Recognizing and Treating Vascular Diseases - OAK WILT

Oak wilt is a disease that has long been recognized as causing massive tree losses in the Texas Hill Country. It has now been identified in 55 Texas counties. Losses vary with location, with the greatest losses occurring in the Hill country. A management program has been developed by the Research and Extension faculty at Texas A&M University. This program involves the use of cultural and chemical controls. Live oak, Shumard red oak, Southern red oak, Spanish oak, blackjack oak, pin oak and water oak are native oak species that are susceptible to the oak wilt fungus. They are members of the red oak group and will normally die in a few weeks to months after symptoms are observed. Members of the white oak group, including Bur oaks, white oaks and post oaks, rarely become infected. They have a high level of resistance and, when infected, seldom die.

OAK WILT MANAGEMENT STRATEGIES: IDENTIFICATION

Oak wilt is caused by a fungus that infects the vascular system of susceptible trees. It has killed trees in 55 Texas counties. Major losses have occurred in the Texas Hill Country. Shumard oak, Spanish oak, blackjack oak, water oak, pin oak and live oak trees are the most commonly infected trees. **Post oak, and other members of the white oak group, such as bur oaks, rarely are infected with the oak wilt fungus**, and when infected, damage is minor and death seldom occurs. Proper identification of the disease is the first step to developing a management program. Field identification based on symptoms is sometimes possible. Infected trees will develop several different foliage symptoms. It's important to recognize the difference. It is common to find as many as three different symptoms on a single live oak tree. In the case of Spanish, Shumard oaks and other red oaks, symptoms are less reliable in identifying an infected tree. Laboratory identification is recommended if the disease has not been identified from that area before.

Field Identification:

LIVE OAK

Four distinct leaf symptoms may indicate live oak trees infected with oak wilt. The only symptom that is a certain diagnosis for oak wilt is when the veins develop the reddish-brown color. Other symptoms can be caused by stress conditions, herbicides or other toxic materials.

Vein coloration is distinct. Between the veins, color varies from light green to a normal green. This symptom should not be confused with the autumn turning of leaves where the veins are sometimes brown but the line between the brown and the green is fuzzy. The vein coloration symptom is visible on leaves still on the tree. Once the leaf falls, the veins will remain dark brown while the area between the veins is light tan. Leaves will hold this color pattern for several weeks after falling to the ground.

The third symptom is when the leaf is a light yellow and the leaf margin is necrotic. This is less common than the first two symptoms. On a small percentage of diseased trees all of the leaves will turn a reddish brown. Affected trees develop this symptom quickly, usually in the early spring when the new leaves near maturity. Leaf shed (defoliation) is rapid for the first three symptoms. If all the leaves on the tree turn reddish brown, the leaves are retained on the tree for several weeks after death. Infected red oaks tend to hold their leaves. Live oaks have died within 30 days after symptoms were observed. In most cases, it will take from one to six months for a live oak tree to die of oak wilt. In areas where oak wilt is found (oak wilt centers), as many as 10 percent of infected live oak trees survive. The trees generally have reduced canopies, from 20 to 50 percent, remaining after infection. These trees do not die immediately but remain in this weakened condition for many years. They never fully recover. Once an oak wilt center is formed, the disease spreads outward until it is stopped by a natural or man-made barrier that breaks the root connections between susceptible trees. Native live oaks often have common root systems that promote a greater rate of spread than for other oak species. Live oaks, native or planted, also form root grafts with nearby trees. Also,

sap-feeding beetles can infect trees. This gives a random appearance to new infection centers.

RED OAKS (SHUMARD, SPANISH, BLACKJACK, WATER and PIN OAKS)

Leaf symptoms are less distinct for the red oak group. The first noticeable symptom is wilting leaves. They often have an oily or greasy appearance. Soon after wilting, leaf tips begin to turn reddish brown. This browning moves inward toward the midvein until the entire leaf is brown. Leaf symptoms commonly develop on one limb and then quickly spread to the entire tree. Leaves stay on the tree for several weeks after death. Diseased trees look similar to a healthy tree that develops fall color at the wrong time of year.

