

Oak Wilt

Enhanced First Detector Training



Enhanced First Detector Training for New York State



Oak Wilt is the disease caused by the pathogenic non-native fungus *Ceratocestis fagacearum* that affects oaks. Oaks in the red oak group (those with sharply pointed tips- like pin oak and red oak) are most severely infected and can be rapidly killed in a single season. The white oak group (those with rounded tips, bur oak, white oak) are also susceptible to infection.

It is one of the most serious oak diseases in the United States, killing thousands of trees each year.



Here you can see characteristic signs of infection. In this case the trees have dying leaves and defoliation.

References for Intro:

http://www.dnr.state.mn.us/treecare/forest_health/oakwilt/index.html

Oak wilt

- History
- Potential impact
- Pathogen biology & transmission
- Hosts
- Signs & symptoms
- Identification
- What to do if you suspect you find it



History

- Widespread oak deaths in 1930s
- *Ceratocystis fagacearum* first identified in 1944
- Has killed many trees throughout the Midwest and into Texas

Widespread oak deaths in 1930s

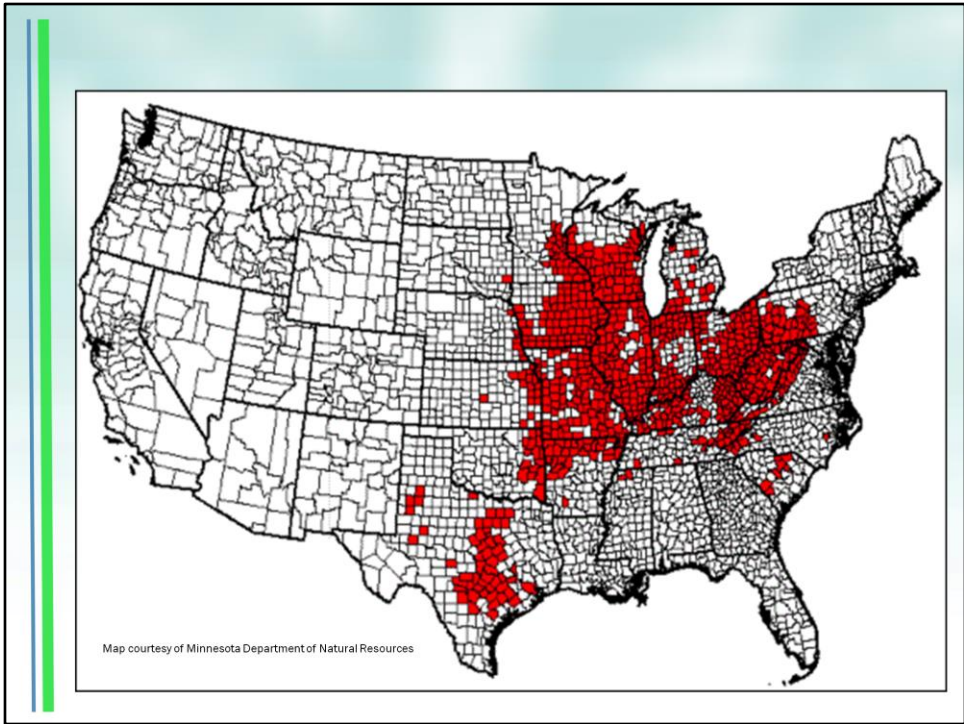
C. fagacearum first identified in 1944. Thought to be a non-native fungus introduced from somewhere in Central or South America

