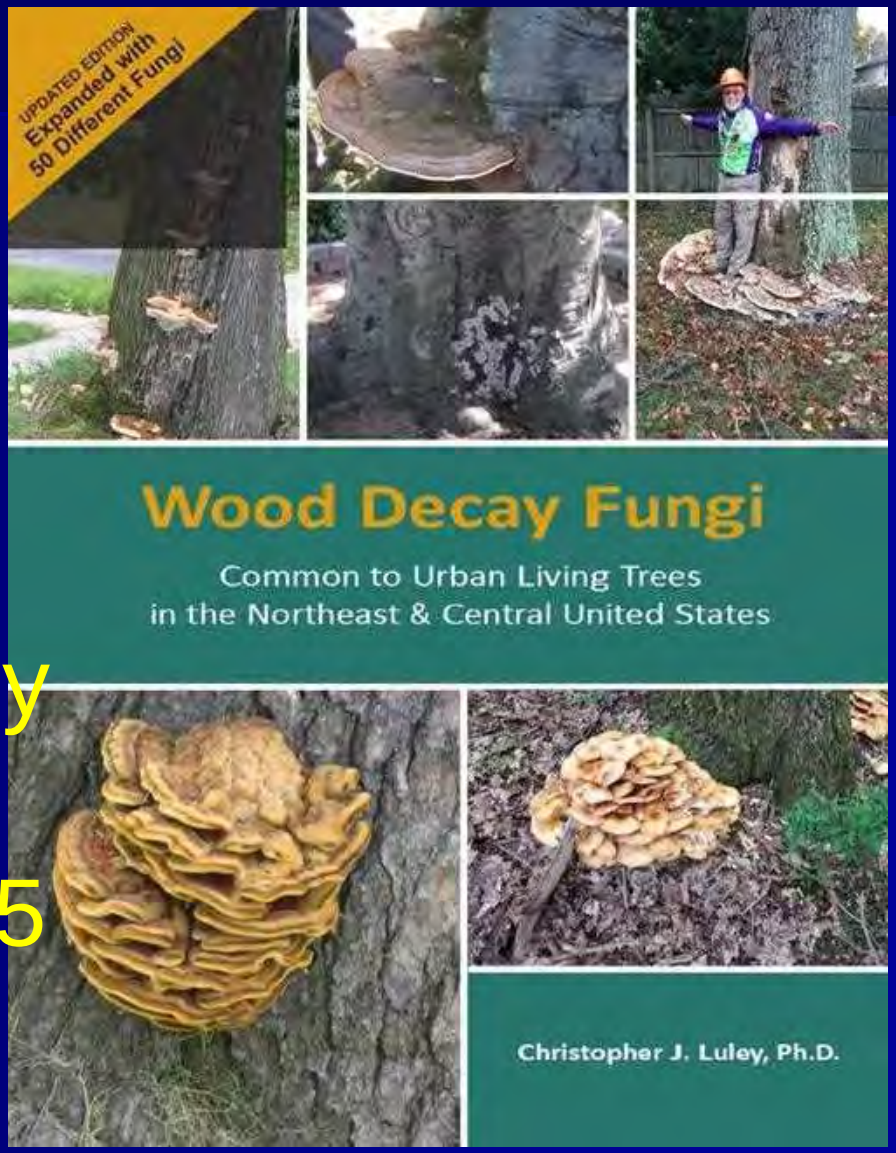
Wood Decay Fungi You Might Want to Know

Christopher J. Luley, Ph.D.

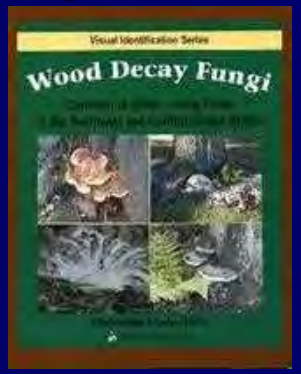
Naples, NY

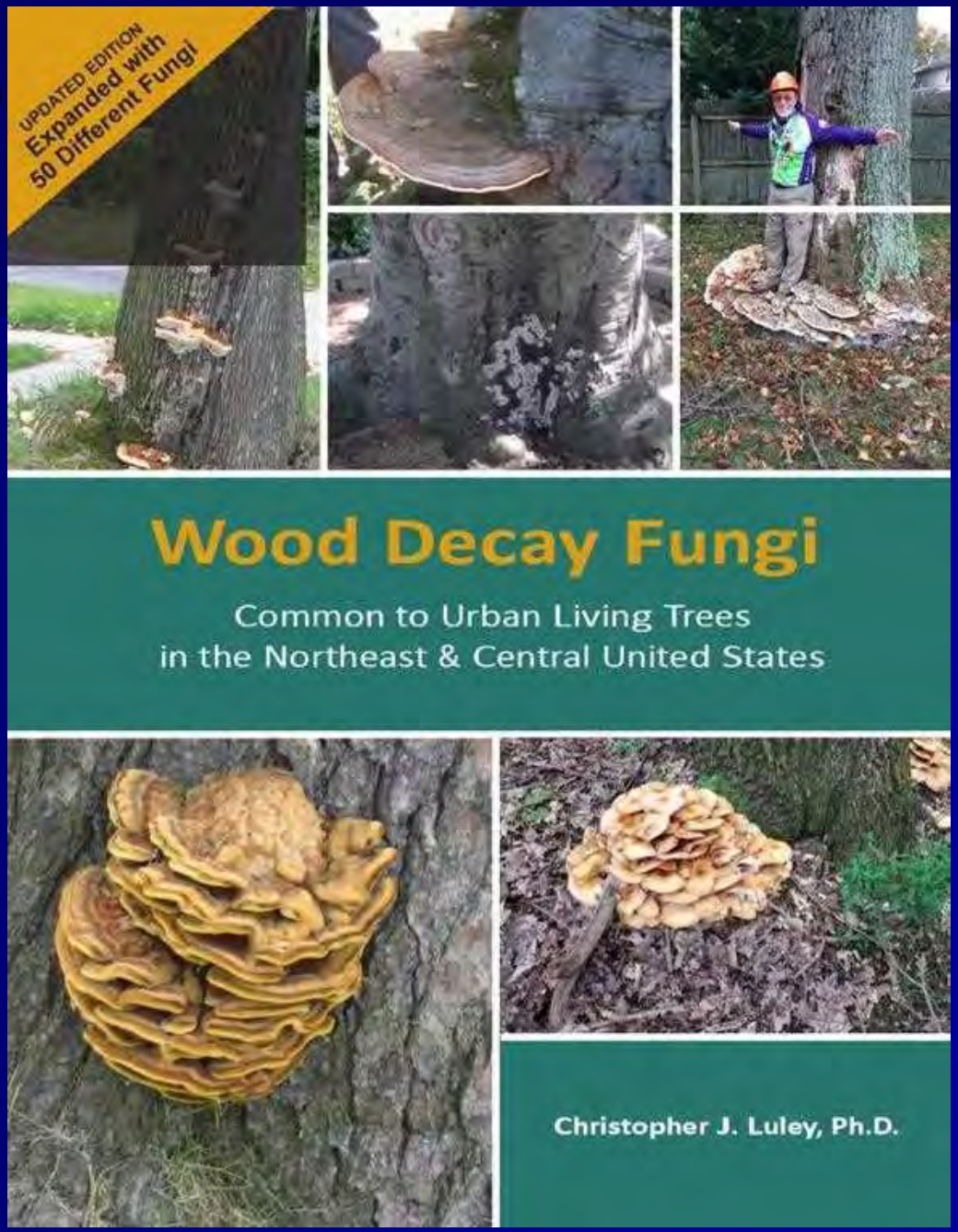
- 50 Different Fungi
- 300+ Images
- 145 pages
- Completely rewritten
- Online read-only version at Treerot.com $35



What's New?

- Virtually all the names have changed or species have been split up
- Gathering information via decay testing





New Names

- Many species have been split into several different species
  - *Ganoderma* sessile
    - *G. lucidum*
    - *G. curtsii*
  - *Laetiporus sulphureus*
    - *L. cinncinatus*
  - *Pleurotus ostreatus*
    - *P. pulmonarius*

New Names

- Genetic analysis has renamed a good number of species
- *Phellinus (Fomes) robiniae = Fulvifomes robiniae*
- *Phellinus (Fomes) pini = Porodaedalea pini*
- *Fomitopsis (Polyporus) spraguei = Niveoporofomes spraguei*

The large print giveth, the small print taketh away

- Positive ID on any fungi you eat
- On trunk of living trees, “no” “poisonous” fungi
  - On ground around trees all bets off
- People react to new proteins

Medicinal Fungi-Living Trees!

