Everything you need to know about:

Oak Wilt

*Ceratosysis fagacearum*

An invasive disease threatening Ontario’s oak trees

Learn about other invasive species at [www.edrrontario.ca](http://www.edrrontario.ca)
Background

• Many slides in this presentation were created by Taylor Wright in 2015 with a major revision by Colin Cassin in Fall 2017. It has been made available for use as an education tool to prevent the establishment of Oak Wilt in Ontario.

• As of summer 2019, Oak wilt is currently not known to occur in Ontario or any other Canadian province, but given its presence <600 meters from Windsor, ON, it is important to know about this non-native disease before it establishes.

• The content of this presentation was last updated in August 2019.
EDRR Network Ontario: In a Nutshell

To create, train and equip an EDRR network to provide eyes on the ground to detect, track, respond to, and control invasive plants and insects in communities across Ontario.

- Increase awareness & knowledge of invasive species
- Support hands-on work to more rapidly detect and reduce invasive species
- Engage youth & students to foster environmental responsibility
- Facilitate community partnerships to support restoration & maintenance of local habitats and recreational spaces

Peel • Halton • Sault Ste Marie
Thunder Bay • Sudbury & Algoma Region

Community-level early detection & action as appropriate
EDRR Ontario Phase I: 2014-2017

EDRR Network initial pilot areas
EDRR Ontario Phase II: 2017-2019

EDRR Network expansion in June 2017 to focus on the “gateway” for many priority invasive species
Oak Trees of Ontario

- Ontario is home to numerous oak (*Quercus* sp.) species including:
  - red oak (*Q. rubra*),
  - black oak (*Q. veluntina*),
  - white oak (*Q. alba*) and others.
- They support wildlife (eg. acorn consuming deer, bear, turkeys, etc.), are important sources of lumber and veneer, and have a rich history of use by Indigenous communities across North America (eg. dyes & food).
10+ native oak species in Ontario:
- Black oak (Q. veluntina)
- Bur oak (Q. macrocarpa)
- Chinquapin oak (Q. muehlenbergii)
- Dwarf chinquapin oak (Q. prinoides)
- Hill’s oak (Q. ellipsoidalis)
- Pin oak (Q. palustris)
- Red oak* (Q. rubra)
- Shumard oak (Q. shumardii)
- Swamp white oak (Q. bicolor)
- White oak* (Q. alba)

1+ exotic oak species in Ontario:
- English oak (Q. robur)
- Plus many cultivars!
Susceptibility of Prominent Ontario Oaks

All species of oak trees are susceptible to oak wilt, however species of the red oak group are the most seriously and quickly affected.

- **Red Oak** *(Quercus rubra)*
- **Bur Oak** *(Quercus macrocarpa)*
- **White Oak** *(Quercus alba)*
Oak Wilt
(Ceratocystis fagacearum)

- A vascular disease that affects oak trees
- Caused by the fungus *Ceratocystis fagacearum*
- The fungus grows on the outer sapwood of trees, restricting the flow of water and nutrients, eventually "suffocating" the tree and causing foliage to wilt and can cause the tree to die
- Trees can be dead within months of exposure to the fungus
Where did it come from?

• The origin of oak wilt is not known, although the leading belief is that it originated in Central/South America

• Detected in 23 states, spread across much of the northwestern states, including Michigan (upper and lower peninsulas), and as far south as Texas

• It has not been detected in Canada, but poses a threat to Ontario’s forests
Circles indicate Grayling (right-most circle) and Kalkaska (left-most circle) Michigan, where Oak Wilt monitoring training (2015) was held. The follow up training (2017) was hosted in SE Michigan at a series of sites near the Sarnia and Windsor borders.
Early Symptoms of Oak Wilt Infection

- Red oaks can show symptoms **within a month** of infection by oak wilt fungus. White oaks are thought to be better able to sustain themselves, although they can still die and can also display related symptoms. Typical symptom progression includes:
  1. The first symptom in red oaks is often a **subtle off-green colour shift** in the upper-crown (typically late-June, early July in Northern US but varies depending on infection occurrence)
  2. Secondary symptoms may include **wilting leaves** from crown towards the ground
  3. Next you’ll see leaves **discolour further**, turning a bronze colour from the leaf margins, moving inward
    - In “prototypical” leaves you’ll see an angular pattern of bronzing, with definitive discolouration lines
    - In many leaves observed in 2017, infected leaves were less obvious – often exhibiting a more dispersed bronzing and lacking the strong, angular lines many OW photos depict
  4. Eventually infected trees will **shed leaves** early in the growing season, compared to nearby uninfected oak trees
Early Symptoms of Oak Wilt Infection
2 Natural Pathways for Spread

