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Preference of *Reticulitermes flavipes* (Kollar) for Southern Pine Blue-Stained Sapwood from Beetle-Killed Trees

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ABSTRACT

Bark beetles and their associated Ophiostomatiod fungi are the major pests of pine forests in the southeastern USA, and termites are the major insect decomposers of dead trees and wood products in the southeastern USA. While both are the principal destructive insects of southern pine trees and southern pine lumber, respectively, no relationship between the two has apparently been reported in the literature. While recently inspecting bark beetle-killed southern pine trees, we noticed that subterranean termites were often present in the lower trunk of pines with incipient bark beetle infestations and always present in trees that had been dead for several months. This unusually rapid termite infestation suggested a possible attraction of termites to beetle-killed wood. AWPA E1 choice termite tests with three colonies of the subterranean termite *Reticulitermes flavipes* (Kollar) always showed a significant feeding preference for both air-dried and kiln-dried blue-stained southern pine sapwood compared to unstained southern pine sapwood. These initial results indicate that subterranean termites play a significant role in the ecosystem of southern pine forests and carbon recycling, and termite attack on southern pine lumber cut from beetle-killed trees may be associated with the death of the host tree. As the implications of these results may be of major importance to forest health, ecology, and utilization of wood products from the southern pines, we are conducting additional laboratory and field studies.

Keywords: Bark Beetle, *Reticulitermes flavipes* (Kollar), Southern Pine, Subterranean Termites

1. INTRODUCTION

Five members of southern pine bark beetle guild are considered the most economically important pest of the southern pine forests (Londo 2010); *Dendroctonus frontalis* Zimmerman (southern pine beetle), *D. terebrans* Oliver, *Ips calligraphus* Germar, *I. grandicolis* Eichhoff, and *I. avulsus* Eichhoff. Each beetle vectors an Ophiostomatoid fungus, which apparently aids the beetle in overcoming the resin flow defence of the host pine tree during the initial attack (Kendall et al. 1989, Nebeker et al. 1993, Paine et al. 1997, Klepzig et al. 2001). Upon harvesting and processing of a bark beetle-killed pine tree into lumber, Ophiostomatoid fungal mycelia remains in the wood and gives the sapwood a characteristic bluish appearance, which is referred to as blue-stained lumber. While girdling of the stem during bark beetle gallery construction seemed at first to be the obvious reason for tree death, it now seems clear that bark beetle girdling and subsequent reduction in the defensive resin flow cannot account for the rapid

decline of the host southern pine (Hodges et al. 1988) and that the associated fungi may play a role (Nebeker et al. 1993, Tisdale et al. 2003).

In recent field inspections of southern pine trees in various stages of bark beetle attack, we noticed that the trees with incipient bark beetle infestation often had subterranean termites in the lower pine trunk, and that trees in the latter stage of attack and death almost always had termites. Due to the economic and ecological significance of bark beetles in southern pine forests, which contains the major commercial tree species in the USA, this unexpected observation warranted further investigation.

The objective of this preliminary study was to examine the preference, if any, of a common eastern subterranean termite *R. flavipes* in AWPA E1 choice tests to blue-stained versus unstained *Pinus* spp. sapwood. To study the possible association/effect of any volatile bark beetle pheromones which might remain in lumber cut from bark-beetle killed pines, both air-dried and kiln-dried blue-stained southern pine wood was examined. However, the high dry bulb temperatures of about 120°C employed during kiln drying of southern pine lumber should evaporate any pheromones remaining in blue-stained lumber.

2. EXPERIMENTAL METHODS

D. frontalis-attacked blue-stained *Pinus taeda* sapwood was obtained from trees in Talladega National Forest in central Alabama, while all other *Pinus* spp. sapwood samples, blue-stained air-or kiln-dried and air- and kiln-dried unstained controls, were obtained from local lumber suppliers. *Pinus* spp. wafers, 25.4 x 25.4 x 6.4 mm, t x r x l, were employed in the AWPA E1 choice test and first air-dried in a 12% EMC chamber for two weeks. Three colonies of *R. flavipes* were obtained from different areas in Mississippi, with the first test having five replicates and the other two tests 10 replicate jars per set. The specific gravity of the blue-stained and unstained control replicate wafers for the three different colonies were matched to within 1% so that wood density would not be a factor in percent weight loss. Each jar contained blue-stained air-dried or kiln-dried wafers along with an unstained control wafer so that the feeding preference, if any, could be directly determined. After the 28 day test, samples were air-dried for 14 days in a 12% EMC chamber, the mass loss determined, and the wafers then photographed and retained for possible future reference.

Mass loss for each set were compared using ANOVA with JMP 8 at an α significance level of 0.05.

