indefinitely through a stand of elms.

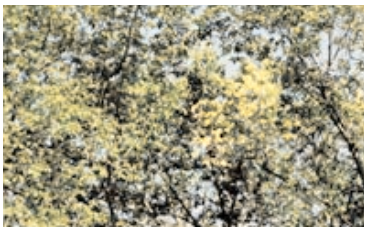
Dutch Elm Disease

Symptoms & Diagnosis

Symptoms

The first evidence of Dutch Elm Disease is wilting or "flagging" in one or more of the branches, usually starting in the outer portion of the crown. Leaves on the infected branches turn dull green to yellow and curl, finally becoming dry, brittle, and brown. The symptoms progress down the limb and eventually throughout the entire tree. Trees infected through root grafts can die very rapidly, while trees infected via the feeding of bark beetles can take 1 - 3 years to die. Another symptom of the disease is the discoloration of the water conducting vessels. This is easily seen by peeling the bark off infected wood, revealing the brownish staining.

Foliar symptoms of Dutch Elm Disease



Diagnosis

Understanding the Dutch elm fungus and how it grows makes diagnosing this disease easier. A few key distinctions will help in accurately making sure that you are in fact dealing with this dreaded disease.

1. Leaves on infected trees are almost always curled or wilted looking. They often drop off. Leaves that are flat and shiny are common in the late summer and are usually caused by branch senescence.

2. The disease symptoms progress as the fungus grows in the tree. Thus, there is a pattern of leaf death outside the tree that reflects the fungus growth inside the tree. Remember that the initial infection grows downward in a narrow band until it has reached the roots. It then spreads sideways and grows back up the rest of the tree. See the Technical Description of Dutch elm disease for more information.

3. Check under the bark close to where there are external leaf symptoms. Dutch Elm Disease always causes the water conducting vessels to turn a dark brown. Finding this discoloration along with wilting leaves is a very good indicator that Dutch elm disease is present. Use a chisel and a hammer to open a hole in the bark to check for the discoloration

4. Trees in the spring can die rapidly – causing the appearance that the disease is moving very quickly. What is happening in reality is the fungus was in the tree from last summer, the tree grew new tissue over the top of the infected wood, and then the fungus colonized the newly formed wood causing rapid dieback. Infections that happen in the current year can be seen reflected in leaf dieback as the fungus grows.

5. If you are unsure if your elm has Dutch Elm Disease– you can take samples and send them to a lab for confirmation. See sending samples to a lab for diagnosis.

Another symptom is discolored brown to black wood under the bark. Healthy elm wood is white.

The fungus grows downward to the roots. After reaching the root area, it spreads sideways and moves back up the tree.

Dutch Elm Disease

Managing the Disease

Dutch Elm Disease is difficult to control and without management it will wipe out a large population of elms in just a few years. However, with a properly implemented program, the devastating effects of the disease can be greatly reduced. An effective program includes four parts: prompt detection and removal of diseased elms, disruption of root graft transmission, saving diseased elms with tracing, and protection of valuable elms through proper Macro-infusion procedures.

Before - A beautiful property before Dutch elm disease

After - The same property after the devastation of Dutch elm disease.

Photo courtesy of City of Evanston

Scouting is the first step of any Dutch elm control program

Scouting for Dutch Elm Disease (DED)

Scouting for Dutch Elm Disease and identifying diseased elms is the first step of any DED program. Scouting also involves checking people's yards and garages for elm wood. Scouts will usually move through an area every 2-4 weeks during the growing season to make sure dying trees are identified and properly dealt with.

Removing Diseased Elms

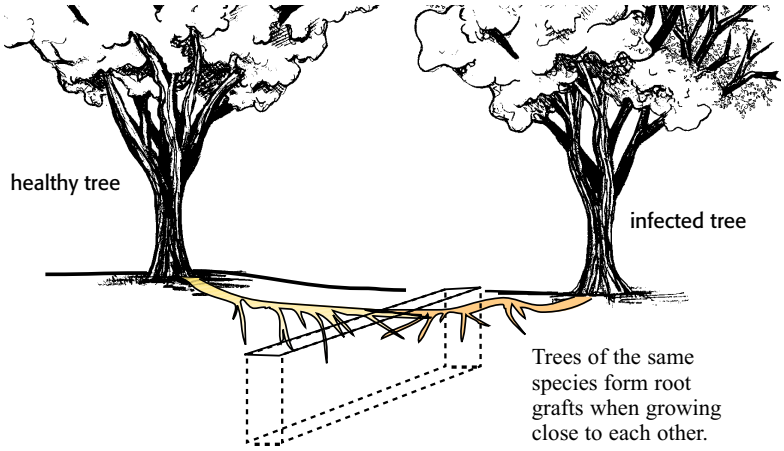
Promptly removing and disposing of elms dying from Dutch Elm Disease is the key to effectively managing Dutch Elm Disease on a community wide basis. It involves identifying diseased elms that cannot be saved by tracing and immediate removal of these trees. This will reduce the number of disease carrying beetles. A single dead elm can produce tens of thousands of contaminated beetles. Without such a program, a substantial majority of a community's elm population will die within a few years. Removed elms need to either have their bark removed, or be chipped, burned, or buried. Storage of diseased elm wood must not be anywhere near valuable elm populations.

