

Challenging Taxonomy



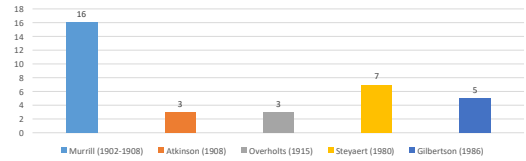
Literature Review

- Introduction

• Results



Recognized North American Laccate Ganoderma spp.



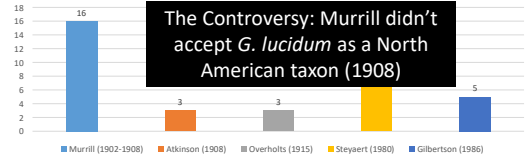
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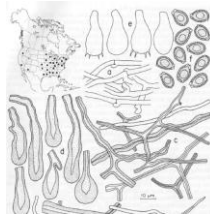
Recognized North American Laccate Ganoderma spp.



Literature Review
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Gilbertson RL, Ryarden L. 1986. North American polypores. Vol. 1. Abortiporus Lindb. Oslo, Norway: Fungiflora. 433 p.

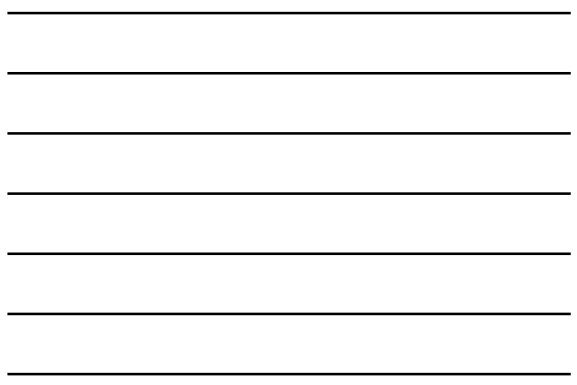
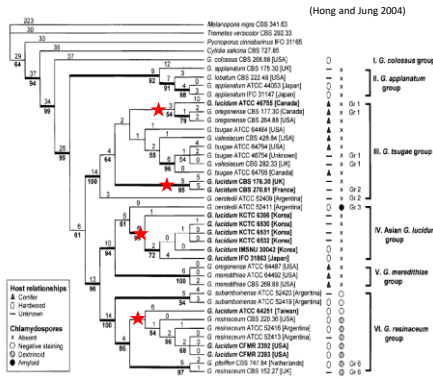


G. lucidum. Gilbertson RL, Ryarden L. 1986. North American polypores. Vol. 1. Abortiporus Lindb. Oslo, Norway: Fungiflora. 433 p.

Remarks - The species of *Ganoderma* with annual basidiocarps all have a wide variation in macroscopic characteristics. The taxonomy of the group can never be stabilized until cultural morphology, physiological characters, and genetic studies including interfertility tests are applied to the problem.



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BOTANICAL GAZETTE

NOVEMBER 1908

OBSERVATIONS ON *POLYPORUS LUCIDUS* LEYS, AND SOME OF ITS ALLIES FROM EUROPE AND NORTH AMERICA
 GEORGE F. ATREIDSON

BULLETIN OF THE TORREY BOTANICAL CLUB
 Vol. 84, No. 6, pp. 424-428 DECEMBER, 1907

GANODERMA LUCIDUM, A PARASITE OF SHADE TREES
 P. P. PHOEN¹

In vitro decay studies of selective delignification and simultaneous decay by the white rot fungi *Ganoderma lucidum* and *G. tsugae*¹

JAMES E. ADASKAVEG AND ROBERT L. GILBERTSON
 Department of Plant Pathology, University of Arizona, Tucson, AZ, U.S.A. 85721
 Received August 14, 1985

Infection and Colonization of Grapevines by *Ganoderma lucidum*

JAMES E. ADASKAVEG, Graduate Associate, and ROBERT L. GILBERTSON, Professor, Department of Plant Pathology, University of Arizona, Tucson 85721

ABSTRACT
 Adaskaveg, J. E., and Gilbertson, R. L. 1987. Infection and colonization of grapevines by *Ganoderma lucidum*. Bot. Rev. 53: 1-14. The objectives of this research were to determine if *G. lucidum* was a pathogen of grapevines.