Maitake

Grifola frondosa

Reishi

Ganoderma sessile

Medicinal Fungi

Ganoderma applantum

Artist Conk

Medicinal Fungi

Chaga on Birch

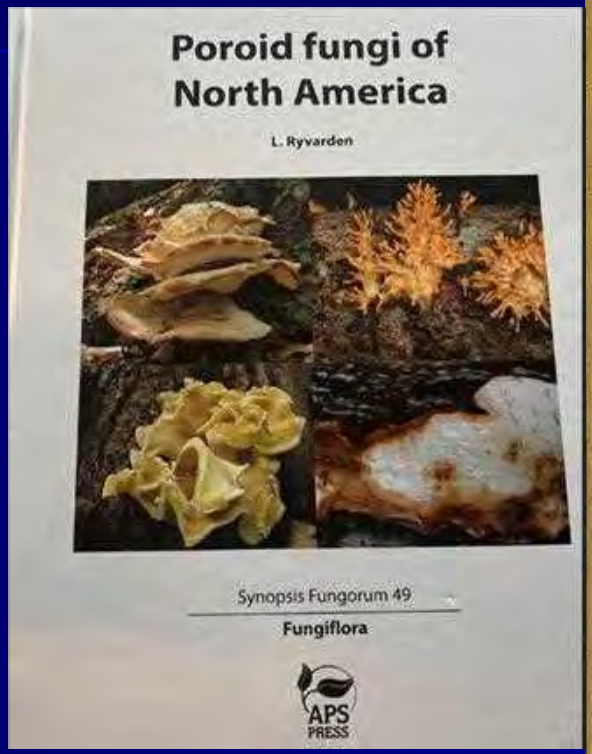
Inonotus obliquus

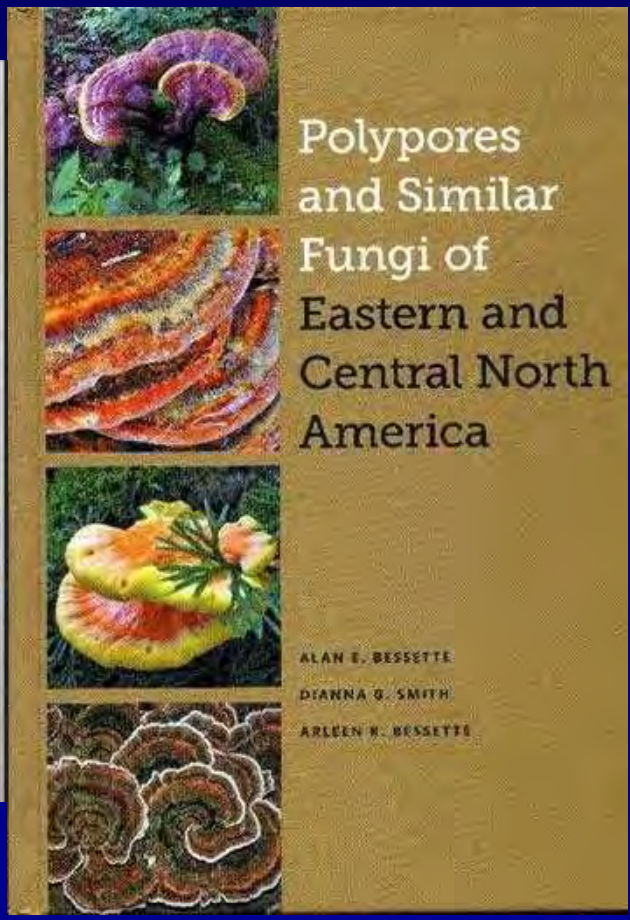
Lion's Mane On oak

Hericium erinaceus

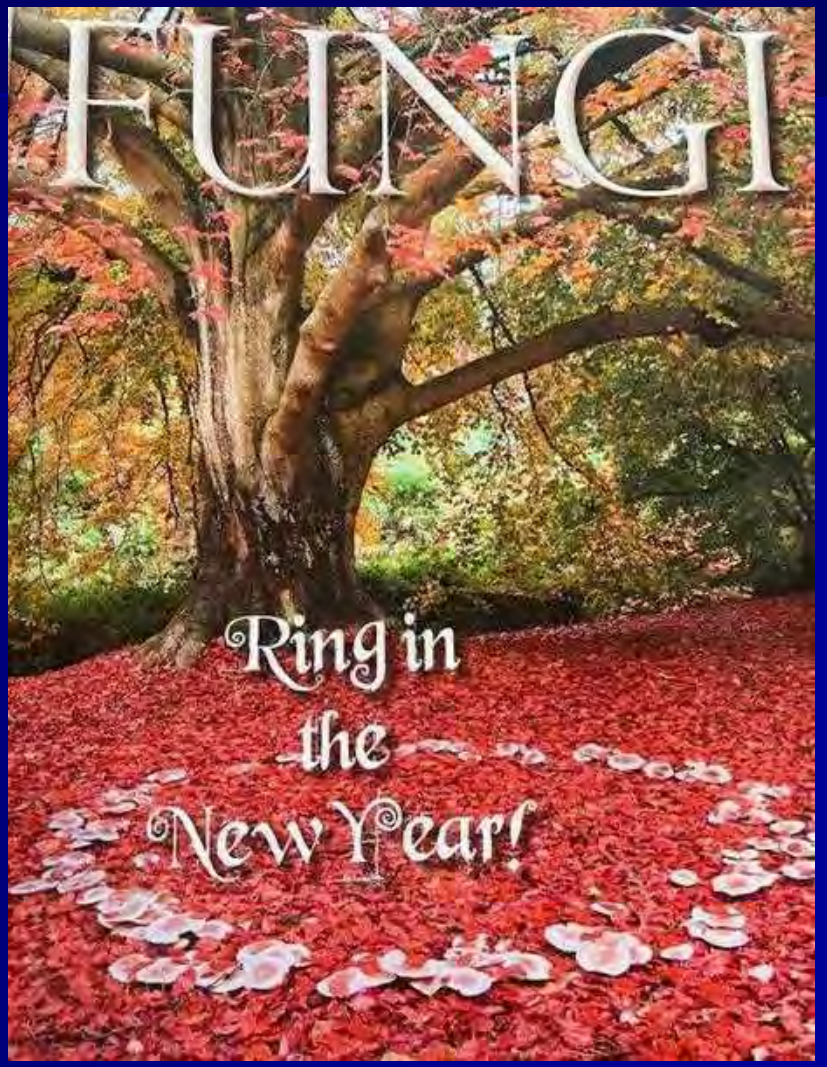
Other Manuals and Online Resources

- Excellent mycological resources
- Online resources
  - Mushroomexpert.com
  - Gary Emberger
    - messiah.edu
- Not very good on pathology
  - Possibly wrong



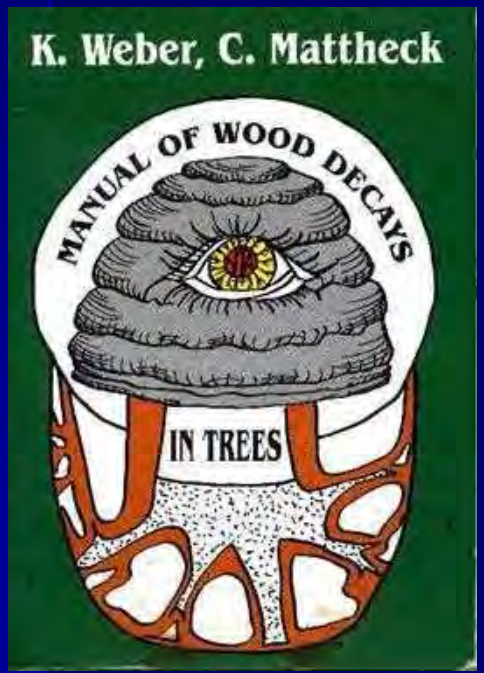


Fungi Magazine $20 per year



European Manuals

- Good manuals!
- Not appropriate for use in North America



Today's Topic

CONTINUING EDUCATION UNIT

The Big Five and Urban Decay Ecology

By Christopher Luley

Learning Objectives

- Learn about the common wood decay fungi likely to affect urban trees.
- Review the difference between facultative pathogens and obligate saprophytes.
- Understand the different methods of identification of wood decay fungi.

CEUs: A, U, M, T, L, Bs, Bp

Reaction Zone—Primarily chemical barriers to decay fungi formed by living, thin-walled parenchyma cells in the sapwood in response to fungal invasion.

Barrier Zone—Also known as Wall 4, the barrier zone is formed by the cambium at the time of wounding; it contains chemical and physical barriers to decay and is the strongest barrier in living trees.

Figure 1. Some wood decay fungi have the unique capacity to breach barrier zones and reaction zones and cause progressive amounts of decay in urban trees. These fungi, such as *Ganoderma applanatum*, shown here breaching reaction zones in a red oak (*Quercus rubra*), are termed facultative pathogens.

There are thousands of fungi that decay wood and produce fruiting bodies on wood (Gilbertson 1980). Fortunately, the number of fungi that decay the wood of living trees is substantially less, partially because of the natural protective barriers that living trees have against wood decay fungi. Although there have been no systematic studies of decay fungi frequency in urban trees in North America, observations indicate that the fruiting of some species is more common. Importantly, there are only a limited number of fungi that commonly fruit and are important to the vitality and stability of urban trees.

One premise of this article is that urban environments and tree species composition affect the species diversity of urban decay fungi. The common and important decay fungi of urban trees in North America have similar characteristics that lend themselves to decaying and fruiting on urban trees. For arborists, this is an important point, as urban conditions potentially reduce the number of important fungi that they are likely to encounter.

All the more destructive wood decay fungi that affect living urban trees are facultative pathogens, meaning that they have the capacity to attack living sapwood and in some cases kill bark and cambium after becoming established in a tree (Shortle and Dudzik 2012). They uniquely have the ability to breach the barrier zones or reaction zones found in living sapwood (Figure 1). The breaching of barriers to decay seems to happen more commonly in physiologically weakened or mechanically damaged trees.

Therefore, management practices such as watering during drought periods or other practices that help maintain tree health are also thought to help slow decay progression.

I have arbitrarily designated five important and common facultative pathogens on urban trees that, based on my observations and limited research (Luley et al. 2009), arborists should be familiar with. The Big Five (Luley 2022) of deciduous trees in order of importance are presented in Table 1.

Table 1. The Big Five common and important decay fungi of urban trees.

Name	Common name	Common hosts	Type of decay	Type of fruiting	Perennial or annual	Fruiting location
Kretzschmaria deusta (Figures 2 and 3)	Brittle cinder fungus	Maple, beech, hickory, hackberry, oak	Soft rot	Black stromatic tissue	Annual	Fruiting tissue and bark
Pseudoinonotus dryadeus (Figures 4, 5, and 6)	Weeping polypore	Oak, sometimes maples	White rot	Bracket	Annual	Roots or very base of tree
Ganoderma tsuga (Figures 7 and 8)	Reishi	Maple, oak, hickory, beech	White rot	Bracket	Annual	Roots or bark
Armillaria mellea (Figure 9)	Honey mushroom	Maple, oak, most urban species	White rot	Mushroom	Annual	Roots or very base of tree
Ganoderma applanatum (Figures 1 and 10)	Artist's conk	Maple, oak, birch	White rot	Conk	Perennial	Bark or trunk

Figure 2a. (right) The light-gray stromal mats of *Kretzschmaria deusta* on a European beech (*Fagus sylvatica*). This fungus is one of the most overlooked and destructive wood decay fungi of urban trees in the Northeastern US.

Figure 2b. (above) Decay in the base of some beech seven years later.

Pathology of Decay Fungi

Shortle and Dudzik 2012

Obligate Saprophytes

- Can only attack dead wood
  - Heartwood
  - Damaged sapwood

Facultative Pathogens

- Can attack
  - Heartwood
  - Healthy Sapwood
    - Dead or damaged also
  - Cambium and bark
    - Canker agents

Obligate Saprophytes

- Location of decay is often very important
- Relative to other defects
- Obligate saprophytes can be important and result in tree failures

Obligate Saprophytes

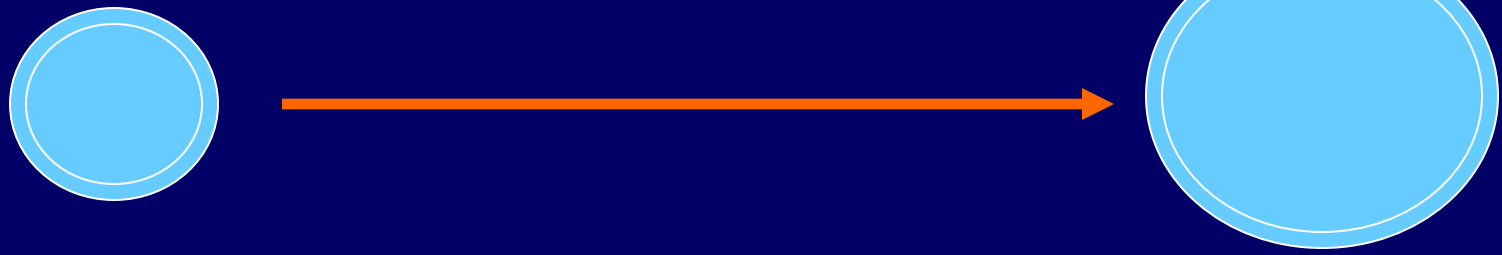
Do not have the ability to breach barrier zone or invade healthy sapwood

Heartwood can occupy large volume of trunk area

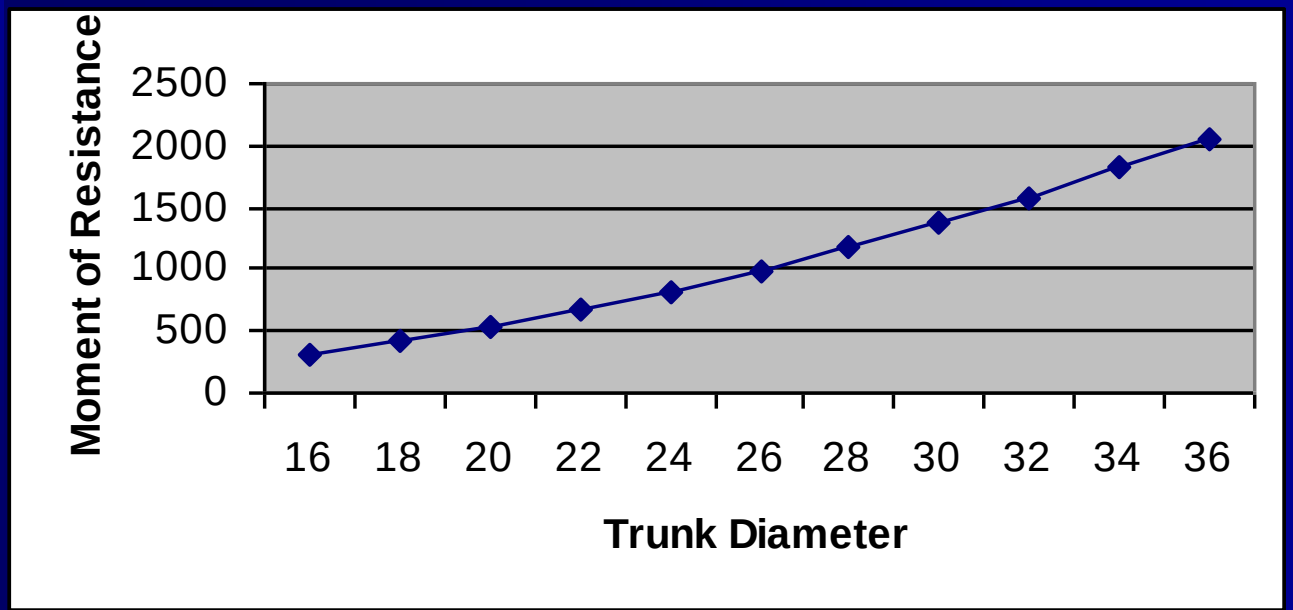
Heart rot or obligate saprophytes can be important to tree stability

Heartwood amount varies so potential impact also

Obligate saprophytes and Other Defects



- Increasing trunk diameter and decay at the same rate
- Amount of sound wood remains static
- Tree becomes more stable



$$MR = \text{pi} * \frac{D4 - d4}{32 * D}$$

Same Load Carrying Capacity
-Amount of Sound Wood Decreases
-Trunk Diameter Increases

Heart Rot?