Dutch Elm Disease

Managing the Disease

Root Graft Disruption

Severing grafted root systems between diseased and healthy elms can save many trees. This is most reliably accomplished mechanically with either a trencher or vibratory plow. In areas where there are utilities an air spade can be used to open a trench so that root grafts can be cut without damaging the utility lines. Remove the diseased elm only after common roots have been disrupted. Accordingly, prompt disease detection as well as installing root graft barrier trenches is very important to the overall success of an integrated control program. See section on root graft disruption.



Trees of the same species form root grafts when growing close to each other.

Saving Infected Elms with Tracing

Tracing is a method of saving recently infected elms. It is far more cost effective than removing and replacing an elm. By utilizing this procedure, a city can save many thousands of dollars. Since the fungus that causes Dutch Elm Diseas grows very predictably in a narrow band downward and only in the current years water conducting vessels – this methodology is easy to learn and incorporate. See section on saving diseased elms with tracing.

Photo courtesy of University of Minnesota

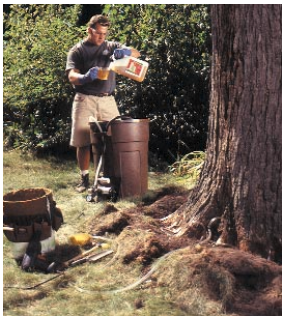
Root grafts must be physically severed to prevent spread of Dutch elm from tree to tree through the roots.

Before - This tree was traced and saved

After - This is the same tree 6 years later. Alive and doing well.

Protecting Valuable Individual Trees

There have been 100's of proposed "cures" or protection products for Dutch Elm Disease over the years, but only one treatment has been proven to work through replicated University trials - macro-Infusion with Arbotect 20-S. Arbotect gives greater than 99% success over 3 years when applied properly. Arbotect does not work if the tree already is infected with Dutch elm disease or the disease fungus enters the tree through root grafts.



Macro-infusion of Arbotect protects elms for 3 growing seasons from Dutch Elm Disease and is 99.5% effective.

Dutch Elm Disease

Root Grafts

When elms are growing near each other their roots come in contact with one another in the soil and graft together. In the absence of Dutch Elm Disease this is an advantage for the trees. The Dutch Elm Disease fungus, however, can pass from diseased to healthy trees through these grafted roots and continue to spread indefinitely through a stand of elms.

An airspade can be used to remove soil and expose root grafts in situations where utilities are present.

Physical Breaking of Roots

The only way to stop the spread of Dutch elm disease through root grafts is by physically breaking the root connections between the infected tree and the healthy tree.

This is most often accomplished with trenchers or vibratory plows. In situations where there are buried utilities, an Air Spade™ or AirKnife™ can be used to remove the soil and expose the root grafts without damaging the utility lines. Trenches should be at least 3' deep in clay soils and 5' in sandy soils, although it is always best to go as deep as your equipment allows. .

Elms that grow close to each other (Canopies touching) are often root grafted.

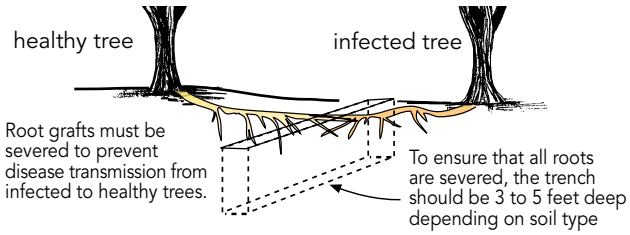
Install Trenches Midway Between Infected and Healthy Tree

Trenches are typically installed midway between the infected tree and the healthy tree, although this can be adjusted in either direction depending on how far the infection has spread.