Has killed many trees throughout the Midwest and into Texas
-found in 21 states

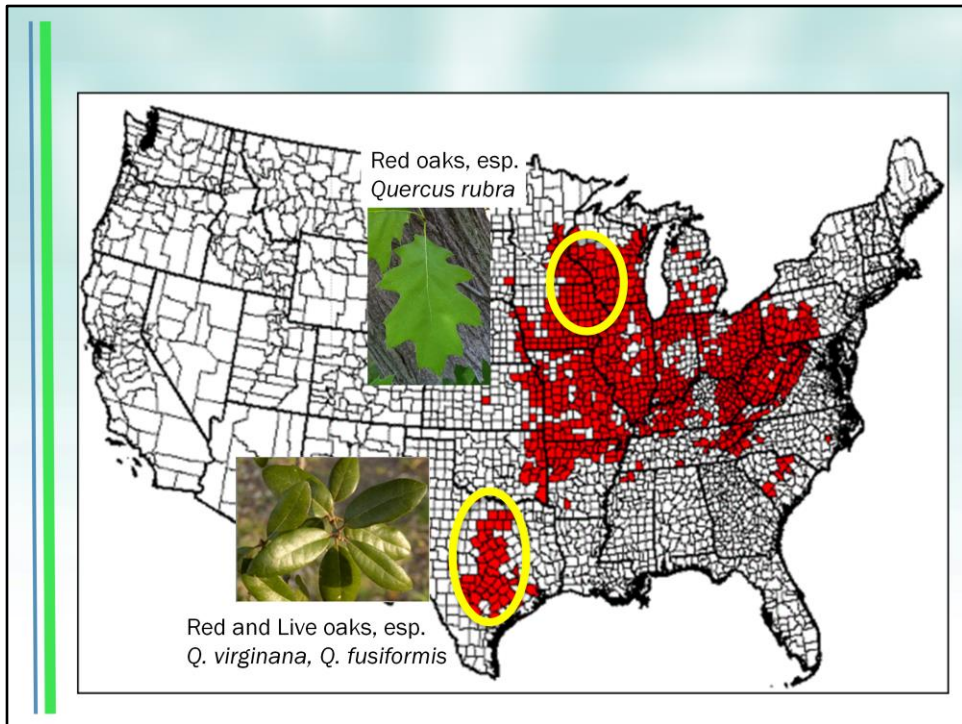
References:

<https://www.austintreeexperts.com/blog/the-history-of-oak-wilt/>

<http://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.htm>




Map of distribution of Oak Wilt



In different areas, different oak species are effected:

Northern Areas: particularly problematic on Red Oaks, *Quercus rubra*

In Texas: Both Red and Live Oaks



Potential impact

- Negative impacts on natural forest ecosystems, urban tree and lumber industry
- Many susceptible trees outside current range and in NY

Photo © Joseph O'Brien, USDA Forest Service, Bugwood.org

Where present, the disease affects natural forest ecosystems (decreasing oak species, changing habitat) and lumber (when oak is a harvested product)

-In Wisconsin, where the disease is very severe, it offsets annual oak growth by 11%

Many susceptible trees outside of current Oak Wilt range and in NY (see list at www.newyork.plantatlas.usf.edu)

- Black Oak (*Q. velutina*)
- Bur Oak (*Q. macrocarpa*)
- Northern Red Oak (*Q. rubra*)
- White Oak (*Q. alba*)

References:

<https://www.austintreeexperts.com/blog/the-history-of-oak-wilt/>

<http://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.htm>

<http://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.htm>

<http://www.wikihow.com/Identify-Oak-Leaves>

http://na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf

Pathogen biology

- *Ceratocystis fagacearum*, fungal pathogen
- Not native to this area but origin is unknown
- As *C. fagacearum* grows through xylem, trees's defense is to produce tyloses that block upward flow of water
- Wilt disease is result of tree's defenses to the pathogen infection



The fungal pathogen *C. fagacearum* causes oak wilt.

