

Examining oak decline

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Oak Forest Distribution



Forest Health Technology Enterprise Team – Mapping and Reporting



Oak Decline Complex Factors

1. Predisposing factors
2. Inciting factors
3. Contributing factors

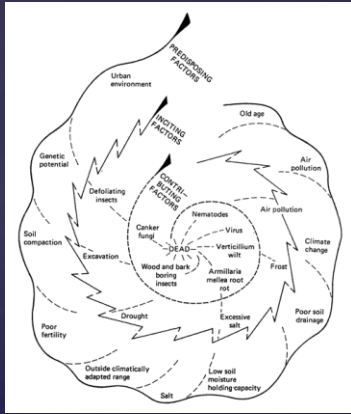


Figure 1. The decline-death spiral showing the many interacting factors, from Manion (1981), Prentice-Hall, Inc

Oak Decline Complex

1. Predisposing factors

Long-term, underlying conditions

- Age
- Species
- Growth rate
- Landform
- Site
- Climate



UGA5030065
Joseph OBrien, USDA Forest Service, Bugwood.org

Predisposing factors

- Slow-growing red oaks
- Mature
- Sites prone to drought, frost damage, or flooding



UGA5052011

Wargo et al., 1983, Clatterbuck and Kauffman, 2006
Joseph OBrien, USDA Forest Service, Bugwood.org

Predisposing factors

- Missouri and Arkansas
- Red oaks older than 65-years-old
- South facing slopes
- Poor soils
- Low-quality sites with black and scarlet oaks



5464059

Kabrick et al., 2008

2. Inciting factors

Incidents that lead to a decline event

- Drought
- Frost
- Flooding
- Insect damage



Lymantria dispar 5445757

Wargo *et al.*, 1983; Manion, 1991
Jon Yuschock, Bugwood.org

2. Inciting factors

- Response may not be immediate
- May take 2-5 years to see impact
- Cumulative effect over time
- Tree with slow diameter growth most severely impact

Wargo *et al.*, 1983; Manion, 1991

3. Contributing factors

Increase the chances of tree damage and death of trees weakened by the predisposing and inciting factors

Wargo *et al.*, 1983; Manion, 1991; Schwingle *et al.*, 2007

3. Contributing factors

- Armillaria root rot
- Red oak borers
- Two-lined chestnut borer
- Biscogniauxia (Hypoxylon) canker
- *Phytophthora* root rot and cankers



Wargo *et al.*, 1983; Manion, 1991; Schwingle *et al.*, 2007

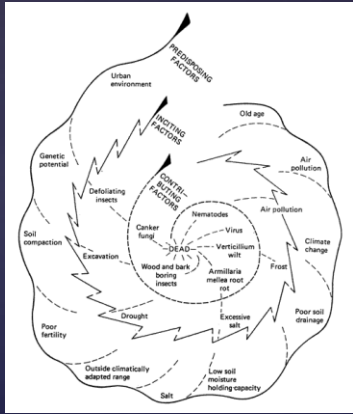


Figure 1. The decline-death spiral showing the many interacting factors, from Manion (1981), Prentice-Hall, Inc

Symptoms of Oak Decline

Begins at branch tips and moves downward in the canopy



Joseph OBrien, USDA Forest Service, Bugwood.org

Symptoms of Oak Decline

Leaves may grow in tufts, be brown or wilt without falling off



Joseph OBrien, USDA Forest Service, Bugwood.org

Symptoms of Oak Decline

Leaves show premature fall color then fall off



Joseph OBrien, USDA Forest Service, Bugwood.org

Symptoms of Oak Decline

Production of epicormic sprouts

Death of parts of the crown

"Stag horn" appearance



Joseph OBrien, USDA Forest Service, Bugwood.org

Stand Symptoms

- The symptoms impact a small population of oaks
- Missouri Ozarks
 - 6% decline of white oak species
 - 10% decline of red oak species
- 76% of white oak species were healthy
- 64% of red oak species were healthy

Fan *et al.*, 2008

Natural Cycling of Forests

- Since oak decline is large dependent on environmental (abiotic) factors, it can be considered part of natural forest cycling
- Necessary to change the structure and composition of the forest
- Leads to long-term management planning

Manion and Lachance, 1992

Oak Decline Treatment

Inciting factors can be impossible to predict and control

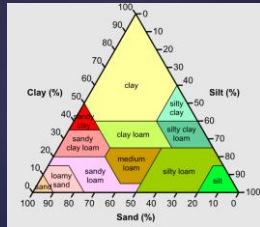
Treatments need to focus on:

1. Reducing exposure to predisposing factors
2. Restoring the effected area after a decline event occurs

Reduce exposure to predisposing factors

In the landscape, things to consider

- Landform
- Soil types
- Site quality
- Hydrology
-
- Stand age
- Species composition
- Defoliator population monitoring



Oak Decline in Chicagoland



Oak Decline in Chicagoland



History Repeating Itself?

