RESEARCH in Progress

Coalition for Advanced Wood Structures
a university, industry, government partnership

Microbial Succession in Naturally Durable Wood Species in Above-Ground Field Tests

Forests in the United States contain a substantial amount of small-diameter material from underutilized tree species. Overstocked stands of trees need to be thinned to help reduce the risks of wildfire and improve overall forest health, but they often have relatively low value because of trunk size, growth habitat, accessibility, or lack of commercial applications. Other introduced tree species have invaded natural ecosystems and reduced biological diversity in native flora and wildlife. Some of these underutilized and invasive wood species are known to be naturally resistant to insects and decay, but relatively little is known about the field performance of wood products from these species or the physical or chemical properties that impart their natural durability. New applications for wood from these species would enhance the cost-effectiveness of thinning operations, create business and employment opportunities in rural communities, and increase options for replacement components in residential and non-residential structures while reducing wildfire risks and improving forest health.

Specimens from seven wood types representing invasive or underutilized species are randomized and installed in an above-ground deck test near Madison, Wisconsin.

Background

Understanding how microbial succession in durable invasive and underutilized wood species correlates with changes in physical and chemical properties in above-ground applications may lead to increased applications of these species. A great deal of evidence points to microbiological succession (bacteria → mold fungi → decay fungi) in wood exposed outdoors, but no accurate method has been available to track that progression beyond microscopic and macroscopic evaluation for signs of deterioration. Culturing all the microbes associated with exposed wood even at one point in time remains an impossible task. A molecular technique—terminal restriction fragment length polymorphism (TRFLP)—can help us sort the microbes present in a piece of wood and differentiate bacteria from fungi. Analyzing wood samples over time with this technique can also differentiate Basidiomycetous fungi present from decay fungi during early stages of colonization. With this information, a model of the microbial processes that occur over time in a piece of wood can be constructed. Correlation of that model with field performance and extractive content from selected wood species will allow us to more confidently make recommendations for utilization of durable invasive and underutilized wood species.

Objectives

This project has three main objectives:

1. Use molecular techniques to periodically assess changes in microbial community composition of underutilized or invasive wood species exposed outdoors for 5 years.

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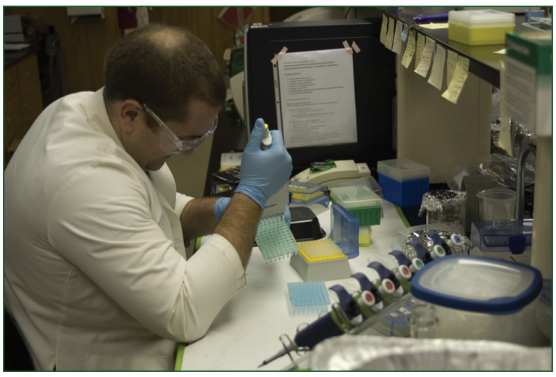
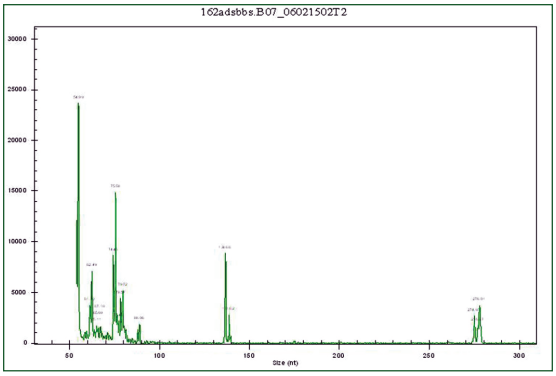


After the DNA has been extracted from the wood, the DNA is prepared and loaded into the plate for fragment analysis by the Beckman Coulter CEQ 8000 Genetic Analyzer (Beckman Coulter, Inc., Brea, California).



Fragment analysis data generated on the CEQ 8000 Genetic Analyzer from field-exposed wood. Each peak represents a genetically unique fungus.

2. Assess field performance of naturally durable wood species in above-ground field tests in high and moderate decay hazard zones.
3. Correlate changes in microbial community with above-ground field performance.

Expected Outcomes

- New design methodologies or improved rational analysis methods that can be robustly applied to a wide range of cases
- A model to assist in the design of force transfer around openings

Approach

Seven underutilized or invasive wood species will be assessed for natural durability in accelerated above-ground deck tests in both high and moderate decay hazard zones of the United States. Untreated specimens will be sampled quarterly for molecular analysis and field-inspected annually for up to 5 years or until failure occurs. Failure will be defined by the standard rating system for field performance prescribed by the American Wood Protection Association. We will track changes to the microbial community, including bacteria, fungi, and more specifically, basidiomycetes as wood specimens succumb to deteriorating organisms. TRFLP and field performance assessments for those wood species will be compared with non-durable Southern Pine and highly durable western red-cedar. Correlating field performance data with successional changes in the microbial community will provide the basic information needed for value-added applications of underutilized or invasive wood species.

Expected Outcomes

- Basic understanding of successional changes in microbial communities and how those changes affect natural durability over time
- Publish research results in refereed journals

Timeline

Fabrication and installation of above-ground field tests in Mississippi and Wisconsin will be completed by fall 2009; annual field inspections will occur in 2010 through 2014. In Mississippi's high decay hazard climate, samples will be collected quarterly from each wood species for molecular analysis. In Wisconsin's moderate decay hazard climate, samples will be collected semi-annually for molecular analysis. The final report will be completed in 2014.

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