Red oaks have died in 10 days or less after symptoms are observed. But death usually occurs within 30 days after symptoms develop. Once infected with oak wilt, red oaks don't survive. Red oaks die more randomly than do live oak trees because spread must be by either root grafts or insect spreads. Red oaks are single trees and don't have common root systems like live oak trees. Sometimes isolated trees escape infection as the disease front advances. In some areas, red oaks have developed oak wilt symptoms but also quickly developed additional symptoms of Hypoxylon canker. Since Hypoxylon canker infects and kills weakened or stressed trees, it is thought that oak wilt weakens the tree and then Hypoxylon canker fungus moves in and kills the tree. Since oak wilt fungus is not a good competitor with other fungi, the Hypoxylon fungus is the only one found when a laboratory diagnosis is made.

FIELD IDENTIFICATION GUIDE

Table 1: Field Identification of Oak Wilt

WORLD OF GREEN, INC. The Shade Makers®	Live Oak	Red Oak Family
Leaf Pattern		
Veinal necrosis.	Yes	No
Veins remain green but area between veins is light green to yellow.	Yes	No
Tip of leaf turns brown (half leaf).	Yes	No
All leaves on tree turns reddish brown.[1]	Yes	Yes
Wilting and necrosis progress inward from tips.	No	Yes
Tree Defoliation		
Leaves retained on tree for a short period of time after tree death.	No	Yes
Tree Dies Within:[2]		
7 - 30 days	No	Yes
30 - 90 days	Yes	No
Spread Pattern		
Tree to tree	Yes	Not Always
Isolated trees	Yes	Yes

[1] In Live Oaks, this condition is often more observed in early spring, and only when all the leaves turn reddish brown. Leaves will stay on the tree for a short time after it dies.
[2] Trees will vary in rate of death.

Laboratory Evaluation:

To positively confirm oak wilt you must actually isolate the fungus from a tree. The fungus is difficult to handle because of its sensitivity to heat. Take the following steps to insure a reliable sample and isolation.

STEPS TO IDENTIFYING OAK WILT

- Sample from oak trees with unusual leaf symptoms.
- Cut several limbs from the affected part of the tree.
- Cut two to three sections from each limb which had disease symptoms. Each section should be 6 inches long and 1-1/2 to 3-1/2 inches in diameter.
- Immediately place all branch sections together in a plastic bag, seal it and label clearly. Place the bag in a cool container immediately following sample collection. Never expose the sections to direct sunlight once they are in the plastic bag. Oak wilt fungus is sensitive to heat and is killed if exposed to temperatures much above room temperature.
- Place leaves from the affected branch in a separate plastic bag.

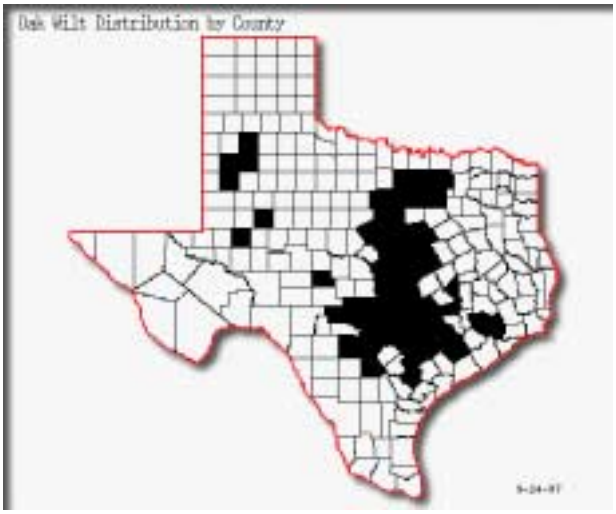
Send samples to the laboratory in an ice chest and by bus or other overnight service. When shipping samples, include a freezer block to keep the samples cold during shipment.