- Mid-1970s - George Ware and Virgil Howe surveyed declining oaks in Downers Grove, Illinois
- 1974-1976 Rainfall was above average
 - 55% above normal
 - 2017-2020 was 45% above normal
- 1981-1983 experience 31% and 66% above average rainfall (3rd highest amount in 150 years)

The Destructible Oak By George Ware

Oaks have long been a conspicuous feature of the landscape in northeast Illinois. Accounts of early travelers and records of surveys document their commonness in pre-settlement times; familiar place names such as Oak Park, Oak Forest, Oak Lawn, Oak Brook, and others are evidence of the appeal of oak woodlands as places to live. Now, unfortunately, thousands of these oaks are dying each year in the rapidly growing suburban areas. In wooded neighborhoods, oak trees in varying stages of decline are common, the evidence ranging from a few bare tips in the tops of some trees to large dead limbs in others. Dead trees or stumps are usually present. The basic cause of death is not a fungus, insect, virus, or any other identifiable agent. The oaks are being lost for ecological reasons—from changes brought about by urbanization. Trees that were intended to contribute to the attractiveness and value of a home-site are often doomed while the house is being built, because of ignorance or disregard of the natural requirements and renewing processes needed to maintain healthy oaks.

A look at the northeastern Illinois landscape and how its woodlands came to be dominated by oaks must precede any understanding of our current oak problems. In pre-settlement times, much of the area was covered by prairie, and prairie fires were common. There were also many oak forests which existed in areas where rivers or topography apparently protected them from prairie fires. Scattered throughout the prairie there were numerous oak openings or groves composed of bar oak, a species resistant to fire damage because of its thick, corky bark. These bar oak openings were island reservoirs of access supply, but the potential for seedling survival was suppressed by the recurrent fires.

When the settlement of Illinois brought about the control of prairie fires, the previously constrained oak forests expanded rapidly, with countless thousands of young oaks appearing at this time. Likewise, the abundant oaks present in the bar oak openings were then able to sprout and develop. The increasing bar oak density and the shading out of prairie plants gradually created conditions favorable for the entry of another oak species, the white oak. In time, many bar oak openings were transformed into true forest communities with soils enriched with humus and conducive to vigorous growth of white oaks.

At this stage another oak species, northern red oak, often became an associate of white oak. Northern red oak similarly requires natural forest conditions with a rich floor of decaying leaves and humus for best growth. The successional pattern in the white oak and northern red oak to build and enrich forests began by bar oak oak, in turn, to develop greater dependency upon the complex forest community of which they are a part. Bar oak is less dependent and may be found growing alone or in isolated groups as well as at the edge of the mixed oak forest.

George Ware, 1970
The Morton Arboretum
Quarterly Articles
6 pages

<https://acorn.mortonarb.org/Detail/objects/10586>

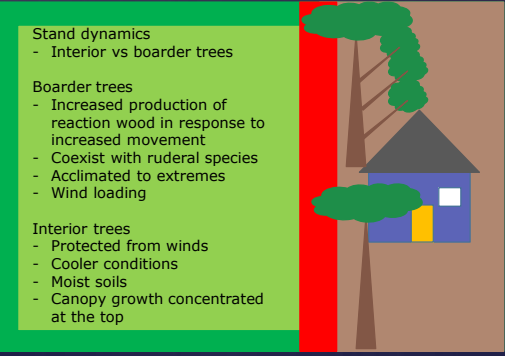
Forest-Urban Interface

- Creating foreign or non-natural environments
- Companion plants, organisms, microbes
 - Fungi
- New variety of stressors
- Different insect and diseases
- Micro-climates



(Inv. Leavitt / Pioneer Press)

Forest-Urban Interface



Stand dynamics

- Interior vs boarder trees

Boarder trees

- Increased production of reaction wood in response to increased movement
- Coexist with ruderal species
- Acclimated to extremes
- Wind loading

Interior trees


- Protected from winds
- Cooler conditions
- Moist soils
- Canopy growth concentrated at the top

Boarder trees

- Increased production of reaction wood in response to increased movement
- Coexist with ruderal species
- Acclimated to extremes
- Wind loading

Oak Decline Factors

- Predisposing**
 - Abiotic factors – soil compaction, genetic potential, water changes
- Inciting**
 - Gypsy moth
 - Forest tent caterpillar
 - Jumping oak gall
- Contributing factors**
 - Armillaria root rots
 - Biscogniauxia*, formerly *Hypoxylon*, canker
 - Two-lined chestnut borer



Urban Tree Health

Tree death that is tolerable or normal in the forest does not translate to the landscape

Minor abnormalities, damage, stressors

Management approaches

Plant health care – chemical and cultural management

Improving Urban Trees

Average urban tree lives 7 years

Breeding, developing, and screening cultivars that tolerate urban environments

Making planting locations more tree friendly

- Space for root growth
- Water movement

Next Steps in Survey of Oak Decline

Identifying what species of *Phytophthora* are involved using real-time PCR and Sanger sequencing

Thorough identification of what canker pathogens are present

Identification of whether oak wilt is present

Next Steps in Survey of Oak Decline

Application of different treatments

Cultural: mulching, leaf compost, aeration and decompaction of soil (radial trenching auguring)

Chemical: Plant growth regulators (paclobutrazol – Cambistat), treating for secondary problems

Next Steps in Survey of Oak Decline

Documenting treatment applications and state of decline

Track changes over time (1, 5, 10...years)

Write up protocols green industry professionals can use in the field


Summary

Aid decline-prone trees during periods of drought stress


Submit samples to plant diagnostic labs for clinical diagnosis

Treat a diagnosis, not a symptom


Plan on treating for secondary problems during periods of stress


Expert Advice **The Plant Clinic**
The Plant Clinic is a leading source of science-based advice about trees, plants, and landscapes.
mortonarb.org/plant-and-protect/expert-advice/

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