- Some decay fungi invade healthy sapwood
  - Yet they are labeled heart rots
- Can breach barrier zone and reactions zones
- Facultative pathogens

Facultative Pathogens

Killing Bark and Cambium or a Canker Rot

Inonotus hispidus

- Can break barrier and reaction zones
- Decay healthy sapwood

Are Heart Rot Fungi Pathogens?

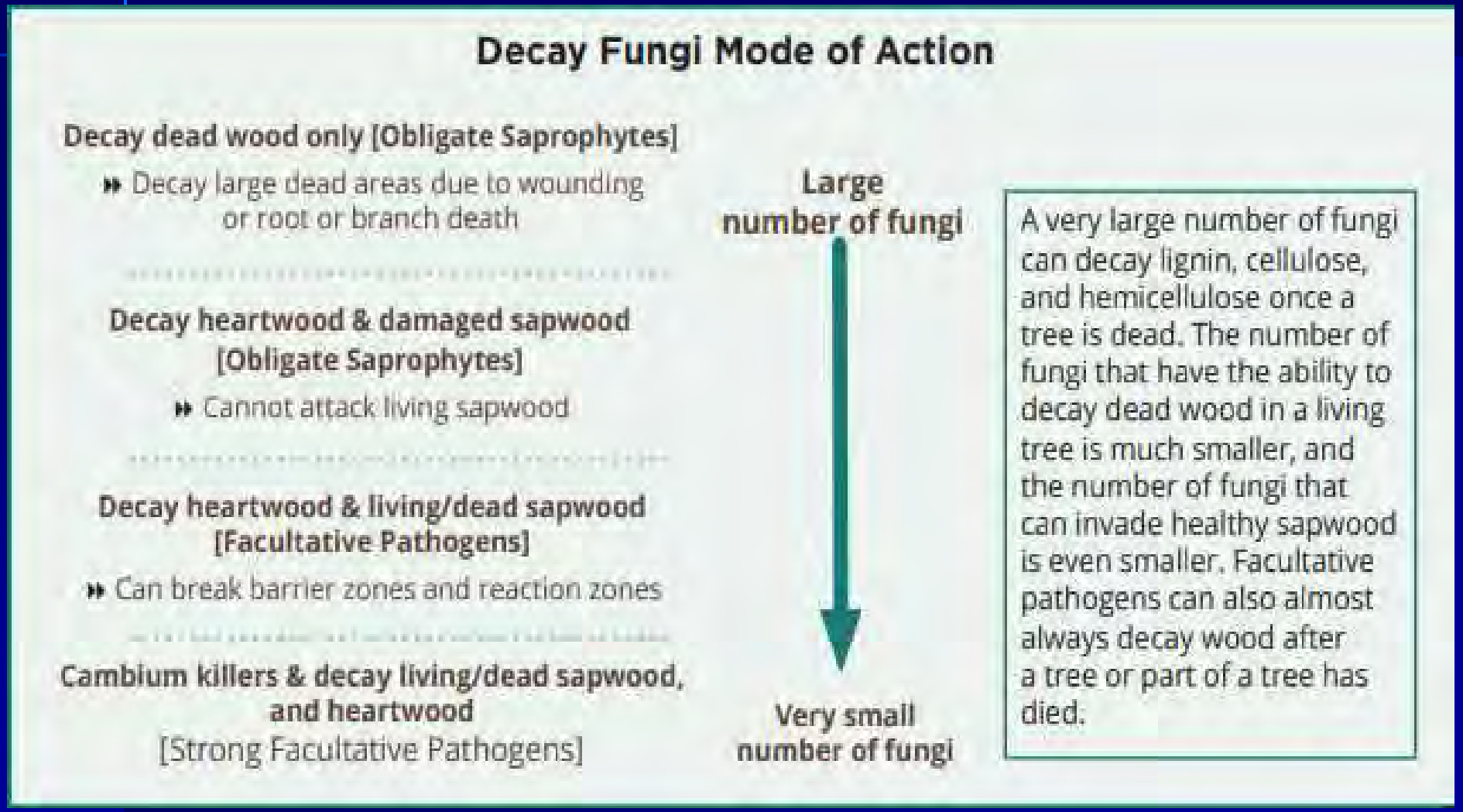
Heart Rot

- Decay in the center of a tree (Boddy 2021)
  - Without regard to pathogenicity of fungi present
- Basically a meaningless term
  - Mixed those fungi that only decay heartwood with those that invade healthy sapwood
- What about trees that don't form true heartwood?

Pathogenicity?


Cerioporus squamosus

Not All Decay Fungi Are Equal



Identification REALLY Matters

Negligence?

Pseudoinonotus dryadeus

Ganoderma sessile

Kretzschmaria deusta

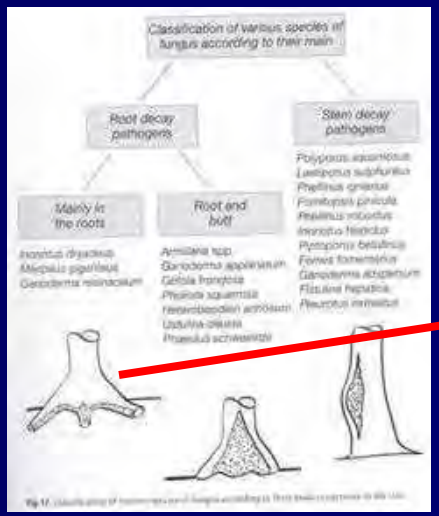
Trevor Hall

Russ Carlson

Gary Raffel

Identification Matters

- Diagnostic approach
  - Decay Presentation
- Biology
  - Decay type
  - Pathogenicity
- Long term prognosis



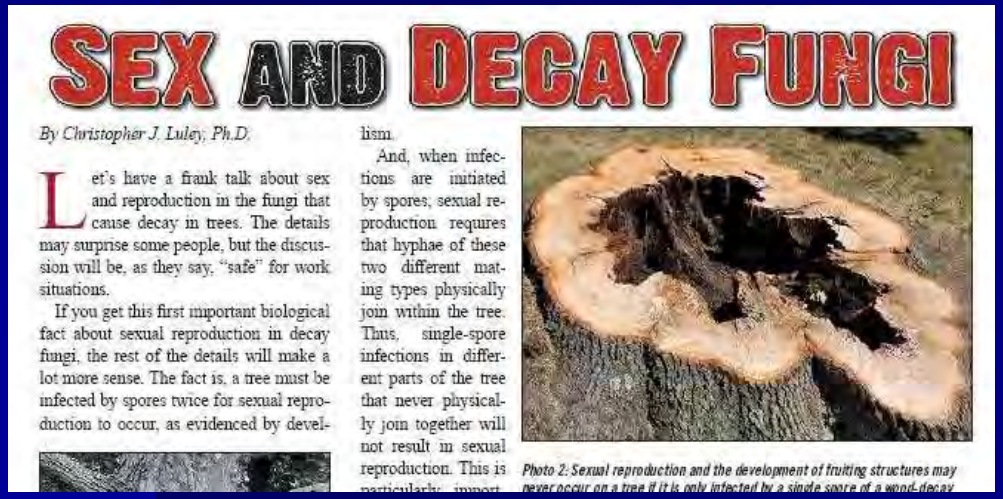
Identification Matters

Grifola frondosa

Pseudoinonotus dryadeus

Multiple Decay Infections

- Do not discount multiple infections
- Most decay fungi require two spore infections to sporulate
  - Mating types



SEX AND DECAY FUNGI

By Christopher J. Luley, Ph.D.

Let's have a frank talk about sex and reproduction in the fungi that cause decay in trees. The details may surprise some people, but the discussion will be, as they say, "safe" for work situations.

If you get this first important biological fact about sexual reproduction in decay fungi, the rest of the details will make a lot more sense. The fact is, a tree must be infected by spores twice for sexual reproduction to occur, as evidenced by develism.

And, when infections are initiated by spores, sexual reproduction requires that hyphae of these two different mating types physically join within the tree. Thus, single-spore infections in different parts of the tree that never physically join together will not result in sexual reproduction. This is

Photo 2: Sexual reproduction and the development of fruiting structures may never occur on a tree if it is only infected by a single spore of a wood-decay

Know the ones you Know

Goal

- Facilitate identification and assessment of common wood decay fungi

Chris Sandstrom

The Ganoderma Trap

- Fungi that slightly resembles *Ganoderma* gets that name
- *Ganoderma* genus includes
  - Annual and perennial fungi
  - Pathogens and saprophytes
- Bracket of a wood decay fungus
  - Tree has decay
  - Fruiting releases spores
  - Rest is context driven

Significance of Conks

- Type of decay
- Likely location of decay
- Pathogenicity
- Potential severity and progression
- Potential need and type of advanced decay testing
- Potential for adjacent trees to be affected
- Potential impact on biological health
- Need and type of follow up laboratory identification such as speciation
- Edibility, medicinal uses, dyes, tinder, amadou

Identifying/Observing

URBAN FORESTRY LLC

Photographing and Documenting Mushrooms and Conks

Taking the good photographs can greatly improve the chance of obtaining a more accurate evaluation or identification of the fungus growing on or around a tree. Some fungi are so common that a single good photograph is adequate for identification, while others require several and specific pictures of certain features. Some fungi cannot be identified from pictures and require fresh samples in good condition for macroscopic evaluation.

The following are desired photographs requested for use of our diagnostic service. Examples are provided as a guide. If the fungus has gills under the cap (# 3 below) and is growing on the ground or lower trunk of the tree, the color of the spore print will be needed for identification (5c #4).

1. General Habit: What the specimen looks like from several feet away. If the fruiting is higher in the tree use the zoom on your camera. Examples below.


2. Close up of top of the mushroom or conk.


Christopher J. Luley, PhD. Mushroom-Conk Identification

3. Close-up of underside of mushroom or conk (you will be taking pictures of the teeth, gills, pores or a smooth surface)


4. Make a spore print of gilled mushrooms (such as the right photo in #3 above). Spore prints are easy to make and are usually needed to identify mushrooms growing on the ground around or on trunk of the tree. Make the print by simply placing the cap of the mushroom on a piece of white and dark paper. Covering with a bowl can speed the dropping of the spores. Take a photo of the spore print or record its color.