Another method is to take samples from the trunk. Remove 6x8 inch windows of rough outer bark of the trees with a disinfected hatchet. This exposes the white wood (sapwood) of the tree. Using a disinfected wood chisel, remove pieces of wood about 1/4 to 1/2 inch deep and several inches long. Place the pieces in a plastic bag and label clearly. As previously noted, keep samples cool until they arrive at the diagnostic lab. Don't get any rough outer bark into the bag. Repeat this sampling at two other locations around the tree. It is best to take one at chest height, move 1/3 of the distance around the trunk and then repeat at waist height and then move around to a spot equidistant between the two earlier samples and take the third at knee height.

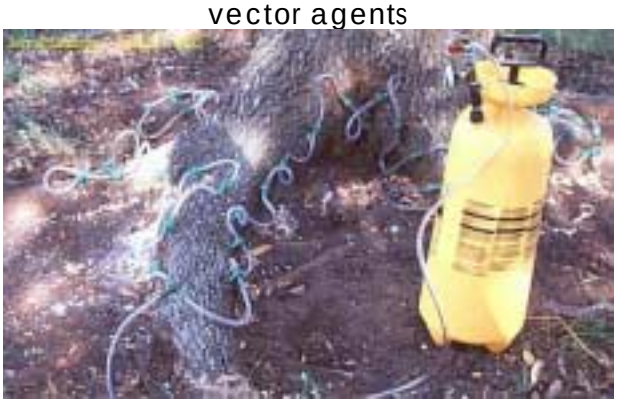
The Texas Agricultural Extension Service maintains a plant disease diagnostic laboratory to analyze and identify plant diseases. Specimen forms are available through the County Extension Office in every county. There is a $15.00 charge for each sample.

Laboratory Address: Texas Plant Disease Diagnostic Laboratory
Texas Agricultural Extension Service
Room 101 L.F. Peterson Building
Texas A&M University
College Station, Texas 77843-2132
Telephone (409)845-8033

Technical References-Arboriculture



Insects (beetles and borers) serve as vector agents



Oak Wilt Distribution throughout TEXAS

One Treatment Method involves pressurized systemic injection of ALAMO fungicide which is labeled as a preventative and therapeutic treatment. Injection method involves high sanitation of drill bits and injection tees.

Applicator precaution: ALAMO causes permanent eye damage

Use Gloves and Protective Eyewear

Oak Wilt (fungus - *Certocystis fagacearum*): This is an important disease of all oaks. Members of the white oak group die very slowly after infection occurs and can carry the fungus in the vascular system without showing any symptoms. Red oaks die rapidly after infection occurs. Symptoms show up on red oaks in early May as a bronzing of the leaves. On live oak, the leaf symptom is variable. The most common symptom is brown necrosis of the leaf veins. The remainder of the leaf may remain green or turn slightly yellow. Severe leaf drop occurs while the leaves are still green. Cuts made through the wood may show discoloration in the last annual ring. Symptom development usually begins on one limb or branch and in time spreads rapidly to the remainder of the tree. Further information is available.

The fungus may be carried from tree to tree by various insects and through root grafts. Sap feeding beetles are important in the short range spread. Red oaks which wilt in the late summer or early fall develop spore mats under their bark during the next spring. As the mats develop, the bark sloughs off or ruptures exposing the fungus. Insects are attracted to the mats. If the insects move from mats to healthy trees which have open wounds the fungus can then enter the healthy tree and move into the water

conducting tissue. Control is obtained by destroying diseased trees immediately. Remove or burn stumps. To prevent spread between trees, cut a ditch two to three feet deep around an infected tree. Vapam can also be used for this purpose. To apply the vapam, drill holes six to eight inches apart and 15 to 24 inches deep. The Vapam is diluted one part to four parts water and one cup of the mixture is applied to each hole. As soon as the hole is filled, it should be plugged with soil. Before using the Vapam treatment or making a ditch, the presence of Oak Wilt should be confirmed by a professional pathologist. This is a severe treatment and can result in plant damage if not done properly. Oak trees should never be pruned during late March, April, May and early June.