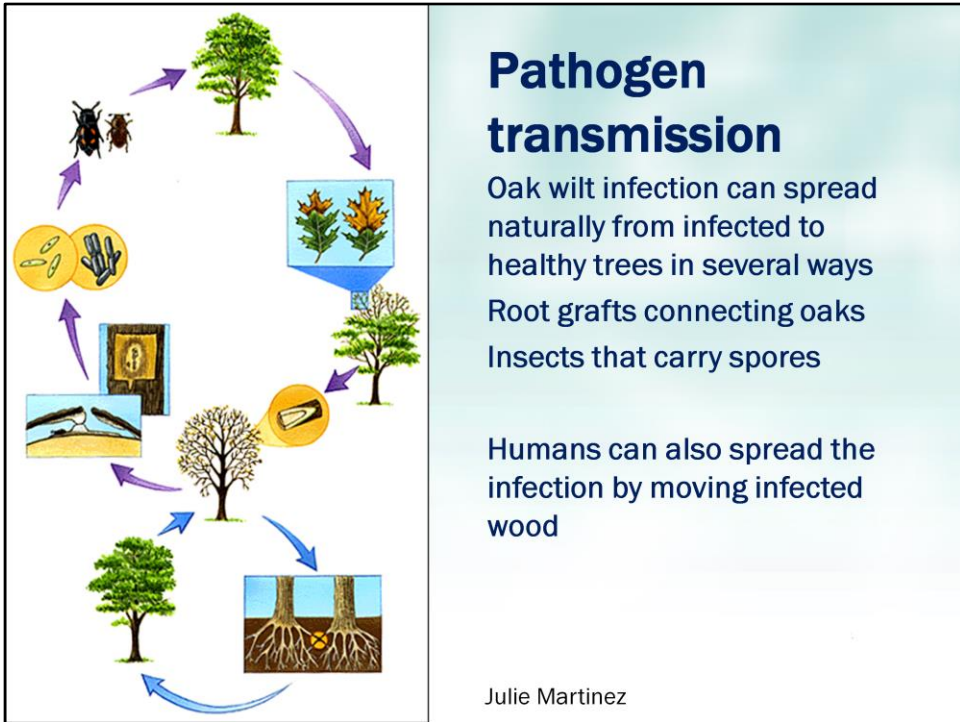
Genetic studies of the structure of *C. fagacearum* population suggest that it is not native to North America and was introduced from somewhere else. This also fits with that pattern of disease reflecting an introduction. But we don't know where it came from because other parts of the world don't indicate its presence. Current hypotheses suggest that it is from Central or South America.

The wilt disease symptoms of infection result from the pathogen growing through the vascular system (the xylem) and cutting off the flow of water to the tree's branches. (Actually the blocking of xylem vessels is the plants defense to infection- it produces tyloses that block the normal upward flow of water through the vessels which then cause the foliage to wilt and die

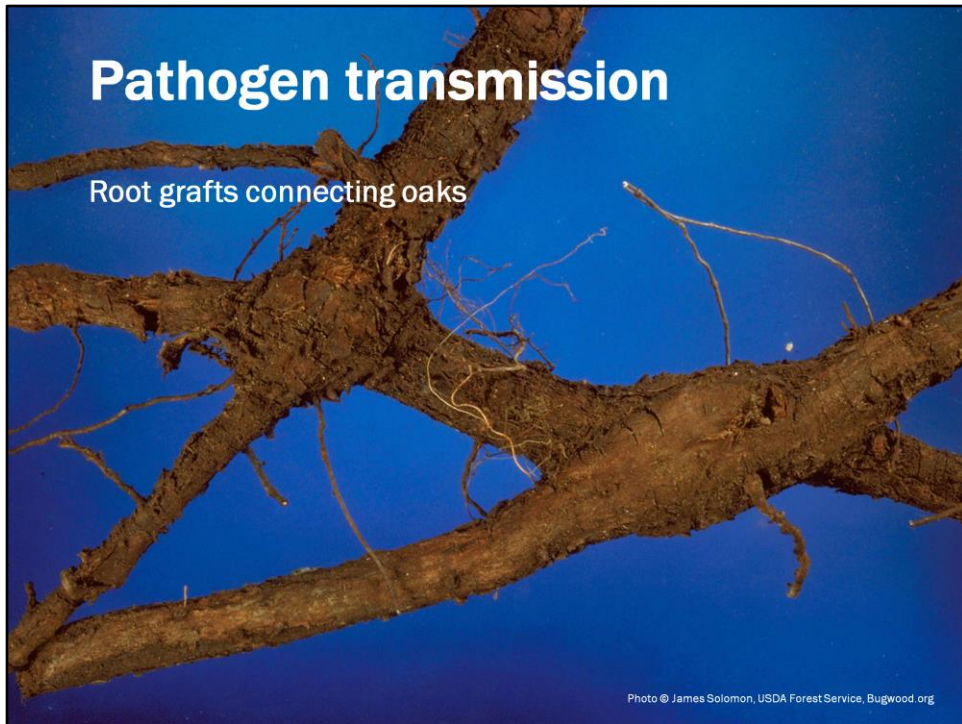
References:

http://na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf

<http://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.htm>



References:



Oaks naturally form root grafts between different trees

In this photo you can see where roots have naturally grafted together

Root grafts between infected and health trees and spread the pathogen.