Christopher J. Luley, PhD. Mushroom-Conk Identification

Spore Layer Observation

Annual

Perennial

TreeRot.com Wood Decay Fungi of Living Trees

- Filters or Keys to ID decay fungi on living trees
- 50+ Wood Decay Fungi
  - Images
  - Important information on each decay fungus

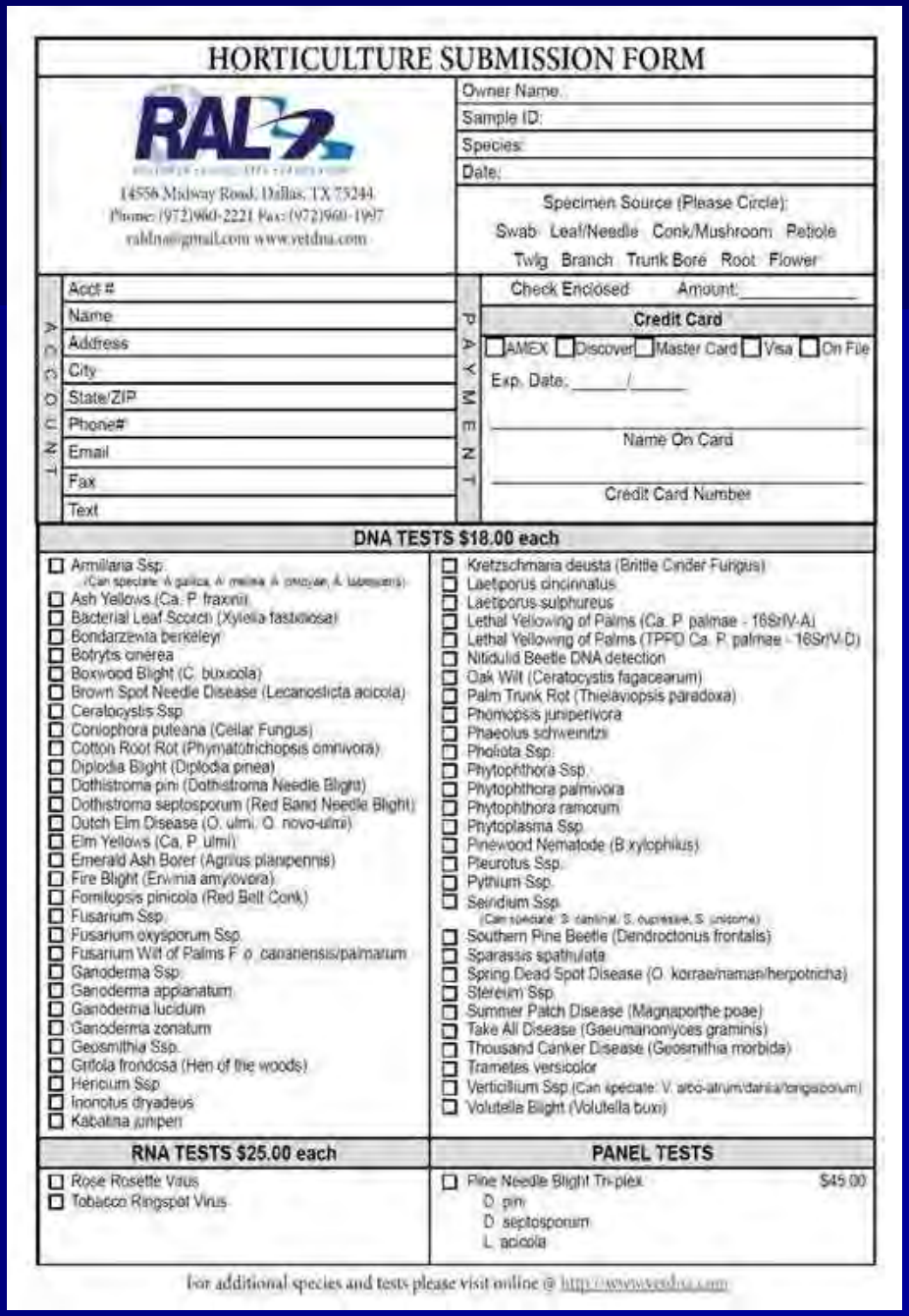
Annual, hardwood, upper trunk

Cerioporus squamosus

Hericium erinaceus

DNA Testing

- Research Associates Lab
  - Houston, TX
  - Vetdna.com
- PCR Realtime
  - Fragments of DNA
- Request based
  - Have to know disease or pest
- Very small samples
- High potential for contamination



HORTICULTURE SUBMISSION FORM

RAL

14556 Midway Road, Dallas, TX 75244
Phone: (972)960-2221 Fax: (972)960-1997
raldfw@gmail.com www.vetdna.com

Owner Name:
Sample ID:
Species:
Date:

Specimen Source (Please Circle):
Swab Leaf/Needle Conk/Mushroom Petiole
Twig Branch Trunk Bore Root Flower

ACCOUNT
Acct #
Name
Address
City
State/ZIP
Phone#
Email
Fax
Text

PAYMENT
Check Enclosed Amount:
Credit Card
AMEX Discover Master Card Visa On File
Exp. Date: /
Name On Card
Credit Card Number

DNA TESTS $18.00 each

- Armillaria Ssp. (Can speciate: A. gallica, A. mellea, A. ostoyae, A. tabescens)
- Ash Yellows (Ca. P. fraxini)
- Bacterial Leaf Scorch (Xylella fastidiosa)
- Bondarzewia berkeleyi
- Botrytis cinerea
- Boxwood Blight (C. buxicola)
- Brown Spot Needle Disease (Lecanosticta acicola)
- Ceratocystis Ssp.
- Coniophora puteana (Cellar Fungus)
- Cotton Root Rot (Phymatotrichopsis omnivora)
- Diplodia Blight (Diplodia pinea)
- Dothistroma pini (Dothistroma Needle Blight)
- Dothistroma septosporum (Red Band Needle Blight)
- Dutch Elm Disease (O. ulmi, O. novo-ulmi)
- Elm Yellows (Ca. P. ulmi)
- Emerald Ash Borer (Agrilus planipennis)
- Fire Blight (Erwinia amylovora)
- Fomitopsis pinicola (Red Belt Conk)
- Fusarium Ssp.
- Fusarium oxysporum Ssp.
- Fusarium Wilt of Palms F. o. canariensis/palmarum
- Ganoderma Ssp.
- Ganoderma applanatum
- Ganoderma lucidum
- Ganoderma zonatum
- Geosmithia Ssp.
- Grifola frondosa (Hen of the woods)
- Hericium Ssp.
- Inonotus dryadeus
- Kabatina juniperi
- Kretzschmaria deusta (Brittle Cinder Fungus)
- Laetiporus cincinnatus
- Laetiporus sulphureus
- Lethal Yellowing of Palms (Ca. P. palmae - 16SrIV-A)
- Lethal Yellowing of Palms (TPPD Ca. P. palmae - 16SrIV-D)
- Nitidulid Beetle DNA detection
- Oak Wilt (Ceratocystis fagacearum)
- Palm Trunk Rot (Thielaviopsis paradoxa)
- Phomopsis juniperivora
- Phaeolus schweinitzii
- Pholiota Ssp.
- Phytophthora Ssp.
- Phytophthora palmivora
- Phytophthora ramorum
- Phytoplasma Ssp.
- Pinewood Nematode (B.xylophilus)
- Pleurotus Ssp.
- Pythium Ssp.
- Seiridium Ssp. (Can speciate: S. cardinal, S. cupressi, S. unicorne)
- Southern Pine Beetle (Dendroctonus frontalis)
- Sparassis spathulata
- Spring Dead Spot Disease (O. korrae/naman/herpotricha)
- Stereum Ssp.
- Summer Patch Disease (Magnaporthe poae)
- Take All Disease (Gaeumannomyces graminis)
- Thousand Canker Disease (Geosmithia morbida)
- Trametes versicolor
- Verticillium Ssp (Can speciate: V. albo-atrum/dahlia/longisporum)
- Volutella Blight (Volutella buxi)

RNA TESTS $25.00 each

- Rose Rosette Virus
- Tobacco Ringspot Virus

PANEL TESTS

- Pine Needle Blight Tri-plex $45.00
  - D. pini
  - D. septosporum
  - L. acicola

For additional species and tests please visit online @ http://www.vetdna.com

What is the Identification

Meripilus sumstinei

Bondarzewia berkeleyi

The Big Five

- Must knows!
- *Kretzschmaria deusta*
- *Pseudoinonotus dryadeus*
- *Ganoderma (lucidum) sessile*
- *Armillaria mellea*
- *Ganoderma applanatum*
- *Phaeolus schweinitzii*

Ustulina

Kretzschmaria

(Hypoxylon deustum)

deusta

Burnt Crust Fungus

Black, crumbly stromatic tissue

Buttress Root and Butt Rot

Cambium Killer

Imperfect State

Asexual spore state

Imperfect State

Asexual spore state

Asexual State

Decay is typically **"advanced" when** fruiting

Perfect State


Ascopores in an ascus

Soft Rot-Brittle Decay

Trevor Hall, Bartlett Tree Experts

Before and After Silver maple

Red Maple

Trevor Hall, Bartlett Tree Experts

Sugar Maple

Wide Host Range

Red oak

Linden

Pignut Hickory

European Beech

Kretzschmaria deusta on Hackberry a Disaster

Pecan

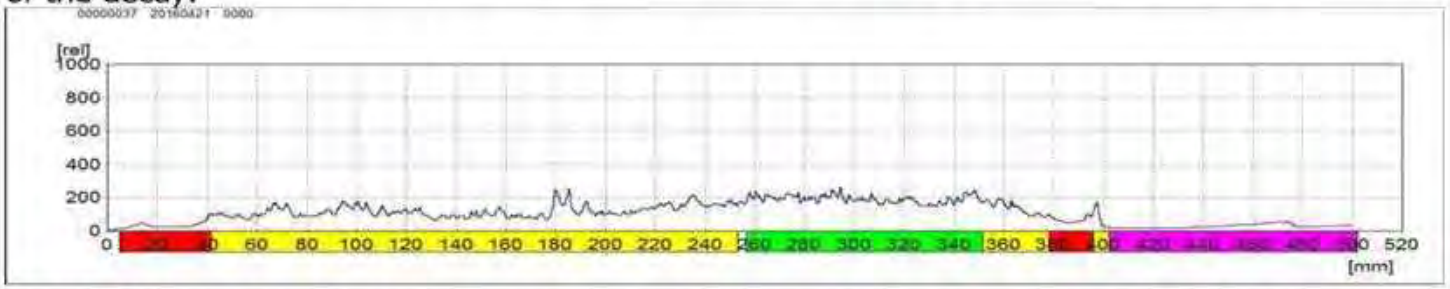
Will kill bark, cambium and sapwood, kill woundwood, penetrate Barrier and Reaction Zones

Sugar Maple

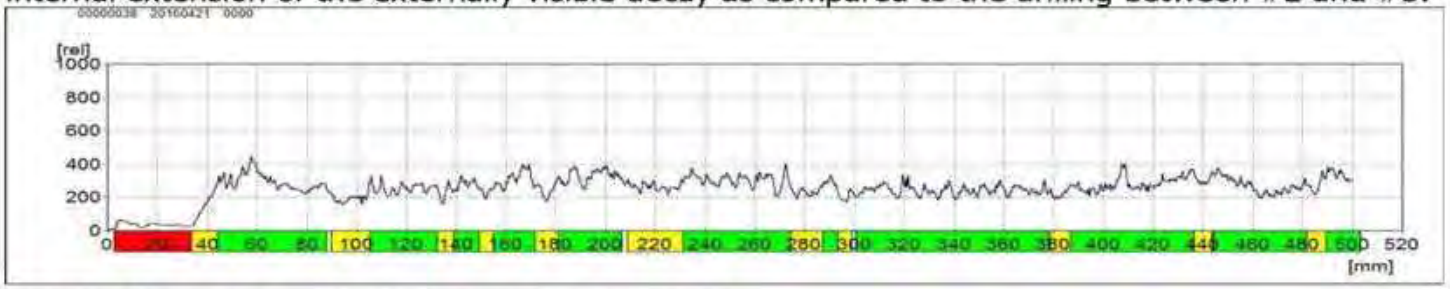
Internal cavities are uncommon

Sounding NOT useful for decay assessment

RESISTOGRAPH® profile of a drilling between sensors #2 and #3, showing the internal extension of the decay:

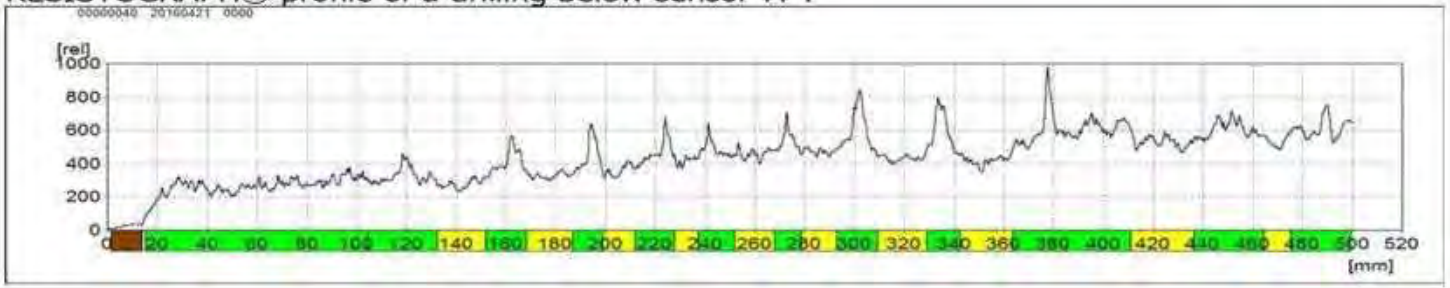


RESISTOGRAPH® profile of a drilling between sensors #6 and #7, showing a much smaller internal extension of the externally visible decay as compared to the drilling between #2 and #3:

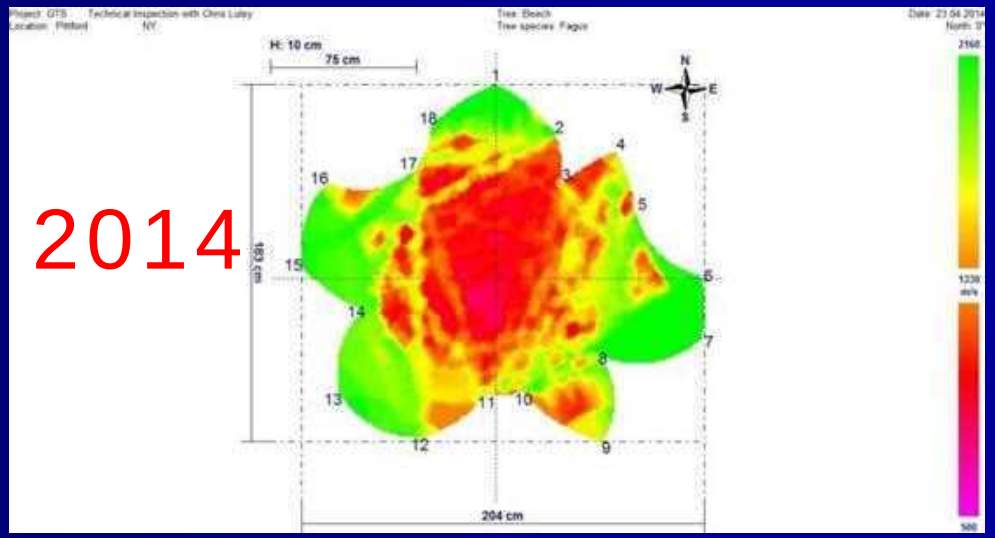


RESISTOGRAPH® profile of a drilling at sensor ?? :

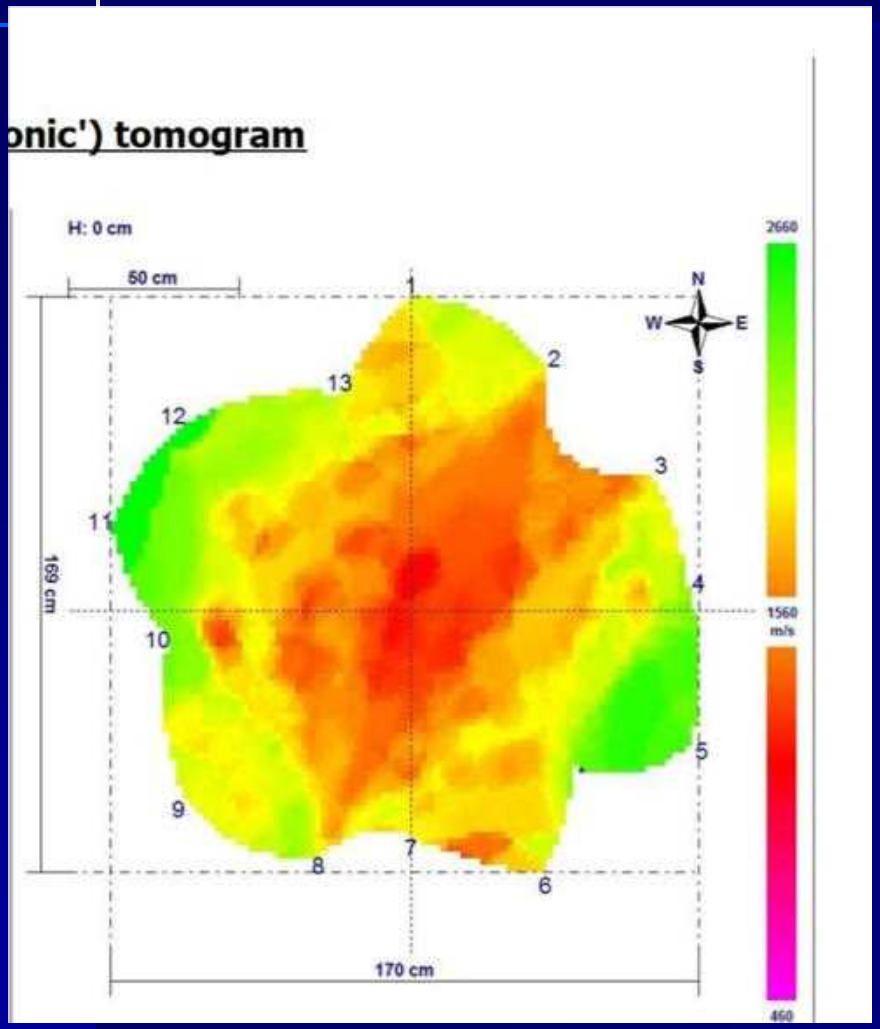
RESISTOGRAPH® profile of a drilling below sensor ?? :



2014



2016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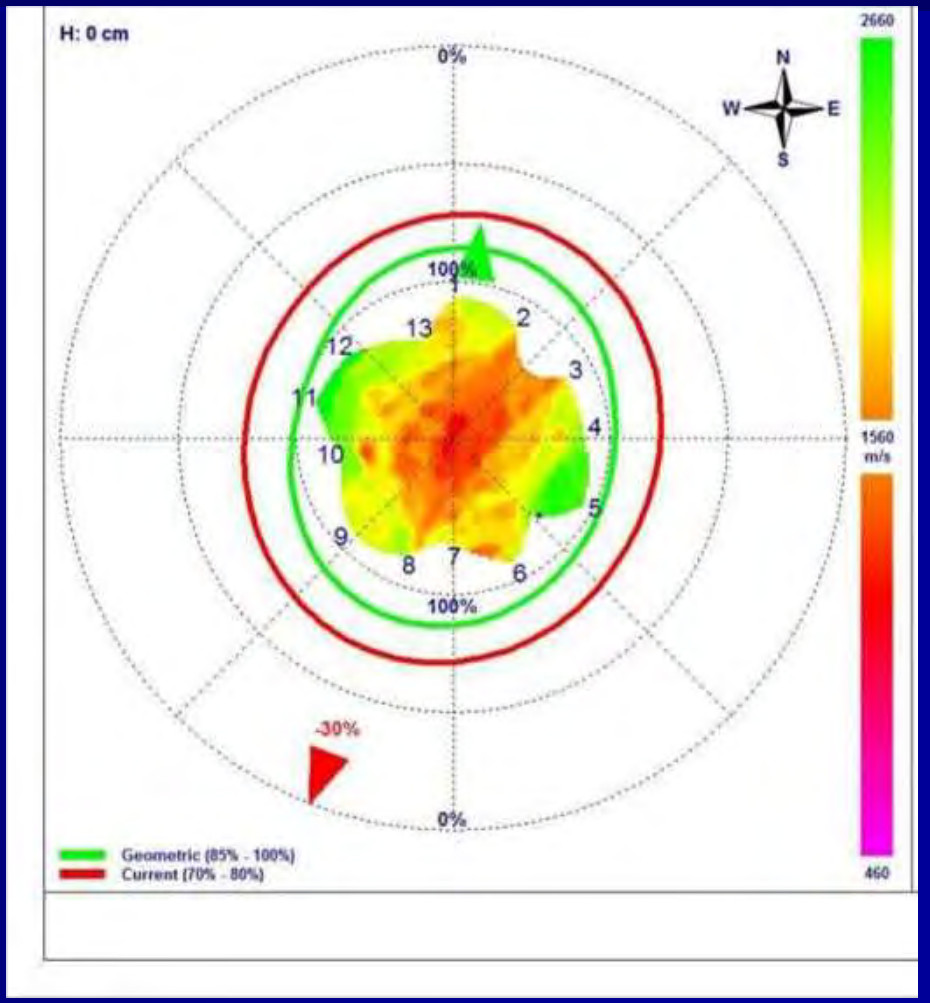
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Geometric (85% - 100%)
Current (70% - 80%)

Home » National News » Town bids farewell to...

Town bids farewell to iconic, 200-year-old copper beech tree

AP By The Associated Press
April 23, 2018 12:51 pm

A public ceremony is planned Monday evening to commemorate the tree that towers over Copper Beech Park in the Rochester suburb of Pittsford. It's dying from a devastating fungus.

Goodbye_Beech_59044 This 200-year-old tree in Copper Beech Park in Pittsford, New York, will be taken down due to a fungus. The fungus attacks the inside of the tree and town officials are afraid fall off. (Jamie Germano/Democrat & Chronicle via AP)

2018

1# Kretzschmaria deusta

- Over 30 species of *Kretzschmaria*
- Wide host Range but common on
  - Beech, Maple, Linden, Hickory
- Approach with care
  - Trees may be extensively decayed
- Soft rot decay is similar in strength loss to brown rot
- Common on stumps

#2 *Pseudoinonotus dryadeus* (*Inonotus dryadeus*)

Warted Polypore

Annual-July-October

On Roots or Very Base

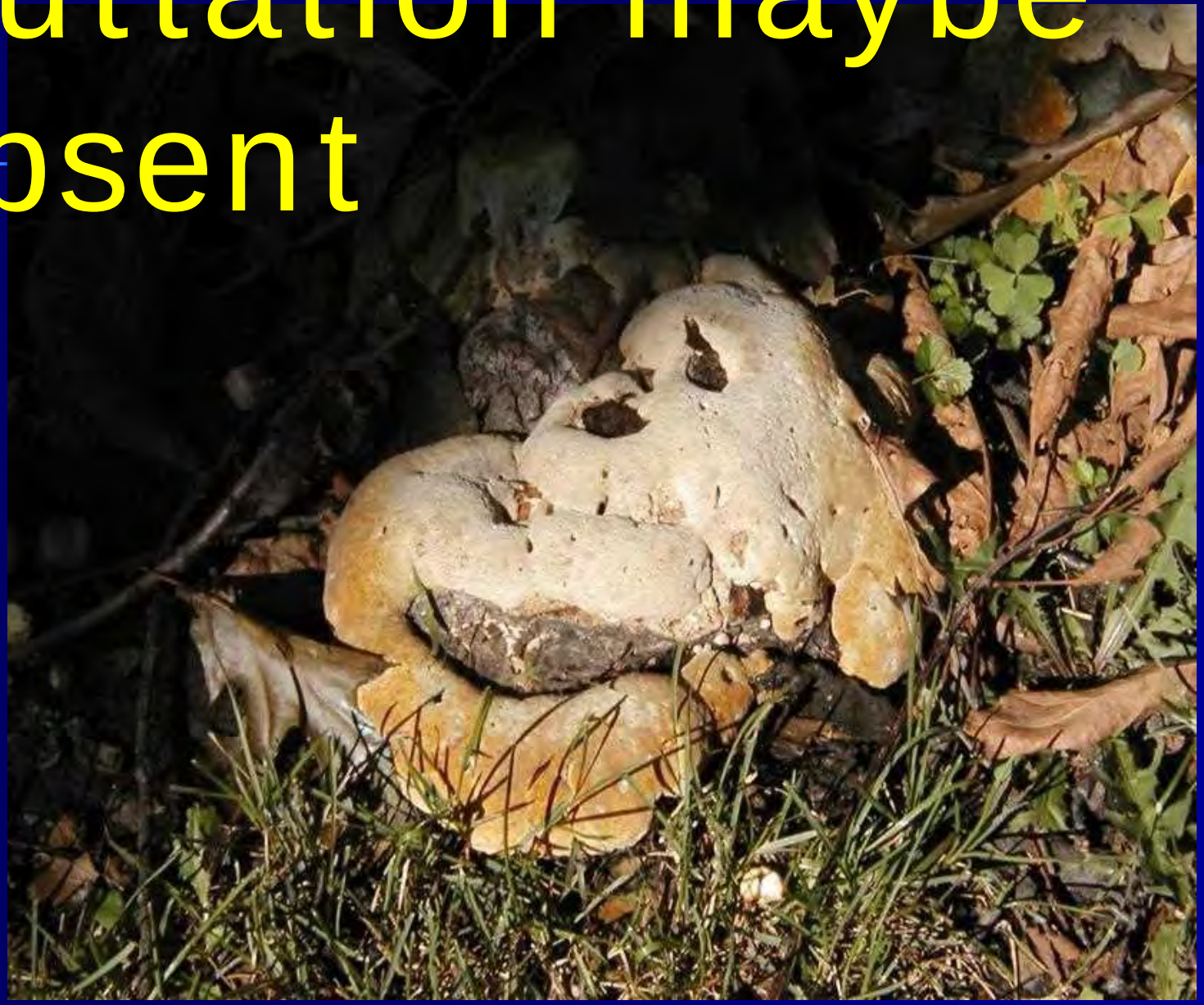
Oaks are the primary host
Reported on Norway maple in Canada

Brackets can be very large
Up to 2 feet in diameter

Turn tan/cream to brown relatively quickly

Guttation

Guttation maybe absent



Small pores, brown context

Crowns may show no symptoms

Crown may show few symptoms

P. dryadeus may produce mycelial growth on bark at end stages of decay

Multiple conks around base is trouble

Russ Carlson

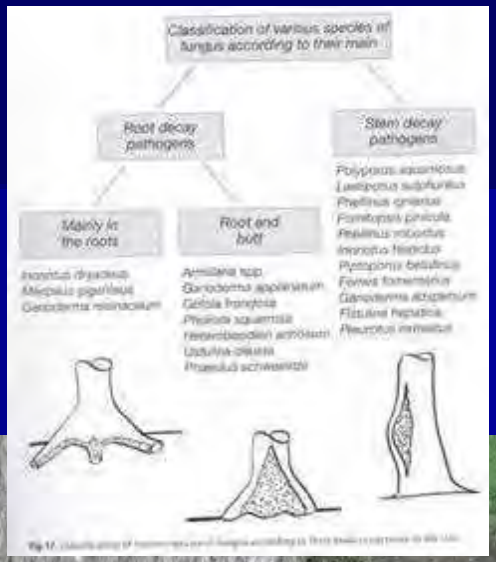
Russ
Carlson

Multiple conks mean trouble but one conk does not mean no trouble

Single conk?