3. RESULTS AND DISCUSSION

Figs. 1 and 2 show the mass losses due to three different colonies of *R. flavipes* for air-dried and kiln-dried blue-stained and unstained southern pine sapwood, respectively. In all six cases significantly greater mass loss ($\alpha = 0.05$) occurred with the blue-stained southern pine wood. Thus, we conclude that the subterranean termite *R. flavipes* has a feeding preference for both air- and kiln-dried blue-stained sapwood over unstained sapwood control wafers.

Wafers employing the same termite colony always had a greater mass loss with air-dried compared to kiln-dried blue-stained wafers. With the high kiln temperatures employed to dry southern pine lumber to the temperatures necessary to kill pine nematodes, it is unlikely that any volatile bark beetle pheromones would remain. However this possibility, or the presence of a semi-volatile beetle or fungal metabolite(s), cannot be ruled out. Further, the controls in the choice test may affect the long-term results (Green et al. 2011).

Due to the importance of bark beetles on the southern pine ecosystem and the economic impact of southern pine products, we are continuing our studies. These include feeding preference with the laboratory E1 tests employing the Formosan subterranean termite, and field AWPA E7 tests employing southern pine sapwood stakes, which are untreated or first exposed to various bark-beetle associated fungi or the wood-decaying fungus *G. trabeum.* We are also hoping to determine a possible association of termites with the death of bark-beetle infested host southern pine trees, and hope to report on the results of these additional studies shortly.

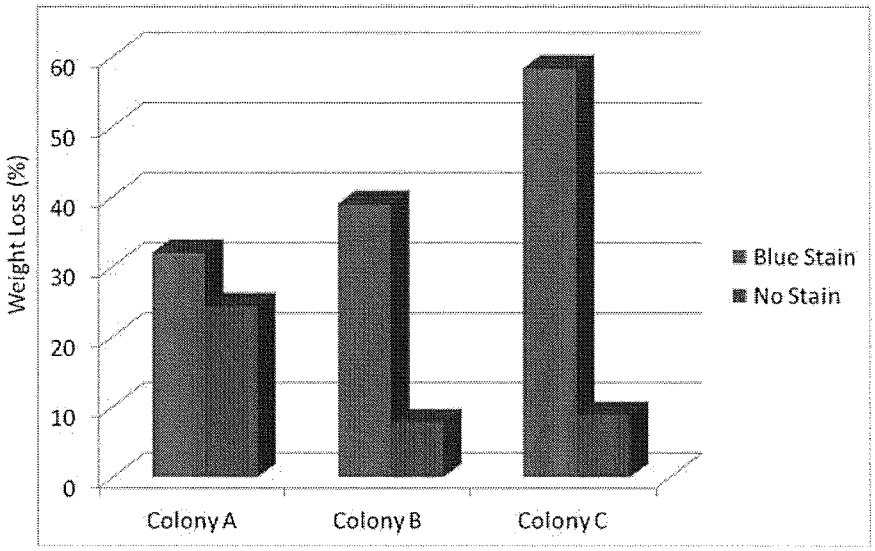

Figure 1: Weight Loss of Blue-Stained versus Unstained Air-Dried Southern Pine Sapwood.

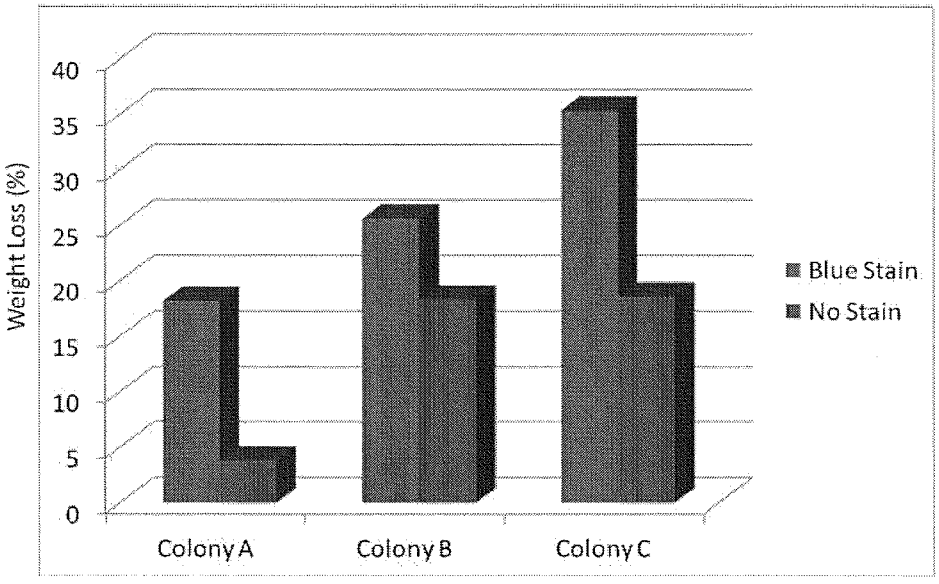

Figure 2: Weight Loss of Blue-Stained versus Unstained Kiln-Dried Southern Pine Sapwood.

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