For longer distance dispersal, the oak wilt disease uses nitidulid (KNIT-I-DOO-LID) beetles (AKA “picnic beetles”) as a vector for spread (depicted in top figure). For shorter distance dispersal, oak wilt spreads through root-to-root contact between trees of close proximity.
Upper Figure: Sap-feeding Beetles

- Starting with a healthy, mature oak tree.
- Disease carrying beetles infect tree.
- First symptom becomes evident: browning leaves from tip towards leaf base.
- Most evident at top of canopy, descending down over weeks.
- Disease inhibits ability of tree to translocate water and nutrients from roots to shoots by clogging resource transportation pathways within the sapwood.
- Mortality can set in within a few months, but in at least some documented cases trees have lived for 2-3 years beyond initial infection.
- After tree death, one or more fungal mats may form under the bark of the tree. These fungal mats often create pressure pads that expose the fungal spores to beetles and other ambient conditions. These fungal mats are said to have a fragrant fruit-like odor (some liken to Juicy Fruit gum!) that can be detected by the human nose.

Lower Figure: Root Grafting

- Root to root contact (grafting) can spread the disease from infected to non-infected trees
Fungus is spread naturally by 2 pathways:
1) Sap-feeding beetles
2) Root grafting

Dead, infected trees develop spore mats, commonly called “pressure pads”
Newer pressure pads are white in colour, changing to gray and eventually turning black (e.g. top right photo)
Nitidulid beetles, are attracted to the smell of the spore mats and tree sap
Feeding beetles transfer active spores to new trees
Fungus infects new host, limiting water and nutrient flow until tree dies; pressure pads form beneath bark
Fungus is spread naturally by 2 pathways:
1) Sap-feeding beetles
2) Root grafting

Infection spreads from diseased to healthy trees through interconnected root systems.

Containing the spread of infection within a woodlot can be attempted by severing these tree-to-tree root connections using a vibratory plough.
Typical Oak Wilt Bronzing

Wilting leaves of a red oak

Pressure pads forming from fungal mats below bark surface
Implications in Ontario

Declines in oak populations could mean:

• Impacts on forest-based economies as oak populations decline and availability decreases

• Increased energy costs for homeowners as trees on private property die off

• Decline in biodiversity, reduction in habitat and food for wildlife

• Reduced property values, especially in areas where oak is dominant

• Impacts on enjoyment of outdoor recreational spaces; parks, trails etc.
Implications in Ontario

Oak occurrence is variable across the province. In Southwest Ontario (eg. Windsor), Central Ontario (eg. Muskoka) and Northern Ontario (eg. Algoma) oak stands are more prominent that in other parts of the province. Loss of this dominant tree species is even more problematic given the losses of many Ash (*Fraxinus sp.*) stands across Ontario in recent years.

1. Oak species are usually killed within one year of infection, therefore populations could decline quickly, thus reducing their available to the forest sector; red oak is a valuable commercial species within Ontario
2. Oak trees that are adjacent to homes can help reduce energy costs by shading the house in the summer and protecting it from wind in the winter
3. Oaks are also one of the greatest supporters of biodiversity given their well-documented importance for wildlife and contribution to habitat creation (eg. Doug Tallamy’s *Bringing Nature Home*).
4. In urban areas, susceptible oak trees are abundant, so the loss of these trees to oak wilt could mean significant reductions in property values. Removal of these trees can also become costly for the homeowner.
5. Loss of a source of Ontario fall colours. The loss of these trees will decrease the aesthetic value of our natural spaces.
What Can We Do?

“An ounce of prevention is worth a pound of cure”
What Can We Do?

1) DO NOT MOVE FIREWOOD

- Live fungal spores can live in cut firewood – transferring this wood to a new area could assist in disease spread

It’s good practice – always burn firewood where you buy or cut it!
What Can We Do?

2) Do not prune oak trees from “April 15 to July 15”
   • Wounded trees are at increased risk of oak wilt infection, as open wounds attract insect vectors that could be carrying oak wilt
   • If possible, leave pruning to colder months when the fungus is dormant
   • It should be noted that some states, including those in comparable climates to Ontario, have found the disease vectoring beetles to be active at times outside the April 15 to July 15 window. Establishing a no-prune period beyond these dates may be advisable.
What Can We Do?