Root Testing for Decay is Highly Recommended

Can be an aggressive decayer of structural roots



Decay Progresses from bottom of roots up to top

Pseudoinonotus dryadeus

- You are on notice
- Should recommend root decay testing
- Decay usually minimal in the butt
- End stages it may move into the butt
- Crowns may be relatively health appearing

Pseudoinontus dryadeus

- Mostly on oaks
- Root rot
  - Mostly restricted to roots
- Trees may show little outward symptoms of infection
  - Eventually may fail
- Must test for decay
  - Difficult in roots

#3 *Ganoderma* (*lucidum*) *sessile* <Reishi; Ling zi>

- White Root and Butt Rot
- Annual
- Likely a complex of species
- *Ganoderma curtsii-* oaks

Very Wide Host Range

Honeylocust

Norway maple

Crabapple

Red and White Oaks

Swamp white oak

- One year old conks

Annual and Tough

Appearing in latter part of summer

Sept 21

Oct 10

On roots or Butt

Shiny, brick-colored top with white margin


Following Spring

Kill Roots and may cause biological health decline and/or decay butt and roots

Ganoderma sessile

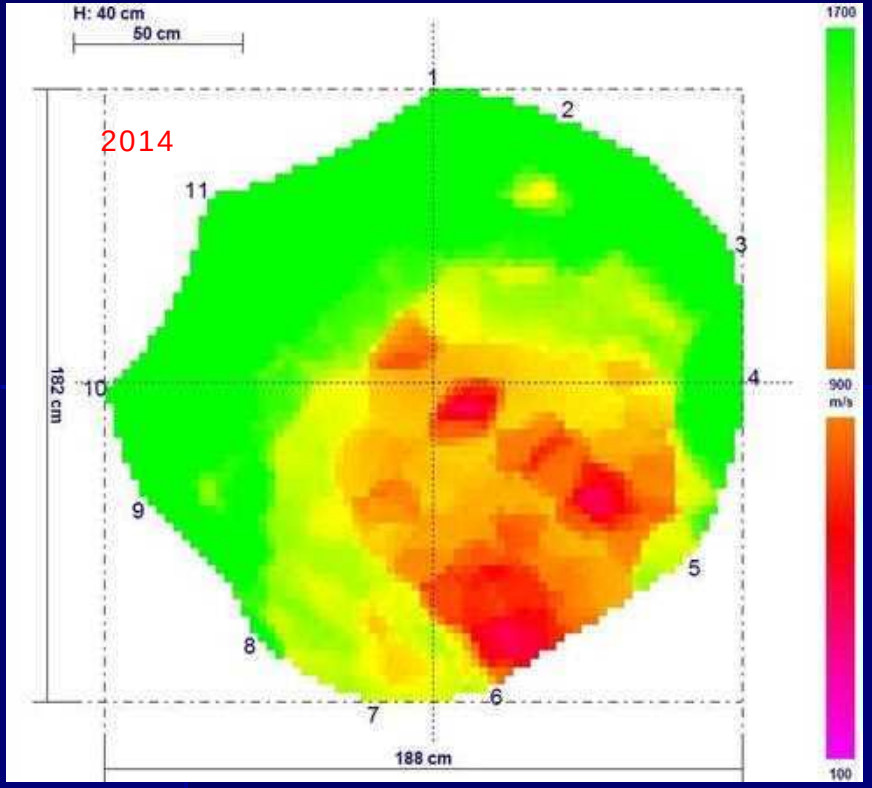
Most trees are probably removed before they fail

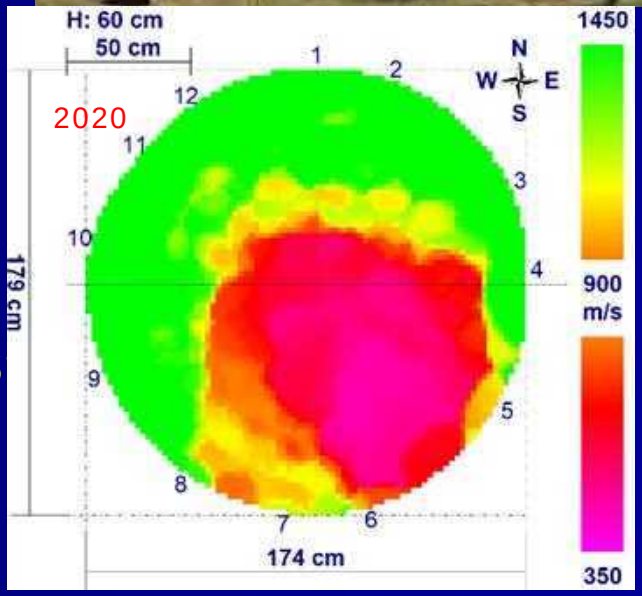
Ganoderma lucidum
Carya glabra

Silver maple

Norway Maple

White Butt and Root Decay


H: 40 cm
50 cm
2014
1
2
3
4
5
6
7
8
9
10
11
182 cm
188 cm
1700
900
m/s
100


H: 60 cm
50 cm
2020
N
W
E
S
1
2
3
4
5
6
7
8
9
10
11
12
179 cm
174 cm
1450
900
m/s
350

S

Decay may not progress much in to trunk

Gary Raffel

Ganoderma sessile

Not!

Ganoderma curtsii
Decline of landscape oaks

Loyd, A. L, et al. 2017. The laccate Ganoderma of the southeastern United States: A cosmopolitan and important genus of wood decay fungi. University of Florida. PP333. 6 pp.

Ganoderma sessile Reishi; Ling zi

- 11 trees with conks
- .6% of trees with conks
  - Sample projection 402 trees
- Average SW/SR = .64
- SW/SR Range 0.24 to 1
- Decay often undetected in trunk!

Ganoderma lucidum Anti-Cancer properties

Ganoderma lucidum (Reishi mushroom) has shown promising anticancer properties in laboratory studies, primarily due to its bioactive components like polysaccharides and triterpenes. Key findings include:

- **Immune Modulation:** Polysaccharides, particularly beta-glucans, enhance the immune system by activating macrophages, natural killer cells, and T cells. This immune response indirectly targets tumor cells [1] [3].
- **Direct Cytotoxicity:** Triterpenes, including ganoderic acids, exhibit direct cytotoxic effects on various cancer cell lines and inhibit angiogenesis and metastasis [2] [4].
- **Inhibition of Cancer Pathways:** Ganoderma lucidum suppresses transcription factors such as NF-κB and AP-1, reducing tumor invasiveness by limiting cell adhesion, migration, and proliferation [1] [2].
- **Synergistic Effects:** Recent studies suggest that Ganoderma

- **Synergistic Effects:** Recent studies suggest that Ganoderma polysaccharides can enhance the effectiveness of conventional cancer treatments like Docetaxel [7].

Despite these findings, there is insufficient clinical evidence to confirm its efficacy as a standalone cancer treatment. It is considered a potential complementary therapy and requires further human trials to validate its therapeutic role [5] [8].

#3
Ganoderma sessile
Reishi; Ling zi

#4 *Armillaria mellea*

- Honey mushroom,Shoestring root rot, Oak decay fungus
- White Root and butt rot

Armillaria mellea

- Morphologically similar appearing species of varying pathogenicity
- Over 40 biological species
  - RNA testing to speciate
  - Infertility testing in culture

Mushrooms appear in late August to October

Any Mushrooms appearing in spring and early summer are not *A. mellea*

Armillaria mellea

- Identifying Features-Mushrooms

1. Honey-colored caps
2. Cespitose clusters
3. Ring around the central stem
4. White spore print

Honey-colored caps

Not orange!

Cespitose or dense clusters attached to roots
-Not singe mushrooms!