It is important to know where the fungus is located in the diseased tree before the trench is installed. If the disease stain is already at ground level in the infected tree it is impossible to determine how far it has traveled through the root system toward the healthy tree, so a second trench may be necessary. This trench would isolate the healthy appearing tree from any others that might be root grafted to it.

Sever the Root Grafts Before Removing the Infected Tree

It is important to sever the root grafts before removing the diseased tree. Because each tree is transpiring, removal of the diseased tree must allow the healthy tree to pull all of the moisture and fungal inoculum out of the other tree's root system quickly.



Root grafts must be physically broken to prevent Dutch Elm Disease from growing into a healthy elm from a diseased elm.

Dutch Elm Disease

Macro-Infusion™ General Information

Arbotect Lasts 3 growing seasons

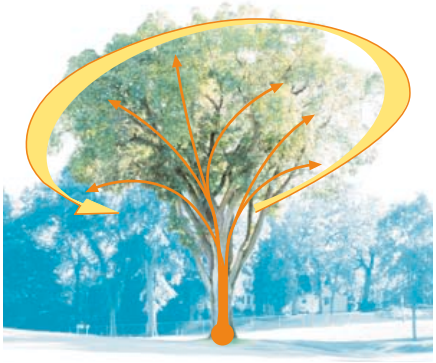
Arbotect is a systemic fungicide that is highly resistant to degradation and moves into new sapwood in sufficient quantity to protect trees for 3 growing seasons.

Rainbow Treecare has had a 99.5% success rate on a group of about 6000 trees under protection over a 3 year period.

The Purpose Is Complete Distribution

The purpose of preventive macro-infusion with Arbotect is to provide even and complete distribution of the fungicide throughout the 2-4 year old twigs where the beetles feed.

Macro-infusion of Arbotect protects Elms for 3 growing seasons from Dutch Elm Disease.



The purpose of macro infusion is to evenly and completely cover the entire internal crown of the tree with enough Arbotect to keep the disease out.

How Long It Takes

The average uptake for 20-60 gallons of fungicide solution is 30-60 minutes if the protocol is followed closely. Trees should be treated after the leaves have fully enlarged or after the seeds have dropped, and the treatments can be administered until there is fall color present in the canopy.

Arbotect Limitations

Diseased elms should NOT be treated with Arbotect. Rainbow's experience is that Arbotect will mask the symptoms of the disease for 1-3 seasons before the tree dies. If your elm is already infected with Dutch elm disease, tracing may be a method that can be used to save the tree. Arbotect does not prevent infections that grow through root grafts, so in situations where this is a concern, install a trench and wait until the following season to make sure the tree is healthy before protecting with Arbotect. As a preventive treatment this process gives highly predictable results.

Do not infuse symptomatic elms or elms that will become infected through root grafts.The process will not be effective.

Macro-Infusion can be done after the leaves are fully formed on the tree and until the tree begins to show fall coloration.

Treatment must be done into the root flares to get even coverage. Do not infuse into the trunk – this will result in poor distribution.

Dutch Elm Disease

Performing Macro-Infusion™

The Purpose Of Macro-Infusion

The purpose of Macro-Infusion is the complete and even coverage of the 2 - 4 year old branches so that if a beetle comes to feed, the disease cannot enter the tree. Infusing into the root flares is critical to the success of even and complete distribution. The tissue in the root flares allows for lateral movement of the chemical as it is infused. Trunk tissue on the other hand is hard and rigid. It is highly compartmentalized. Infusion into trunk tissue will provide very limited lateral movement of the Arbotect solution and will result in small portions of the crown receiving a large dose of Arbotect with other areas receiving nothing.

Equipment need to perform Macro-Infusion on elms.

The Process

Step 1 - Inspect the tree

- Make sure the elm you are treating is not diseased. Fully scan the crown to make sure there are no symptoms. If the tree is diseased - DO NOT TREAT. Use the tracing process to isolate any disease that might be present.
- Measure the tree and determine your dosage. Elms require 12 oz of Arbotect per 5" DBH. (Diameter breast height). Each ounce of Arbotect is diluted in 2 gallon of water. You can find a copy of the DOSAGE TABLE by clicking on the link.
- Large trees could require increased amounts of chemical to achieve complete distribution. Small elms, or trees with portions of the crown missing may require a reduced dose. See Dosing Considerations for more information.
- Determine how much root flare excavation is needed.
- Look for root rot or significant decay in the root collar area - if present do not treat.

Every aspect of macro infusion is designed to get even and complete crown coverage of the Arbotect solution.