3) Learn to identify oak wilt signs and symptoms

- Wilting and bronzing of foliage, splits in bark, fungal growth beneath bark, vascular streaking

(Photo: Paul A. Mistretta, USDA Forest Service, Bugwood.org)
4) **Report** suspicious trees to your local Canadian Food Inspection Agency (CFIA) or Ministry of Natural Resources and Forestry (MNRF) offices

**Invading Species Hotline**
- Toll-free: 1-800-563-7711
- Google: Invading species hotline

**Canadian Food Inspection Agency**
- Toll-free: 1-800-442-2342
- Google: CFIA invasive species reporting

Early Detection is **KEY** to effectively managing this species!
For more information on oak wilt, visit:

Forest Invasives Canada  
www.forestinvasives.ca

Canadian Food Inspection Agency  
www.inspection.gc.ca

Ontario’s Invading Species Awareness Program  
www.invadingspecies.ca
Michigan Oak Wilt Case Studies

Fall 2017
Michigan DNR staff detected Oak Wilt in Belle Isle, a high-traffic State Park less than 600m from Windsor, Ontario. Bell Isle is 1000 acres in size. Infected trees were identified and an additional buffer zone was created around them, including neighbouring trees whose roots were likely grafted but had yet to express oak wilt symptoms.
Oak Wilt Detection Case Study: Belle Isle State Park, MI

• Staff began control procedures to contain the oak wilt disease from spreading via long distance dispersal
• Infected trees were located in particularly sensitive part of the park, and were cut and removed by helicopter
• Stumps can be an infection source, and were pulled out or destroyed by a stump grinder
Oak Wilt Detection Case Study: Belle Isle State Park, MI

**Oak Wilt Control (Belowground Pathway)**
To restrict belowground transfer of the disease (via root-grafting) staff brought in an external contractor to operate a vibratory plough (Ditch Witch brand), severing root grafts between trees to a depth of 5 feet, with the plough blade (width= a few inches) around each of the delimited infected zones. The photo above shows the approx. 10ft wide path that was brushed to allow the machine to travel along the ploughing lines. The disturbance to the soil and vegetation was apparent even months after ploughing occurred but was necessary to prevent neighbouring trees from infection.

In addition to using the vibratory plough, a select (approx. 100-200) number of particularly high-value, uninfected trees (various oak species) were treated with a fungicide to reduce the chance of loss. Some of these trees were in the infected zones, while some specimens were found in more parkland type locations throughout the island. The fungicide used is currently not registered for use in Canada, but is being evaluated by the PRMA, a branch of Health Canada.
Oak Wilt Detection Case Study:
Belle Isle State Park, MI

Approx. 10’ Clearance

Approx. 6” Plough Blade Width
Oak Wilt Detection Case Study: Waterford, MI

In mid-summer 2017 the Michigan Department of Natural Resources received a public inquiry about a suspected Oak Wilt case in a residential neighbourhood in suburban Michigan.
During a mid-July site inspection, state DNR staff surveyed for signs of oak wilt. They noted the tree in question had notably drooping leaves, which were nearly all bronzed. Some leaves on the ground showed the classic angular bronzing pattern that is commonly associated with oak wilt, but many other leaves displayed a more general bronzing evenly distributed throughout entire leaves.
Oak Wilt Detection Case Study: Waterford, MI

Using a hatchet, state DNR staff were able to “tap” the tree searching for hollow-sounding pressure pads. Since the tree was presumably recently infected, pressure pads had yet to form. Branch samples were collected and oak wilt presence was confirmed in a lab.

Detection occurred on private lands making the homeowner responsible for control actions (removing and disposing of the tree, and to have the stump removed or ground below grade). A difficult aspect of this detection was the proximity to neighbouring properties and nearby oak trees on adjacent lands - collaborating with neighbours is paramount to the long-term success of this control effort.
Oak Wilt Detection Case Study: Fenton, MI

In a semi-rural residential community in Michigan, a homeowner contacted the Michigan State DNR to report oak tree decline occurring along 2-3 adjacent properties sharing an oak-dominated stand. In June 2017 DNR staff were able to assess the properties for presence of Oak Wilt.
Upon inspection, a number of trees were found displaying early, mid, and longer-term signs of oak wilt, indicating a multi-year establishment of oak wilt. Some trees had angular bronzing leaves, others retained fully bronzed leaves and a range of leaves were apparent on the forest floor and in adjacent areas.
Using a hatchet, the technician was able to locate a series of fungal mats that had created pressure pads on the oak tree's trunk.

The loosely attached bark was removed, and a distinct smell was observed. Some describe the odor of oak wilt as a “fermented apple cider vinegar, bubble-gum, Juicy Fruit flavour”, while others liken it to earthy smells of pickled beets. A range in expected oak wilt odor is likely given how long the fungal mats have been present.
Oak Wilt Photos

Photo credit: Colin Cassin, Sept. 2017
Oak Wilt Photos

Photo credit: Colin Cassin, Sept. 2017
Oak Wilt Photos – Fungal Mats

Photo credit: Colin Cassin, Sept. 2017
Oak Wilt Photos – Fungal Mats Ctd.

Photo credit: Colin Cassin, Sept. 2017
Oak Wilt Photos

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