Central Stem

Ring around stem

White/Ivory spore print

Armillaria mellea

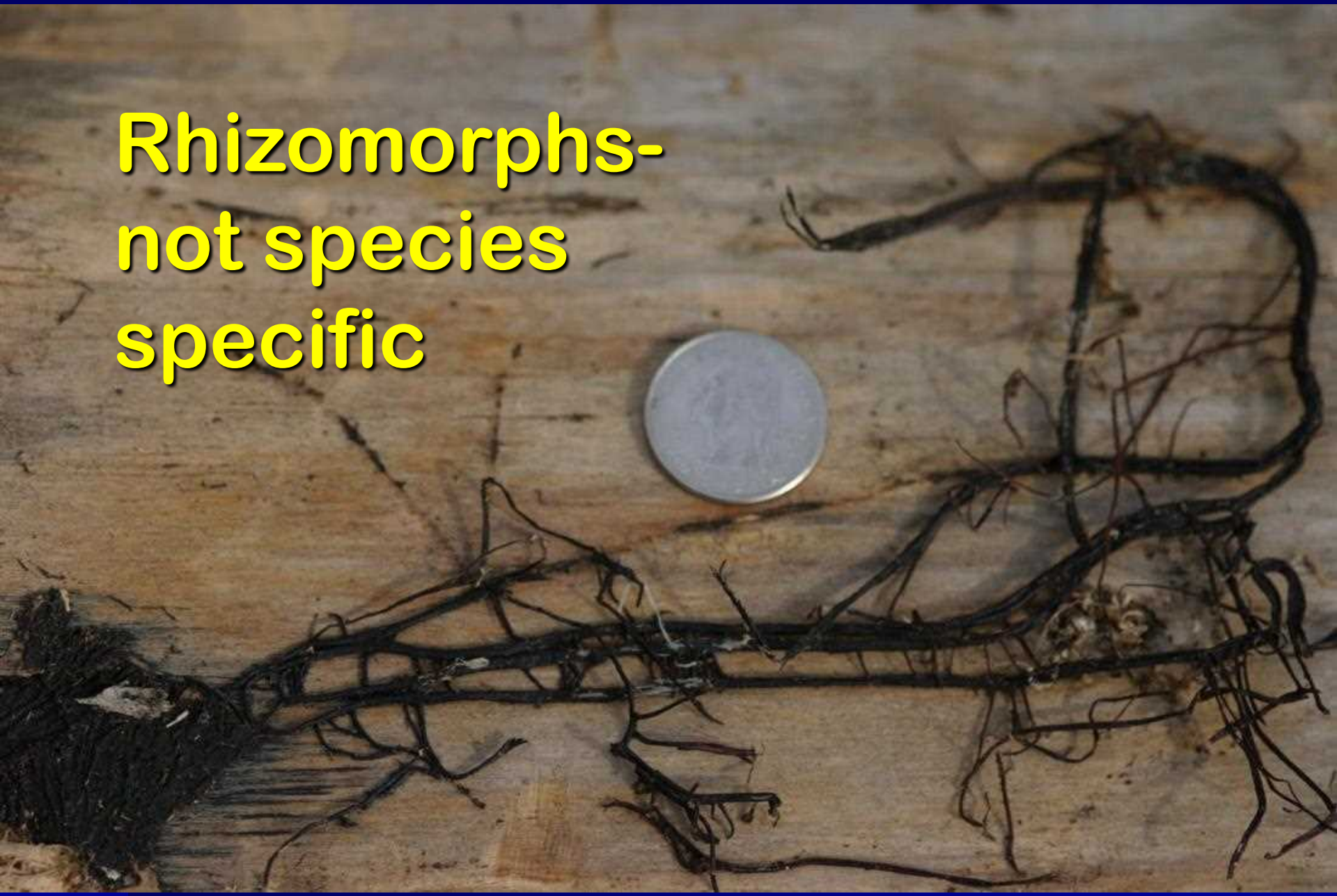
- Identifying Features-Mushrooms

1. Honey-colored caps
2. Cespitose clusters
3. Ring around the central stem
4. White spore print

Armillaria mellea

- Other Identifying Features
- On Dying Trees

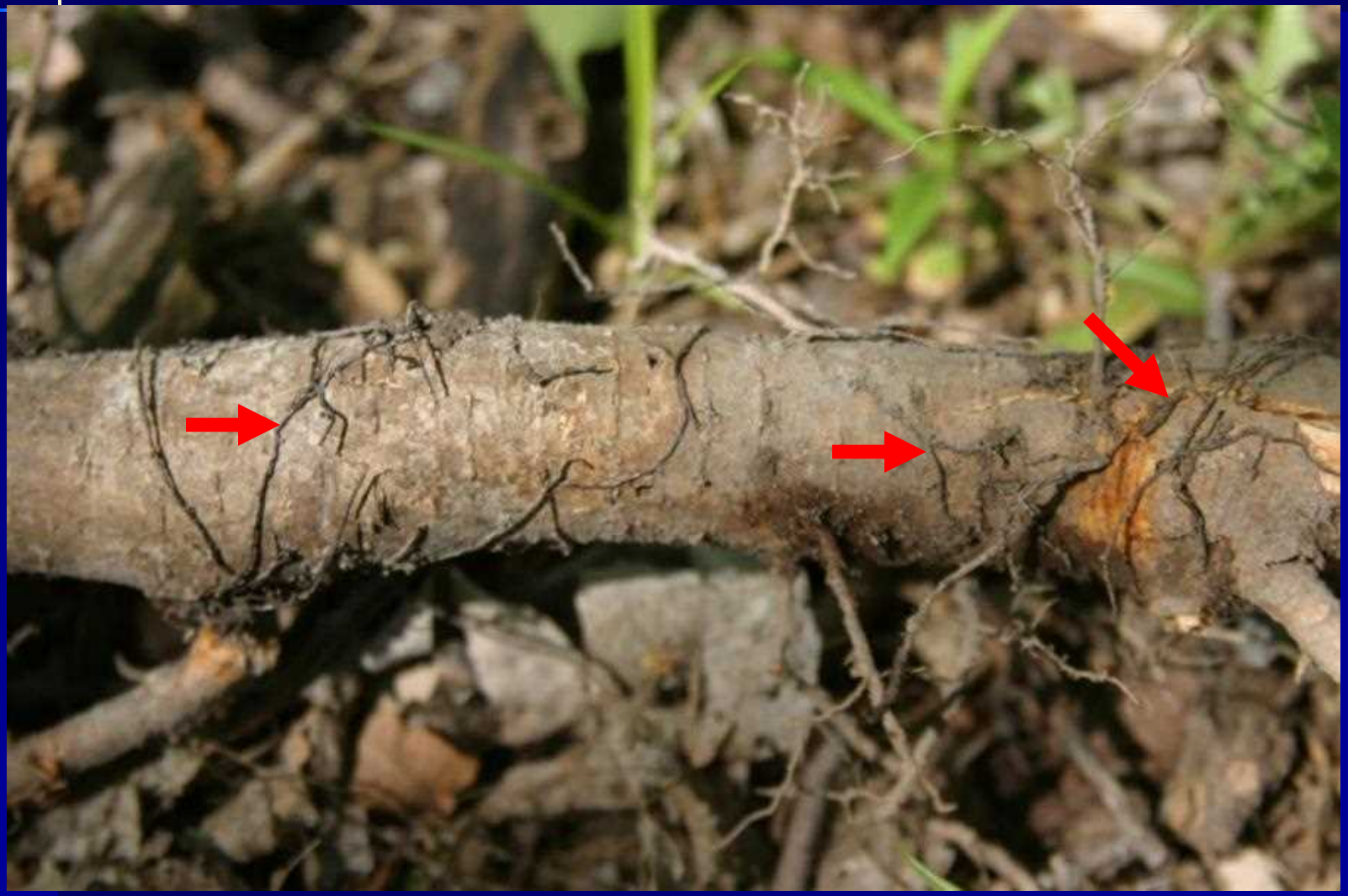
1. Rhizomorphs
2. Mycelial fans


Rhizomorphs-
not species
specific

Rhizomorphs are flattened under bark

Rhizomorphs

Round outside bark



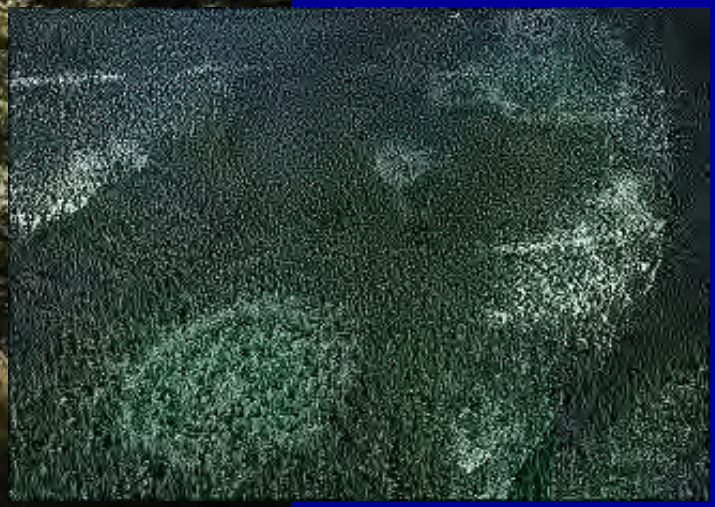

Mycelial Fans

Mycelial fans

Actively dying trees only

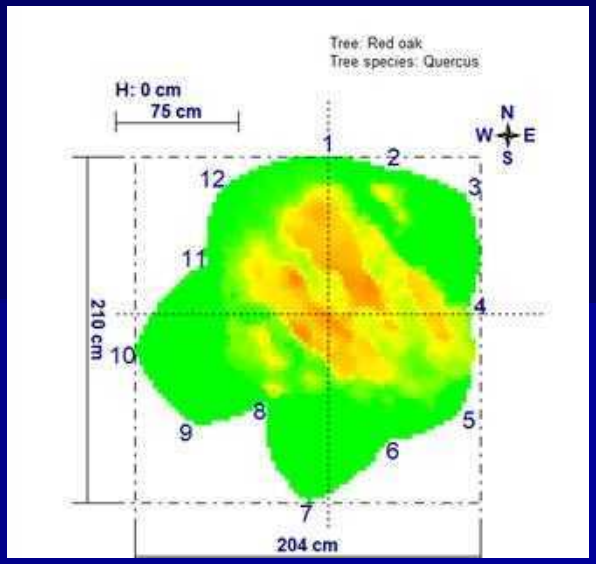
Killer of stressed trees

Most trees are probably removed before failure

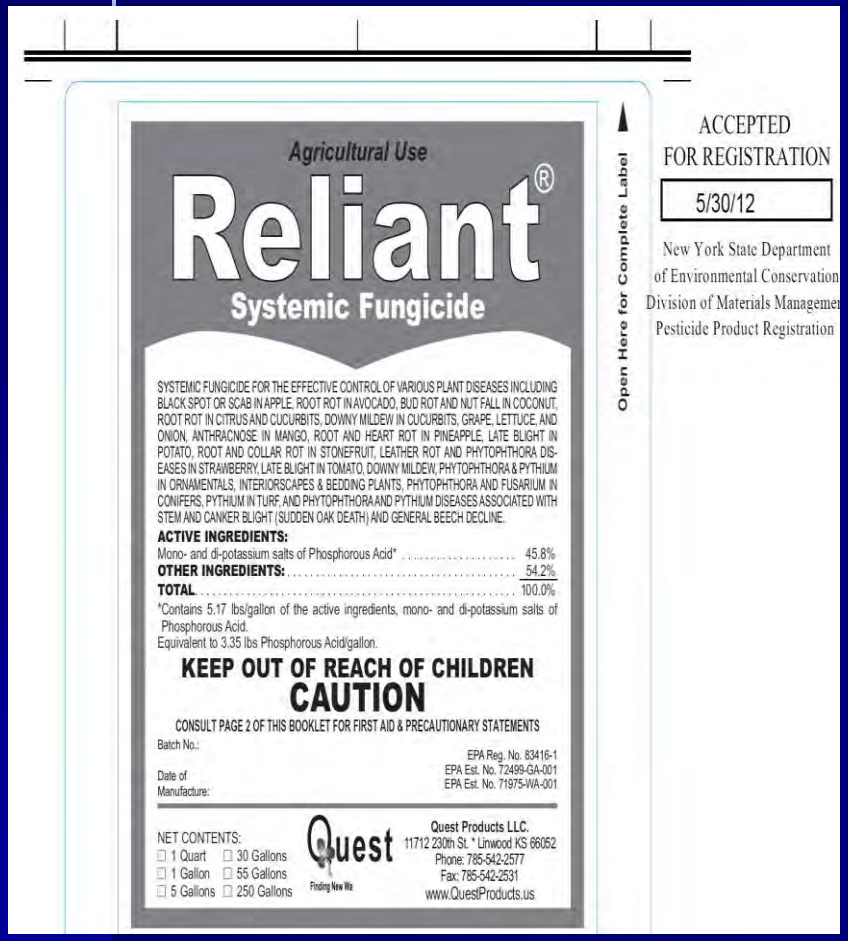


Armillaria will cause tree root failures

Under ground spread



Armillaria fungicide treatment
Expose infected area to air



Agricultural Use

Reliant®

Systemic Fungicide

SYSTEMIC FUNGICIDE FOR THE EFFECTIVE CONTROL OF VARIOUS PLANT DISEASES INCLUDING BLACK SPOT OR SCAB IN APPLE, ROOT ROT IN AVOCADO, BUD ROT AND NUT FALL IN COCONUT, ROOT ROT IN CITRUS AND CUCURBITS, DOWNY MILDEW IN CUCURBITS, GRAPE, LETTUCE, AND ONION, ANTHRACNOSE IN MANGO, ROOT AND HEART ROT IN PINEAPPLE, LATE BLIGHT IN POTATO, ROOT AND COLLAR ROT IN STONEFRUIT, LEATHER ROT AND PHYTOPHTHORA DISEASES IN STRAWBERRY, LATE BLIGHT IN TOMATO, DOWNY MILDEW, PHYTOPHTHORA & PYTHIUM IN ORNAMENTALS, INTERIORSCAPES & BEDDING PLANTS, PHYTOPHTHORA AND FUSARIUM IN CONIFERS, PYTHIUM IN TURF, AND PHYTOPHTHORA AND PYTHIUM DISEASES ASSOCIATED WITH STEM AND CANKER BLIGHT (SUDDEN OAK DEATH) AND GENERAL BEECH DECLINE.

ACTIVE INGREDIENTS:

Mono- and di-potassium salts of Phosphorous Acid* 45.8%

OTHER INGREDIENTS: 54.2%

TOTAL 100.0%

*Contains 5.17 lbs/gallon of the active ingredients, mono- and di-potassium salts of Phosphorous Acid.

Equivalent to 3.35 lbs Phosphorous Acid/gallon.