Elms infected with Dutch elm disease should not be treated

Significant canopy die back or stress may compromise uptake time and distribution and be a sign of a serious problem slowly killing the tree

Step 2 - Excavate the root flares (if necessary)

- Use a shovel and trowel to remove sod and soil without damage to the tree
- Thoroughly brush soil from root flares with a hand broom
- Infusion sites should be 8-10 inches below the top of the root flare

Soil left on the root flare can dull the bit and plug the xylem.

If sod is carefully removed it can facilitate fast cleanup.

Remove all soil from root flares with a brush. Drilling into a dirty flare will dull your bit and push dirt into the hole – slowing down the uptake.

Infusing into the root flares is critical to achieve even and complete distribution of the Arbotect solution throughout the crown of the tree.

Dutch Elm Disease

Performing Macro-Infusion™

Step 3 - Drilling the holes

- Use a sharp, high helix drill bit (change every 5 trees)
- Drill perpendicular to the surface of the flare
- Drill one inch past the bark
- Drill at slow speeds and do not excessively spin the bit in the hole
- Use 1 to 1-1/2 infusion sites (in the root flare) per diameter inch (measured at breast height)
- Place at least one infusion site on each root flare

Do not place infusion sites into or below dead tissue
Do not drill into deep valleys or sunken areas
Begin filling the reservoir with water while drilling the holes

Drill a series of small one inch deep holes around the tree at the root flares.

Step 4 - Inserting the tees

- The current year xylem are the only vessels that will take up the solution. Make sure your tee is properly positioned to deliver the Arbotect there.
- Check each tee to be sure it is not plugged and replace any that are badly damaged
- Firmly insert tees by hand and very lightly tap each tee to set it
- Attach tubing from solution reservoir to feed into the harness in 2 locations. These 2 sites should be on opposite sides of tree

Plugged tees will prevent that portion of the xylem from receiving chemical
The only vascular tissue that conducts water is the current year's xylem

Use a sharp HIGH HELIX drill bit for fastest uptake. Replace drill bit every 5 trees.

Insert infusion tees and hook up tubing harness to pump.

Make sure the Macro - Infusion tee is delivering solution to the current year's xylem. This is the only water conducting tissue that will take up solution.

Step 5 - Starting the Infusion

- Pull out 2 tees on opposite sides of the tree
- Prime the pump (if it is not self-priming)
- Turn on the pump and bleed the air out of the line
- With all air out of harness, re-insert the 2 tees and check for leaks
- Adjust the pressure to15-20 psi
- Lightly tap any leaking tees

Increasing the pressure will not make the infusion go faster
If a tee persists in leaking, drill a new hole.
Use a very small hammer to tap leaking tees - this helps prevent driving them in too far

Dutch Elm Disease

Performing Macro-Infusion™

Step 6 - Mixing the Chemical

- Do not mix the chemical into the reservoir until the system is running and free of leaks
- Arbotect will form a white precipitate in water that is hard or has high pH.
- Mix a small amount of Arbotect and water in a clear measuring cup
  - If the solution stays clear add the appropriate dose to the reservoir
  - If a white precipitate forms and falls to the bottom of the cup, the water needs to be treated
  - Add muriatic acid to the reservoir at 1 oz. per 6 gallons of water
  - Add the Arbotect and watch for white precipitation
  - If no precipitate forms, continue with the infusion
  - If the precipitate forms again, continue to add muriatic acid at the rate listed above until the Arbotect stays in solution
  - Passing water through a deionizing tank also prevents Arbotect precipitation problems

Be careful about water source. Treat water with muriatic acid if pH is high. Avoid hard water or run through a deionizer.
Arbotect will precipitate out of solution in hard and high pH water

Muriatic acid is available at hardware or building supply stores.

For infusions that require a larger volume of solution than the reservoir holds, use 5 gallon buckets to measure the remaining dose and add to the reservoir.

White air bubbles may be seen floating in the reservoir if air gets into the lines. Do not confuse this with when Arbotect precipitate falls out of solution to the bottom of the reservoir.

Macro-Infusion uptake should take less than 1 hour – 90% of the time. Call Rainbow for technical support if uptake is consistently longer than this.

Step 7 - During the Infusion

- Monitor tees for leaks
- Maintain pressure at 15-20 psi
- Pack other equipment such as drill, unused chemical, etc.
- Prepare other trees on site for treatment

Step 8 - Cleanup

- Turn off pump when air is drawn into the harness
- Remove tees from the tree
- Replace soil and sod around base of tree

Do not plug the infusion holes with wax, wooden plugs, or any other substance

Rainbow Treecare uses 30 gallon trash cans for the solution reservoir and packs all equipment in these when the infusion is over

Macro infusion is 99.5% successful in protecting elms for 3 years when performed properly.