Pathogen transmission

Insect transmission

- When some oak hosts (especially red oaks) are killed by Oak Wilt the fungus produces mycelial mats
- Beetles (especially picnic beetles and oak bark beetles) move spores

Photo © John N. Gibbs, ForestryCommission, Bugwood.org

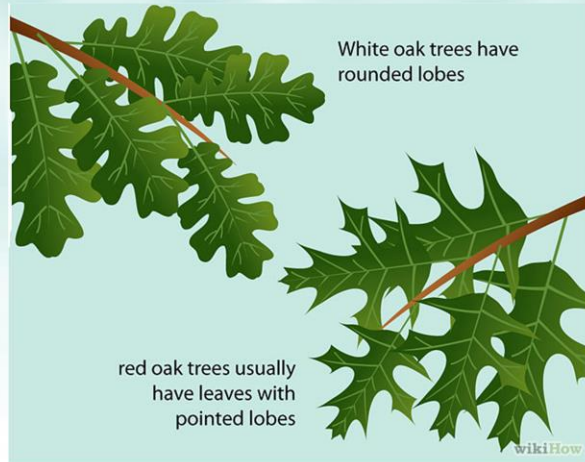
When some oak hosts (especially red oaks) are killed by oak wilt the fungus produces mycelial mats (containing spores) under the bark surface. (you can sometimes see long longitudinal cracks in the tree bark where this is happening).

Beetles are attracted to a fruity odor produced by these mats. When they burrow in the mycelia mats they pick up infectious spores which can be transmitted to new hosts.



Susceptible hosts

- All oaks are thought to be susceptible
- Disease in red oaks progresses very rapidly and trees may die within a season
- Disease also occurs in white oaks although typically less severe or rapid



All oak species are thought to be susceptible although they experience different disease severity

Red Oaks (those with pointed lobes) experience severe disease symptoms which can progress rapidly. Trees may die within a season and symptoms advance rapidly.

Live Oaks (oval leaves with pointed to round tips, within the Red Oak Group) may also be severely affected, especially problematic in parts of Texas with Oak Wilt

White Oaks also experience disease but it is typically slower or less severe

References:

<http://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.htm>

<http://www.wikihow.com/Identify-Oak-Leaves>

Symptoms on red oak group

- Leaves wilt and discolor from outer edges in with a distinct line between brown and green leaf tissue
- Defoliation of green and brown leaves, seldom uniformly throughout crown
- Rapid disease progress with trees dying between 1 month and a year after onset
- Fungal mycelia mats may form under bark of dead trees, causing longitudinal cracks in the bark

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The main period of infection is in the spring and red oaks may show symptoms very early on.

Leaves may turn dull, brown, dry, wilt.

Damage occurs from the tip and outer edges in to midrib/ base

Line btween brozen/brown leaf tissue and green leaf tissue on a leaf is very distinct
Symptoms appear quickly throughout the crown (within weeks) and leaves at end of branches are dropped

Defoliation of both green and symptomatic brown leaves, but not all at once and crowns are seldom uniform brown (like you would see with girdling)

Disease progresses rapidly, trees die between 1 month and a year after onset

Fungal mycelia mat (containing infectious spores) may form under the bark, causing longitudinal cracks in the bark and attracting insects

References:

<http://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.htm>



Sample slide

Symptoms on red oak group



Photos: (left) Steven Katovich, US-FS; (right, top) Ronald F. Billings, Texas Forest Service, and Minnesota Department of Natural Resources Archive, Minnesota Department of Natural Resources, Bugwood.org



Symptoms on white oaks

- Similar to Red Oak Group but more variable
- Typically slower disease progression
- Discoloration of infected annual rings, no mycelia mats



Symptoms often similar to those for Red Oaks, although more variable.