KEEP OUT OF REACH OF CHILDREN

CAUTION

CONSULT PAGE 2 OF THIS BOOKLET FOR FIRST AID & PRECAUTIONARY STATEMENTS

Batch No.:

Date of Manufacture:

EPA Reg. No. 83416-1
EPA Est. No. 72499-GA-001
EPA Est. No. 71975-WA-001

NET CONTENTS:
☐ 1 Quart ☐ 30 Gallons
☐ 1 Gallon ☐ 55 Gallons
☐ 5 Gallons ☐ 250 Gallons

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FOR REGISTRATION
5/30/12
New York State Department
of Environmental Conservation
Division of Materials Management
Pesticide Product Registration

LANDSCAPE, GOLF COURSE, NURSERY, FORESTRY, AND PARK APPLICATIONS *(cont.)*

Disease	Application Method	Rate	Application Program
Suppression of Verticillium wilt Suppression of Armillaria	Basal Bark spray	1 1/2 to 2 quarts RELIANT® SYSTEMIC FUNGICIDE + 2 quarts of water + 2 fl. oz. Pentra-Bark™	Spray a combination of RELIANT® SYSTEMIC FUNGICIDE and Pentra-Bark™ around the complete circumference of the tree trunk until saturation/runoff. Spray from ground level up to 5 feet above the soil line, including the base of the first scaffolding limbs, if present. For large trees larger than 24 inches DBH (Diameter at Breast Height, 4.5 feet above ground) that have been previously attacked by Verticillium wilt, make a fall application prior to leaf senesce and a spring application for best results. For trees less than 24 inches DBH, make an early spring application.
Needle Cast		2 to 2 1/2 pt	Treat when symptoms first appear. Repeat appli

White, butt and root rot

Desarmillaria (Clitocybe) tabescens

"Ring less Armillaria"

- Appears to mostly kill cambium
- Usually associated with branch dieback
- Can progress rapidly
- No Rhizomorphs

Desarmillaria (Clitocybe/Armillaria) tabescens
"Ringless Armillaria"

Root killer and tree decline

Armillaria mellea

- Uncommon in true urban areas
- Very common where forest soils or forest edges were in the near past
- Fruiting is relatively rare on living trees
- Many urban look-alikes aka fakers

Jack O'Lantern Fungus

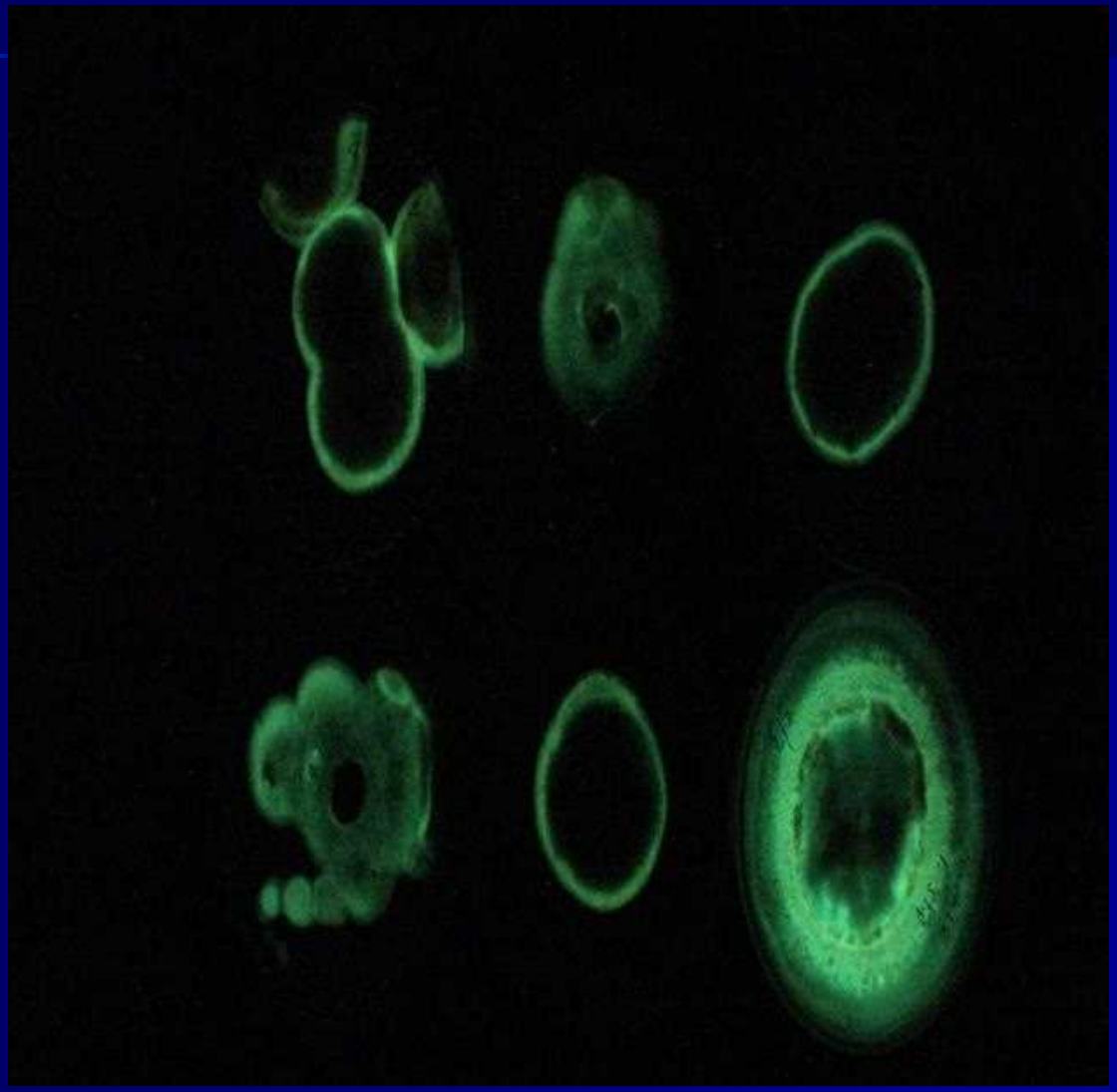
Pholiota species

Brown
Spore
Print

#4 *Armillaria mellea*

- More important killer of stressed trees
  - Also root and butt rot
- Infection centers
- Edible
- Foxfire (bioluminescence)

FireFox



#5

Ganoderma applanatum

Artist's Conk

White Rot

Stem, Butt and Buttress Root Rot

Very Wide Host Range

- Oaks
- Maples
- Virtually any hardwood

Perennial-very hard, large and woody

Perennial

3-5 years common, older possible

Produces annual pore layers

Can be rather large
1′ by 2′


ARTIST
COUNT

5
Ganoderma applanatum

- Presence usually mean extensive internal decay
  - At least in the location of the conk
- Trees are often declining and decay is obvious
- Can spread by root contact
- Cause for immediate removal
- Future failure likely

Phaeolus schwienitzii
Cow Pile Fungus

Brown cubical root and butt rot of conifers

Fruiting August - October

Developing Conk

Cow Pile a.k.a Meadow Muffin

Very soft and watery

Pore layer bruises black
Angular pore openings

Brown Cubical Decay

Phaeolus schweinitzii

- Serious brown root and butt rot
- A must know on conifers
- Will fruit even in downtown urban areas

Niveoporfones (Fomitopsis) spraguei

- Common on oaks
- Root and butt rotter
- Brown rot
- Appearing later summer

Fomitopsis spraguei

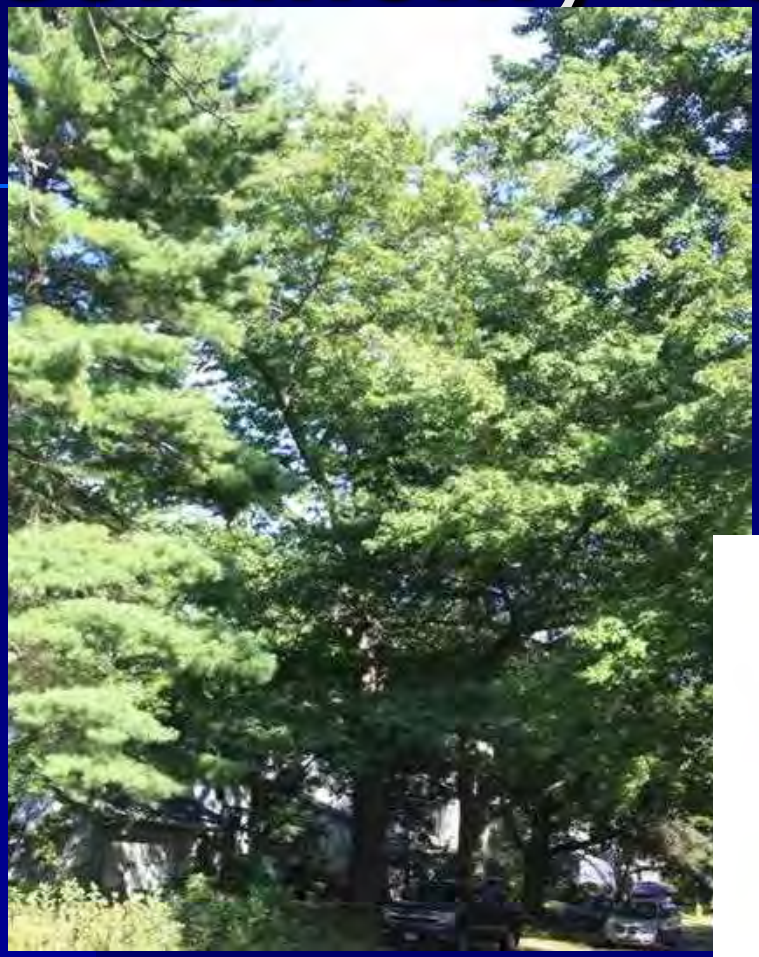
Gray-white marbled top

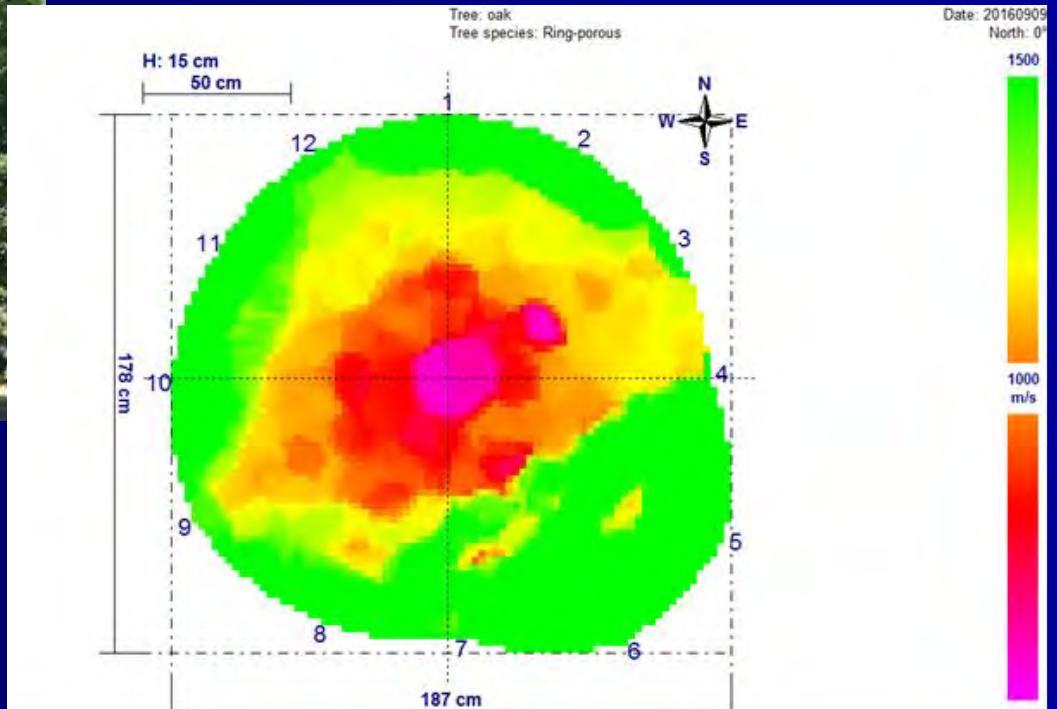
Context like marble

Small pores

Stains slowly green!

Commonly Reported on Oak





Bondarzewia berkeleyi **Berkeley's polypore**

- Oak is the main host
- Very common
- Confused with Meripilus
- Root and butt rotter

July through October

Bondarzewia berkeleyi

Berkeley's polypore

Largest of the Fleshy Fungi

White to Cream Top- Slightly Zonate

Large Pores

Drying Brown and not Black

Bondarzewia berkeleyi

- Root and butt rot
- Literature report hollow form in butt
- Test tree if on butt?

Porodaedalia pini
Fomes pini; Phellinus pini

- Most important trunk rot on pines
- Reported to cause more volume loss than any other single fungal species
- Perennial

Porodaedalia pini