EIGHT STEP PROGRAM TO OAK WILT MANAGEMENT

by Jerral Johnson and David Appel, Texas A & M University Plant Pathology Labratory

A Plan For Reducing Losses To The Oak Wilt Fungus

Oak wilt is a major disease problem on live oaks, Shumard oaks, Spanish oaks, water oaks, black jack oaks and other members of the red oak family. Vast areas of the Texas Hill Country have been devastated by the fungus that causes the disease called oak wilt. Researchers, foresters and Extension workers at Texas A&M University have developed a program to stop this needless loss of one of Texas's most precious natural resources. This program is known as the "Eight Step Program to Oak Wilt Management." When implementing any disease management program, it is important to start early in the disease development. Each of the following eight steps is important to preventing and controlling oak wilt.

Step 1. Identify the Problem

An accurate diagnosis is important to the control of this disease. Leaf symptoms, pattern of spread, rate of tree mortality and laboratory isolation of the fungus from infected tissue are all means of identifying an oak wilt infection. The following table summarizes the diagnostic characteristics of oak wilt infection.

Table 1: Field Identification of Oak Wilt

Technical References-Arboriculture

Leaf Pattern

	Live Oak	Red Oak/Black Jack Oak
Veinal necrosis	Yes [Photo]	No
Veins remain green but area between veins is light green to yellow	Yes [Photo]	No
Tip of leaf turns brown (half leaf)	Yes [Photo]	No
All leaves on tree turn reddish brown	Yes	Yes [Photo]
Wilting and necrosis progresses inward from tips	No	Yes [Photo]

Tree Defoliation

Leaves are retained on tree for a short period of time after tree death	No [Photo]	Yes [Photo]

Rate of Tree Mortality

7 - 30 days	No	Yes
30 - 90 days	Yes	No

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Spread Pattern

Tree to tree	Yes	Not Always
Isolated trees	Yes	Yes

1. This condition is more often observed in early spring and only when all of the leaves turn reddish brown. Leaves will be retained on tree for a short time after tree death.
2. Some trees will vary with the rate of mortality.