Dutch Elm Disease
Dosing Considerations

Dosing Considerations When Preforming Macro-Infusions

The purpose of macro-infusion is to provide enough chemical so that it is evenly distributed throughout the entire crown of the tree. If the dose is too high there may be a phytotoxic reaction, and if the dose is too low infections may occur.

Dosage is determined by measuring the diameter of the trunk at breast height (DBH). Trunk diameter alone, however, does not always reflect the proper dose because it may not reflect canopy development. Very few trees are open-grown in the urban setting. Their canopy development has been influenced by the proximity of buildings, other trees, power line clearance, etc. Our experience in treating trees over the past 20 years has taught us that proper dosing is an art as well as a science, and it is a key to predictable results.

How to Dose Trees

1. Use the label rate for trees between 22" – 28" DBH with average size crown and no major limbs missing. For smaller trees, reduce the dose by 3% for every inch below 20" DBH.
2. For trees with significant canopy losses, it is necessary to reduce the dose accordingly. For example, if 15% of the canopy was lost due to storm damage, reduce the dose by 15%.

Example #1 A 25" DBH elm with approximately 30% missing crown from pruning and storm damage: Step 1 - Label rate = 12 oz per 5" DBH = 25"/5" x 12oz = 60oz Step 2 - Estimate of missing crown = Subtract 30% **Total dose =** 60oz – 30% (18oz) = 42oz Arbotect	**Example #2** A 17" DBH elm with a full crown Step 1 - Label rate = 12oz per 5" DBH = 17"/5" x 12oz = 41oz Subtract 3% per inch under 20" = sub ~ 9% Step 2 - Estimate of missing crown = Minus ~ 0% **Total dose =** 41 oz - 9% (4 oz) = 37oz

3. Large trees (above 28" DBH) require a higher dose to achieve the best results. Increasing the dose above the label rate, however, is not legal and we do not recommend you break the law. Rainbow Treecare is conducting research to determine optimal doses for larger trees and will use these results to make appropriate label changes. The procedure we will test for large trees, consists of making reductions to the canopy, as described above, and increasing the dose by 3% for every inch of diameter above 28" DBH.

Symptoms of Overdose

Overdoses tend to occur on smaller trees, and the effects are temporary for the tree. When overdosed, leaves tend to turn a gray brown color and may curl or remain flat. Affected leaves may drop from the tree. Symptoms tend to develop in the lower canopy, and often on suckers of elm trees. Damaged trees may refoliate later in the season or bounce back the following spring.

Slippery elms *(Ulmus rubra)*

Reduce the dose to one-half of the label rate. A full dose may give phytotoxicity.

Macro-Infusion™

Advantage

Complete Crown Coverage with Macro-Infusion

Macro-Infusion is a large volume application of fungicide/water solution. Research shows that fungicides need a high volumes of a carrier to get complete distribution throughtout trees.

Fungicide

Macro-Infusion vs **Micro-Injection**

	Macro-Infusion	Micro-Injection
Chemical Carrier	Water	Alcohol/Xylene
Years Between Treatment	3 years	1 year
Tree Injury	Low	High
Volume of Material	20 - 40 gallons	1-2 ounces
Distribution in Tree	Complete	Minimal
Application Time	40 - 90 minutes	30 to 40 minutes
Injectio Wounding Size	15/64"	11/64" *

*Some micro-injectors use smaller holes

Proven Fungicides

Macro-Infusion™ of Arbotect and Alamo is the treatment method recommended by universities for Oak Wilt and Dutch Elm Disease.

This includes:
Texas A&M
Texas Forest Service
University of Minnesota
Michigan State

Complete Distribution Requires Root Flare Application

The science of infusing materials into trees has evolved. The purpose of any infusion is even and complete distribution of the material in the tree. This is difficult to accomplished with trunk injection. Trunk tissue is hard and compartmentalized preventing lateral chemical movement. Root flare injection allows lateral movement of material and complete crown coverage.

The Difference between Insecticides and Fungicides

There is a substantial difference in the mode of action between an insecticide and a fungicide. Insecticides work in small quantities and their mode of action is to kill the intended target, thus micro injection of insecticides can be effective. Many fungicides are really fungistatic in nature, this means they do not kill the fungus – but merely prevent it from growing. Once the fungistat chemical is gone – the fungus will continue to grow again. Fungistatic materials need to be administered in much higher volumes, this is why Macro-Infusion protocols are designed to deliver large quanities of fungistatic solution to get significant amounts of product into the crown of the tree.