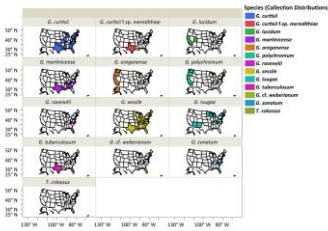
Major Research Questions

- **TAXONOMY: WILL THE REAL *GANODERMA LUCIDUM* PLEASE STAND UP?**
 - Chapter 1: Elucidating "lucidum": distinguishing the diverse laccate (shiny) *Ganoderma* species present in the United States (**PloS one 2018**)
 - Chapter 2: Identifying the "Mushroom of Immortality": Assessing the *Ganoderma* Species Composition in Commercial Reishi Products (**Frontiers in Microbiology 2018**)
- **FUNCTION: ARE ALL *GANODERMA* SPECIES CREATED EQUAL?**
 - Chapter 3: Cultural Characterization and Resiliency to Extreme Temperatures of the Ganodermataceae Present in the Eastern United States (**Mycologia 2019**)
 - Chapter 4: Elucidating wood decomposition by four species of *Ganoderma* from the United States (**Fungal Biology 2018**)
 - Chapter 5: Pathogenicity of *Ganoderma* Species on Landscape Trees in the Southeastern United States (**Plant Disease 2018**)

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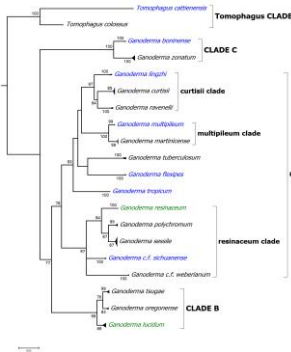
We have clarity!



- 507 collections across 34 states
 - 88 collectors
- 13 putative laccate *Ganoderma* taxa

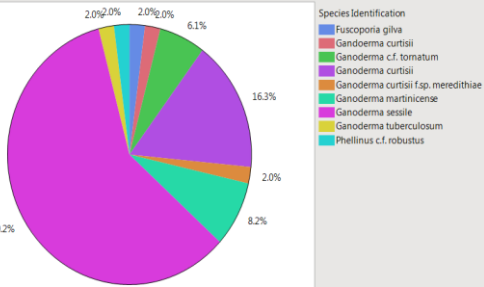


We have clarity!



We have clarity!

Reannotations of Herbaria Collections of *G. lucidum* in the Southeastern U.S.



Chapter 1: Elucidate "lucidum"
• Introduction
• Materials & Methods
• Results
• Discussion

Conclusions

- 13 laccate *Ganoderma* taxa present in the U.S., and *G. lucidum* is not widespread
- Host-group affinities and nuanced morphological differences (*dichotomous key produced in submitted manuscript*)
- *G. lucidum* IS NOT native to the U.S.
 - was introduced to the U.S. via medicinal fungi or tree nursery trades
- *G. curtisii* is sister to the Asian taxon *G. lingzhi* (Asian *G. lucidum*), which is the most widely cultivated species (*more on this later*)

Chapter 4: Decay
• Introduction
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FUNCTION

Wood decomposition by four species of *Ganoderma* from the United States

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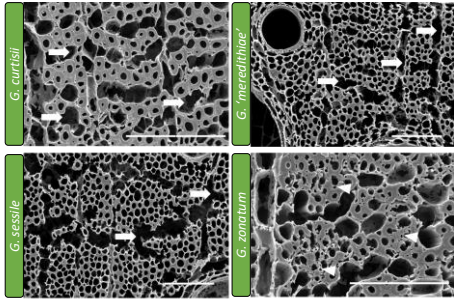
Brown vs. white rot



Chapter 4: Decay
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Quercus nigra

1 Decay by mass loss

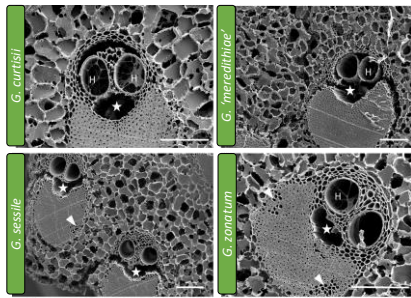


Micrometer 100um

Chapter 4: Decay
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Sabal palmetto

1 Decay by mass loss

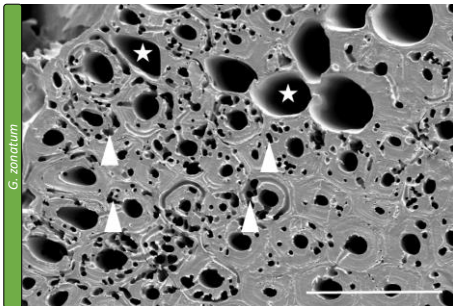


Micrometers 250um

Chapter 4: Decay
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1 Decay by mass loss