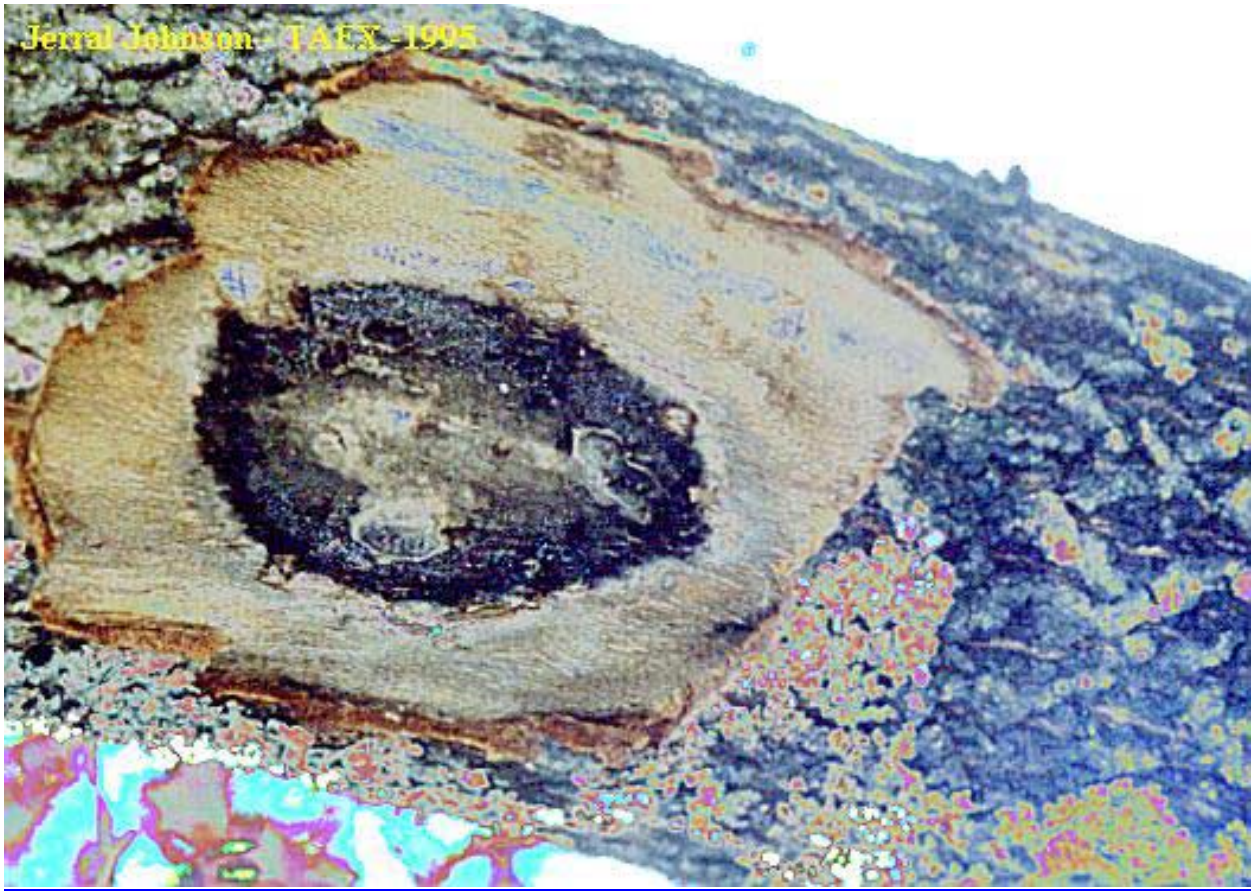
Step 2. Create a Buffer Zone

Oak wilt fungus transmission through root spread between adjoining trees accounts for most of the tree loss in oak wilt centers. Root spread can be stopped by creating a buffer zone between the oak wilt center and healthy trees. A trench should be established at least 100 feet from the last symptomatic tree. Using a rock saw, commercial ditching machine or a backhoe, the trench is dug at least 48 inches deep. The trench is immediately filled. It severs the roots between neighboring trees and prevents fungus spread between trees through root connections.

Step 3. Sanitation

Remove dead or diseased trees in the oak wilt center if they are not going to be treated with a systemic fungicide.

Trees should be burned in place when possible, especially if Spanish, Shumard, water and black jack oaks are present in the disease center. These species of oak trees form fungal mats



that produce spores which can spread infection. Spores become attached to the bodies of sap feeding insects attracted by the sweet smelling fungal mats, and spread to healthy trees, creating new disease centers.

Step 4. Pruning

Plant sap on the surface of a cut or wound attracts sap feeding beetles. During insect feeding, the fungus spores transported by the beetles are dislodged on to the tree's surface, germinate and infect the new host. Studies have shown that the beetles are most active in the early spring. This is also the time when the fungal mats are actively producing spores. Avoid pruning between February 15 and June 15, the period for maximum insect and fungal mat activity. This window of spread will vary depending upon location in the state. In the South Texas area, the timing will be slightly earlier, but in the Panhandle the timing would be later. When possible prune trees between December 1 and February 1, or between July 1 and October 1.