For White oaks, usually only a couple branches show symptoms and die each year

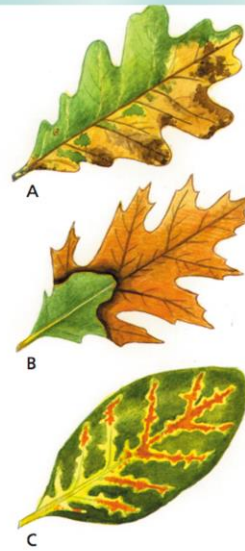
Unlike in red oaks, infected White Oak tend to have discolored infected annual rings when disease but lack mycelia mats under their bark

References:

<http://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.htm>

Diagnosis

- Scout for leaf symptoms, crown thinning and wilt on oaks
- Laboratory testing is needed to confirm identification,
 - Many look-alikes
 - Management can be costly



http://na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf



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References:

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http://na.fs.fed.us/spfo/pubs/howtos/ht_oaklab/toc.htm

Diagnosis: building the case

A. Leaf symptoms, characteristic and fast





Diagnosis: building the case

- A. Leaf symptoms,
characteristic and fast
- B. Vascular
discoloration ...
maybe



Diagnosis: building the case

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- B. Vascular discoloration ...maybe
- C. Disease in infection centers

Photo © D.W. French

Diagnosis: building the case

- A. Leaf symptoms, characteristic and fast
- B. Vascular discoloration ... Maybe
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D. Signs



Photos © D.W. French



Diagnosis: building the case

- A. Leaf symptoms,
characteristic and fast
- B. Vascular discoloration ...
Maybe
- C. Disease in infection
centers
- D. **Signs**



© D.W. French

Look-alikes

Other pathogens:

oak anthracnose, bacterial leaf scorch and others



Photos © (left) Joseph O'Brien, USDA Forest Service, Bugwood.org and (right) John Hartman, University of Kentucky, Bugwood.org

Drought and other abiotic stresses (girdling, poisoning, lightning) can produce similar symptoms to oak wilt

Many other disease have symptoms similar to Oak Wilt, so laboratory identification is important

Other pathogens, like Bacterial leaf scorch and Oak Anthracnose illustrated here, also produce leaf symptoms

In addition, Abiotic stresses like drought, mechanical girdling, poisoning and lightning damage can produce similar wilt symptoms on the tree

References:

http://na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf

What to do if you find symptoms

- Send leaf and wilted branch samples to lab
- Helpful guide produced by Forest Service: “How to Collect Field Samples and Identify the Oak Wilt Fungus in the Laboratory”

http://na.fs.fed.us/spfo/pubs/howtos/ht_oaklab/sample.htm

http://na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf

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http://na.fs.fed.us/spfo/pubs/howtos/ht_oaklab/toc.htm

Prevent introduction

Prevent introduction of *C. fagacearum* to uninfected areas

- Don't move firewood from infected to uninfected areas
- Avoid wounding (ex pruning) during high risk periods



Photo © Joseph Carren, USDA Forest Service, Bugwood.org

Eradicate new infections

- Remove infected trees
- Disrupt potential root connections to uninfected trees
 - Chemical treatment
 - Trenching and Vibratory Plowing
- Fungicide treatment