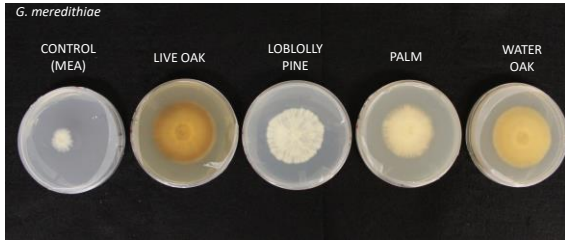
Decay of Sabal palmetto sclerenchyma fibers caused by G. zonatum



Chapter 4: Decay
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2 Wood chemicals

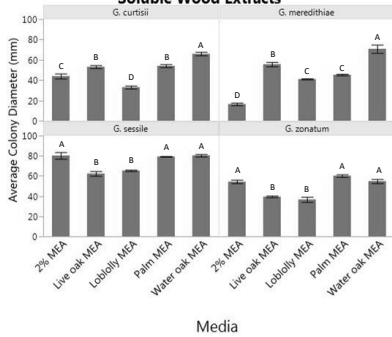
Effects of Water-soluble Wood Extracts on Growth of *Ganoderma*



Chapter 4: Decay
 • Materials & Methods
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2 Wood chemicals

Average Colony Diameter When Exposed to Water-Soluble Wood Extracts



Chapter 4: Decay
 • Materials & Methods
 • Results
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Conclusions

- Despite rare combinations of wood type:*Ganoderma* species, decay was similar in all combinations, except *G. zonatum* on live oak
 - Decay rates not always proportional to culture growth rate
- All four *Ganoderma* species caused simultaneous decay of sapwood cells, except for putative selective delignification with *G. zonatum* on oaks and palm
- Generally, wood type was more important than *Ganoderma* species
- All *Ganoderma* species grew slower on water-soluble pine wood extracts, except *G. meredithiae*, which grew more than the control on all wood medias
- Decay and host specificity is complex, and involves more than just chemistry. Fungal competition is likely how these *Ganoderma* have specific groups of substrates

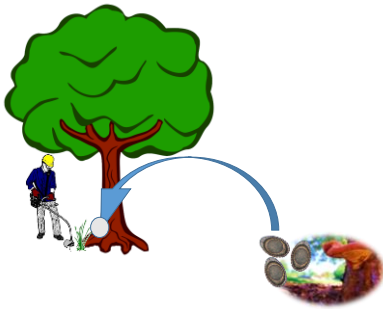
Chapter 5: Pathogenicity
• Introduction
• Methods
• Results
• Discussion

The Current Paradigm



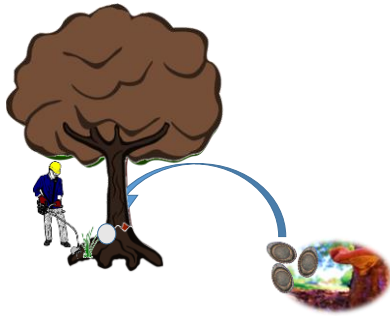
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The Current Paradigm



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The Current Paradigm



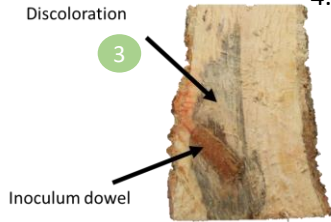
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1
Tree Health Rating

1. Healthy
2. Symptomatic
3. Dead

2
Wound Response

1. Complete
2. Partial
3. None
4. Cavity



Chapter 5: Pathogenicity
• Introduction
• Materials & Methods
• Results
• Discussion

1 2

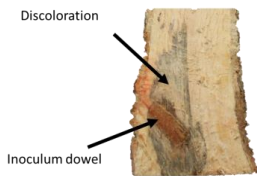
use

- All tree species rated as healthy for tree health
- All trees had completely or partially closed over wounds
- Subtle differences in internal discoloration, few significant

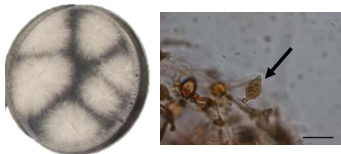


Chapter 5: Pathogenicity
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Reisolations



- *G. sessile* was the only species recovered
- Recovered from the dowel and discoloration in oaks and just from dowels in pine
- Only species that produces chlamydospores (survival structures)



The Many "Faces" of *G. lucidum*