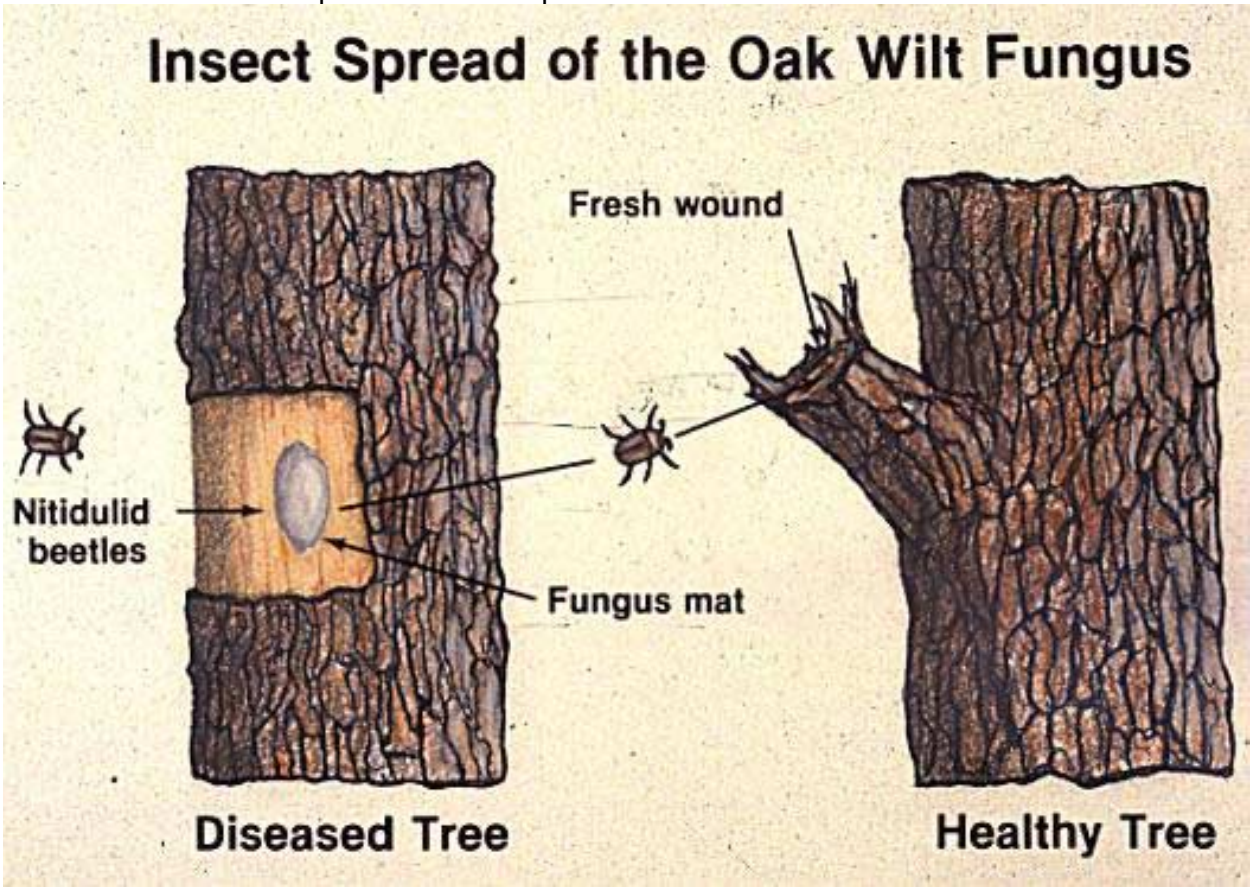
Step 5. Protecting Pruning Cuts or Wounds

Trees near oak wilt centers that are wounded or that must be pruned during the most active insect and fungal mat season, should be protected with a wound paint. These materials provide a protective layer between the fresh cut and the sap feeding beetles. Apply the paint in a thin layer immediately after wounding.

Most products have either an asphalt or latex base. All cuts greater than 1/2 inch should be painted. Wound paints should always be used when pruning trees in the immediate vicinity of an oak wilt center. Trees within 3 miles of an oak wilt center should be painted during critical periods of insect and fungus activity. Paint is not required for trees in areas free of the oak wilt fungus.