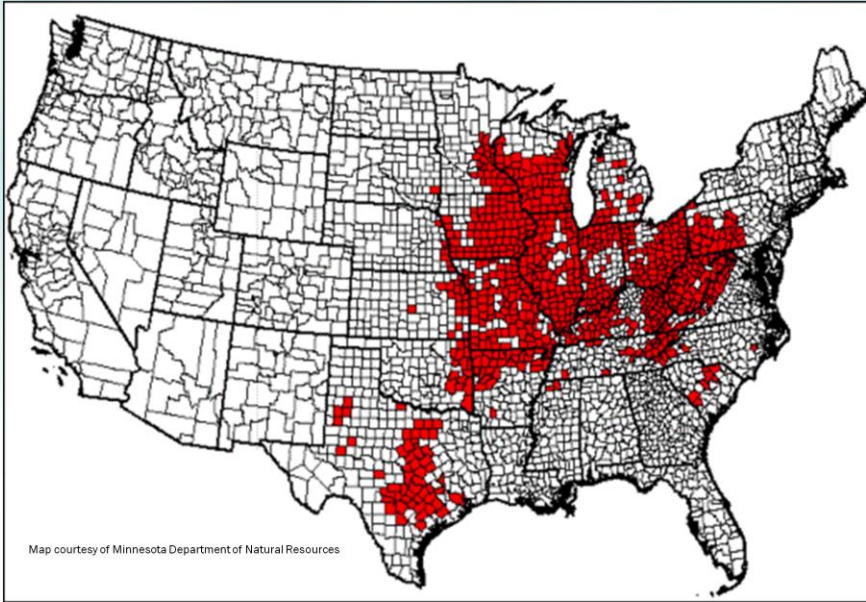


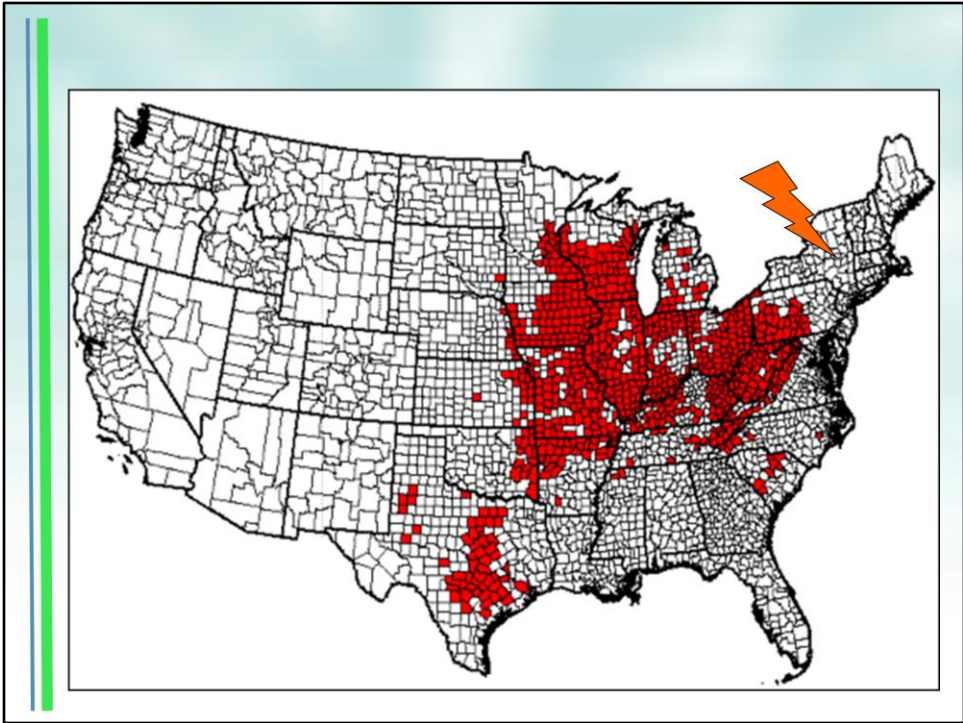
Photo © Ronald F. Billings, Texas Forest Service, Bugwood.org

References:

http://na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf

A recent case history for First Detectors





The Glen Oaks Neighborhood

©J. Carlson, NYS-DEC



Located 15 miles northwest of Albany in the Town of Glenville, Schenectady County





Spore Mat



This spore mat was found on a log from one of the infected trees.

The Cutting Plan



Each oak tree was precisely located by land surveyors, assigned an ID number and tagged.

The Tree Crews Arrive



The Backyard - Before



A yard full of trees.

The Backyard After



©J. Carlson, NYS-DEC

Seven trees removed in this yard and two in the yard behind.



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Seven trees removed in this yard and two in the yard behind.



