Research in Progress

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

Strobilurins—A Novel Co-Biocide for Copper-Based Wood Protection

The hypothesis for the proposed research arose from three observations: (1) wood treated with copper-based preservatives is susceptible to decay when attacked by copper-tolerant fungi (Fig. 1), (2) copper removal is an energy-intensive process (Tang et al. 2013), and (3) strobilurins are agricultural fungicides that interfere with energy production (Bartlett et al. 2002). This project will determine whether wood treated with a copper–strobilurin combination can be protected from decay fungi that are known to be copper tolerant. In addition, an enhancer of strobilurin activity (namely salicylhydroxamic acid, or SHAM) will be added to the copper–strobilurin treatment to determine if it increases protection against decay.

Figure 1. Damage caused by a copper-tolerant fungus growing on a wooden post treated with a copper-based preservative.

Background

Environmental concerns and the push for green products have motivated wood protection scientists to develop organic co-biocides that are used with copper to protect treated wood from decay by copper-tolerant fungi. Strobilurins are anti-fungal organic compounds that inhibit spore germination (Bartlett et al. 2002). Similar to arsenic, they interfere with energy production. Their toxicity, however, is lower because they do not share the same molecular targets as arsenic. Strobilurins are widely used in agricultural crops for disease prevention and show relatively low toxicity against non-target organisms. However, their toxicity against growing mycelia of decay fungi and their potential to act as a co-biocide for copper-based wood protection are unknown.

Objectives

To explore the feasibility of using strobilurins as a co-biocide, this study will focus on four objectives:

(1) establish analytical methods to quantify strobilurin and SHAM from solutions and wood,

(2) develop single formulations for treating wood with two- (copper–strobilurin) and three- (copper–strobilurin–SHAM) compound combinations,

(3) determine the efficacy of the two- and three-compound combinations for wood protection in laboratory soil block tests, and

(4) evaluate compound retention in treated wood blocks after laboratory leaching.

U.S. Department of Agriculture • Forest Service
Forest Products Laboratory
www.fpl.fs.fed.us

MISSISSIPPI STATE UNIVERSITY

Table 1. Adding strobilurin and SHAM increases wood protection compared to copper only in preliminary laboratory tests exposing wood to a copper-tolerant fungus[a]

Copper–strobilurin–SHAM treatment		Copper-only treatment	
Copper (lb/ft^3)	Decay (%)[b]	Copper (lb/ft^3)	Decay (%)
0	100	0	100
0.01	65	0.01	100
0.03	58	0.03	94
0.1	36	0.1	52

[a]Retentions of copper are shown. Retentions of strobilurin and SHAM were 0.03 lb/ft^3.
[b]Decay was calculated as percentage compression strength loss compared to unexposed controls and then expressed relative to the exposed controls within the same column. Controls were treated with water only (0 lb/ft^3).

Approach

Compounds will be extracted from wood and liquid samples, purified, concentrated, and then quantified by ICP-OES, HPLC, or GC-MS, as appropriate. Surfactants, dispersants, and other additives will be evaluated for developing a formulation that can be used to pressure-treat small wood blocks for laboratory studies. Laboratory procedures for testing preservative efficacy and leachability will follow those outlined in the *American Wood Protection Book of Standards* (AWPA 2015). Results of a preliminary study using sublethal combinations of copper, strobilurin, and SHAM to treat wood showed that growth was slowed when the fungus was exposed to wood treated with the three-compound combination compared to the copper-only treatment. Moreover, the three-compound combination protected the wood wafers better against decay than copper alone after four weeks of exposure to fungus (Table 1).

Expected Outcomes

The expected outcomes of this project are formulation development, efficacy data, and analytical methods for a novel copper co-biocide wood protection system.

Timeline

Analytical methods to quantify strobilurin and SHAM from solutions and wood will be completed by December 2016. Formulation development will be completed by June 2017. Laboratory soil block tests will be conducted by December 2017. Analysis of compound retention in laboratory leaching studies will be completed by June 2018.

Cooperators

USDA Forest Service, Forest Products Laboratory

Mississippi State University

Contact Information

Juliet D. Tang
USDA Forest Service, Forest Products Laboratory
Starkville, Mississippi
(662) 338-3107; julietdtang@fs.fed.us

Darrel D. Nicholas
Mississippi State University
Starkville, Mississippi
(662) 325-8838; dnicholas@cfr.msstate.edu

References

AWPA. 2015. American Wood Protection Book of Standards. Birmingham, AL: American Wood Protection Association.

Bartlett, D.W.; Clough, J.M.; Godwin, J.R.; Hall, A.A.; Hamer, M.; Parr-Dobrzanski, B. 2002. The strobilurin fungicides. Pest Management Science. 58: 649-662.

Tang, J.D.; Parker, L.A.; Perkins, A.D.; Sonstegard, T.S.; Schroeder, S.G.; Nicholas, D.D.; Diehl, S.V. 2013. Gene expression analysis of copper tolerance and wood decay in the brown rot fungus *Fibroporia radiculosa*. Applied and Environmental Microbiology. 79: 1523-1533.