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Dutch Elm Disease

Saving Diseased Trees- Tracing

Macro Infusion Does NOT work on Diseased Elms

Our company has never had success saving a symptomatic elm infected with Dutch elm disease using Macro-Infusion. What typically happens when a diseased tree is treated with Macro-Infusion is the symptoms of the disease become masked and the tree then dies in 2 -3 years. We have had tremendous success utilizing a process we developed called tracing.

The 4 Distinctions you Need To Know to Successfully Save Infected Elms

In recent years developments have accured which make saving infected elms a possibility. It is now possible to save elms that are infected into the trunk using a process that physically isolates the Dutch elm disease fungus. To understand this process you need to become familiar with 4 key distinctions.

Tracing can save elms diseased into the trunk.



Distinction 1 -

How the Fungus Grows

The Dutch Elm Disease fungus starts in the 2-4 year old twigs. It grows down the branch in a narrow band until it reaches the root system. Once in the root flares, the fungus can move laterally and spread rapidly throughout the tree. For Tracing to work, the fungus must not have entered the root flares.

This wound on this small 4 year old twig was caused by a beetle that introduced Dutch Elm Disease to this tree.

The fungus grows down the tree in a narrow band until it reaches the roots.

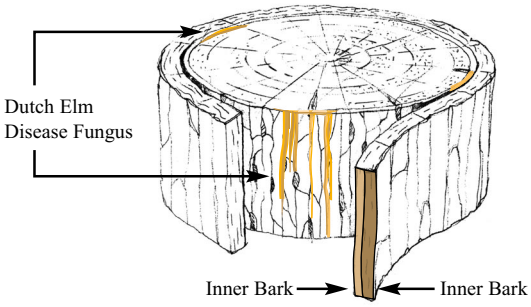
Dutch Elm Disease

Saving Diseased Trees- Tracing

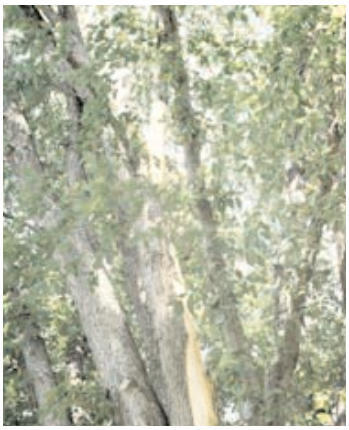
Distinction 2

The Fungus Growth Is Predictable

The Dutch Elm Disease fungus is highly compartmentalized by the tree and grows in a very limited fashion. It can only grow in the current year's water conducting tissue, and has very limited lateral movement because the cell walls in the trunk and branches are very rigid. Thus, the fungus can be easily isolated from the rest of the elm by making some narrow and shallow cuts.



The fungus only grows in the current year's xylem.

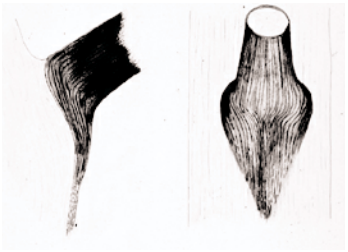


By making some narrow and shallow cuts, the fungus can be isolated.

Distinction 3

The Fungus Can Only Grow Straight Down From A Branch Into The Trunk

Branch vascular tissue is only connected at its base to the trunk vascular tissue. This knowledge adds more predictability for the arborist practitioner on where the fungus is growing and where to look to begin the tracing process.



The branch vascular tissue is only connected to trunk vascular tissue at its base.

Distinction 4

The Stain is Produced By The Tree – Not The Fungus

The stain found under the bark is actually produced by the tree in response to the fungus and serves as your guide for the tracing process. It takes time for the stain to form and thus is not exactly representative of how far the fungus has grown down the tree. As a general rule, the stain will be 5 feet or so behind the fungus, thus the Arborist practitioner needs to continue the tracing process an additional 10 feet past the stain to ensure the fungus has been isolated.

The stain under the bark is actually produced by the tree in response to the fungus. The fungus itself is growing ahead of the stain.

Tools Needed

The tools needed include a small chain saw, a hammer, and a large flat headed screw driver. As well as the equipment to get up in the tree safely.

The Process of Tracing (PDF)– A detailed description of how to save elms with tracing.