Trenching

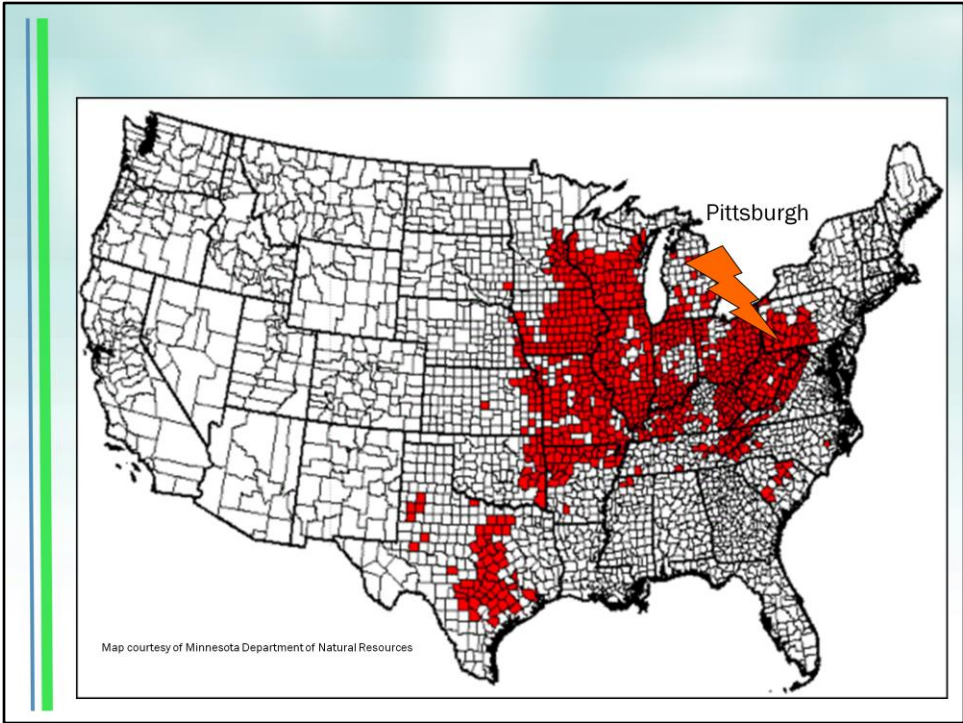


The damage from the trenching was minimal. The excavator was driven in on sheets of plywood and the trench was filled as it was dug, making the disturbance barely noticeable.

Problem was with shallow water lines and irrigation; trenching was limited.

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Problem was with shallow water lines and irrigation; trenching was limited



Credits

- Ellen Crocker, Department of Plant Pathology and Plant-Microbe Biology, Cornell University
- Margery Daughtrey, Department of Plant Pathology and Plant-Microbe Biology, Cornell University
- Rachel McCarthy, Department of Plant Pathology and Plant-Microbe Biology, Cornell University

Adapted from presentation by George Hudler

Department of Plant Pathology and Plant-Microbe Biology, Cornell University



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Online Resources

There are lots of great resources online about Oak Wilt if you would like to learn more:

The USDA Forest Service has several helpful publications:

- How to Identify, Prevent and Control Oak Wilt
http://na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf
- How to Collect Field Samples and Identify the Oak Wilt Fungus in the Laboratory
http://na.fs.fed.us/spfo/pubs/howtos/ht_oaklab/toc.htm#intro

Also, the Cornell Cooperative Extension Invasive Species Task force page:

http://www.nyis.info/index.php?action=invasive_detail&id=46



References

- http://na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_contr ol_oak_wilt_print.pdf
- http://na.fs.fed.us/spfo/pubs/howtos/ht_oaklab/toc.htm#intro
- http://www.nyis.info/index.php?action=invasive_detail&id=46
- http://www.dnr.state.mn.us/treecare/forest_health/oakwilt/index.html
- <http://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.htm>
- <http://www.wikihow.com/Identify-Oak-Leaves>
- <http://www.extension.umn.edu/environment/trees-woodlands/oak-wilt-in-minnesota/>



Collaborating Agencies

U.S. Department of Agriculture Animal and Plant Health
Inspection Service (USDA-APHIS)

Cooperative Agricultural Pest Survey Program (CAPS)

New York State Department of Agriculture and Markets
(NYSDAM)

National Plant Diagnostic Network (NPDN)

Sentinel Plant Network (SPN)

Protect U.S.

Department of Plant Pathology and Plant-Microbe Biology,
Cornell University



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