Step 6. Firewood

Firewood cut from tree species that form oak wilt mats can spread the fungus. If questions arise about where the trees were cut for wood or the species of tree cut, it is best to cover the wood pile with clear plastic. Make sure the edges are tucked into the soil to prevent insect spread



For trees that die in the spring or early summer, firewood can be safely cut by the fall. As the tree dries, it can no longer support growth of the oak wilt fungus. Also, the oak wilt fungus is not a good competitor with other fungi or bacteria that invade dead wood. Smoke from burning diseased logs does not represent a problem. Heat from the fire kills all spores or beetles that might be present. It is suggested that firewood be burned during the season it was purchased and not stored for the following season.

Step 7. Tree Injection With Systemic Fungicide Trees within the buffer zone can be treated with a systemic fungicide

Alamo is the product labeled for use in the control of oak wilt. It is applied by injecting the fungicide into the root flares. Alamo is most effective when applied as a preventive treatment. However, it can be applied after the tree develops symptoms. Trees that are symptomatic have less chance of complete recovery than those that are free of symptoms. Trees with more than 30% canopy loss should not be treated.

Step 8. Replanting

In some areas, oak wilt has already caused extensive losses to landscape trees. Property owners can successfully replant live oaks, Spanish, Shumard and water oaks if precautions are taken to avoid wounds. It is always best to use a mixed planting of trees to add variety to the landscape and reduce the chance of a recurrence of oak wilt or similar disease problems.

Post oak is a species of white oak that is resistant to the fungus but cannot be successfully replanted due to slow root development. Overcup oak, bur oak, white oak and other members of the white oak family are resistant to the fungus and can be planted in oak wilt centers. Chinkapin and swamp chestnut oak are chestnut oaks that can be grown in some areas of Texas and have some resistance to the oak wilt fungus. Cedar elm and Chinese elm are suggested for planting in many of the areas where oak wilt is a problem. Chinese pistache, ball cypress and flowering pears are other trees that can be planted in most areas where oak wilt is a problem. Before planting a tree, check with your local County Extension Agent, County Horticulturists, Arborists, Forester or Nurserymen on how that tree will do in your location.

How To Sample For Oak Wilt Diagnosis

How samples are taken and handled is vital to the success of a laboratory analysis. By following the steps outlined below, the chance of recovery is greatly improved.

- Select symptomatic limbs from trees.
- Dead limbs and those in an advanced state of decline cannot be used for isolation.
- Samples should be 1.5 to 2 inches in diameter and 6 inches long.
- Send in leaf tissue from sampled limbs. These will help to diagnosis the problem if the oak wilt fungus is not isolated from the limb samples. Keep the two samples separate.
- Keep samples cool during sampling and shipping, but not freeze tissue.
- Ship samples in sealed plastic bags. Do not add water or wet materials to the sample.
- Ship in an ice chest with a frozen freezer block.
- Ship by bus, overnight mail or bring in person to the laboratory. The samples should be shipped on a Monday, Tuesday or Wednesday. The samples will arrive at the laboratory, so that they can be processed that week.
- Results from the isolations will be available in 2 to 3 weeks. Reply time depends on how fast the fungus develops in culture.
- To aid in the diagnosis the following information is helpful:
    1. When did the problem develop?
    2. How many trees are involved?
    3. Does the problem appear to be spreading?
    4. Has anything been done over the root system of the tree? As a rule of thumb, the roots extend beyond the trunk 2.5 to 3X the distance between the trunk and the tree's drip line.
    5. If trees are dying, how fast is the mortality?
- Ship the samples to the:

    Texas Plant Disease Diagnostic Laboratory
    Room 101, L. F. Peterson Bldg.
    Texas A&M University
    College Station, TX. 77843-2132
    Telephone No. (409) 845-8032

Contact your County Extension Agent, County Extension Horticulturist, Texas Forestry Representative or Extension Plant Pathologist for more information on oak wilt.
