LABORATORY DECAY RESISTANCE OF PRESERVATIVE-TREATED RED ALDER[1]

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ABSTRACT

Alder represents an abundant but underutilized resource that has little natural resistance to decay. Treated alder might be used for stakes, posts, or other nonstructural applications. The performance of alder treated with chromated copper arsenate (CCA), copper 8 quinolinolate, zinc naphthenate (ZN), or thiocyanomethylthiobenzothiazole (TCMTB) was assessed in soil block tests. CCA provided the best protection, and ZN and TCMTB provided reasonably good protection. Copper 8 required loadings of at least 6 kg/m^3 to provide protection.

Keywords: Red alder, soil block test, preservative treatment, waterborne preservatives, chromated copper arsenate, copper 8 quinolinolate, thiocyanomethylthiobenzothiazole, zinc naphthenate.

INTRODUCTION

Declining supplies of naturally durable wood species, coupled with an increasing demand for wood that has been pressure-treated with preservatives, have stimulated interest in the treatment of less commonly used wood species (Graham 1954; Miller 1986, 1961; Cooper 1976; Barnes and Buchanan 1984; Barnes et al. 1985). Most of these efforts have concentrated on species growing in the Northeast and South, where abundant oak and other hardwoods exist. Although Douglas-fir, western hemlock, and ponderosa pine continue to dominate the western wood market, there is an increasing interest in the use of secondary species such as red alder (*Alnus rubra*) (Nielson 1977; Briggs and Bethel 1978; Wright 1987). Small alder logs are relatively inexpensive and may represent a source for low-cost stakes, posts, or other nonstructural materials. Untreated alder is extremely susceptible to stain and decay fungi; it lasts less than 2 years in contact with soil (Miller 1986), but its diffuse porous structure should be highly receptive to penetration of preservative solutions. Few data exist on the performance of preservative-treated alder. This study examines the ability of four waterborne wood preservatives to protect alder in soil block tests (American Wood-Preservers' Association 1986a).

MATERIALS AND METHODS

Freshly cut red alder boards were selected for lack of defects and straightness of grain prior to oven drying for 3 days at 55 C. The boards were cut into blocks 1.905 cm square. These were oven-dried at 55 C and weighed (0.001 g).

The chemicals tested were chromated copper arsenate (CCA Type C) (Osmose Wood Preserving, Inc., Buffalo, NY), copper 8 quinolinolate (CU 8) (Maag Chemical Co., Vero Beach, FL), thiocyanomethylthiobenzothiazole (TCMTB) (Buck-

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man Chemical Co., Memphis, TN), and zinc naphthenate (ZN) (Mooney Chemical Co., Cleveland, OH). The blocks were treated over a range of each test chemical to produce a set of target retentions of 1.2, 2.4, 3.6, 5.4, and 7.4 kg/m^3 for CCA and zinc naphthenate; 1.0, 2.4, 4.0, 6.0, and 8.0 kg/m^3 for TCMTB; and 0.18, 0.3, 0.7, 0.8, and 1.18 kg/m^3 of copper 8 quinolinolate (as copper). Additional blocks were left untreated to serve as controls.

Forty blocks were immersed in each test solution, which was subjected to a double vacuum impregnation cycle (two 15-minute cycles of 20-inch Hg vacuum). Immediately after treatment, the blocks were blotted to remove excess solution and weighed (0.001 g) to determine net solution uptake. The blocks were left overnight at room temperature, then oven-dried for 48 hours at 55 C and re-weighed. They were then stored for 3 to 4 weeks to allow complete chemical fixation.

The soil block chambers were prepared in 454-ml French square bottles by adding to each 150 g of forest soil, 35 ml of distilled water, and an untreated alder wafer measuring 3.81 cm by 2.86 cm by 3 mm. The jars were capped, autoclaved for 45 minutes at 121 C, cooled overnight, and reautoclaved for 15 minutes at 121 C. After cooling, each chamber was inoculated with one of these Basidiomycetes: *Coriolus versicolor* (L) Quel. (Madison 697), *Gloeophyllum trabeum* (Pers. ex Fr.) Murr. (Madison 617), or *Poria placenta* (Fr.) Cke (Madison 698). The fungi were introduced by means of an agar disc cut from the edge of an actively growing culture of the test fungus. The inoculated chambers were incubated until the feeder strip was overgrown by the test fungus. The alder blocks were removed from storage, placed in petri dishes, and autoclaved for 20 minutes at 100 C. The sterilized blocks were then placed on the feeder strips, two per bottle.

The assembled chambers were incubated for 16 weeks at 28 C in a humidified cabinet. They were then removed from the jars, scraped free of adhering mycelium, and weighed (0.001 g) to determine wood moisture content. Blocks below the fiber saturation point were not further examined. The rest were oven-dried for 48 hours at 55 C and reweighed to determine weight loss due to fungal exposure.

These weight loss figures were compared to those of treated blocks not exposed to the test fungi, and to those of untreated blocks exposed to the test fungi. They were then plotted to determine the preservative threshold for each chemical-fungus combination.

RESULTS AND DISCUSSION

The alder blocks readily accepted preservative solutions, with approximate weight gains of 1.5 g of solution per gram of oven-dried wood. Trials of end-sealed alder stakes 2.5 cm by 2.5 cm by 15 cm have produced similar absorptions (M. E. Mitchoff, unpublished data). Thus, achieving acceptable preservative loadings should pose little difficulty; in fact, treatment of dry wood by nonpressure methods may be adequate for this species.

CCA provided the greatest protection to the alder blocks, with thresholds of around 1 kg/m^3 for each of the three tested fungi (Fig. 1). This chemical binds strongly to the wood (Hartford 1986). This, coupled with the apparently uniform penetration, produced excellent protection.

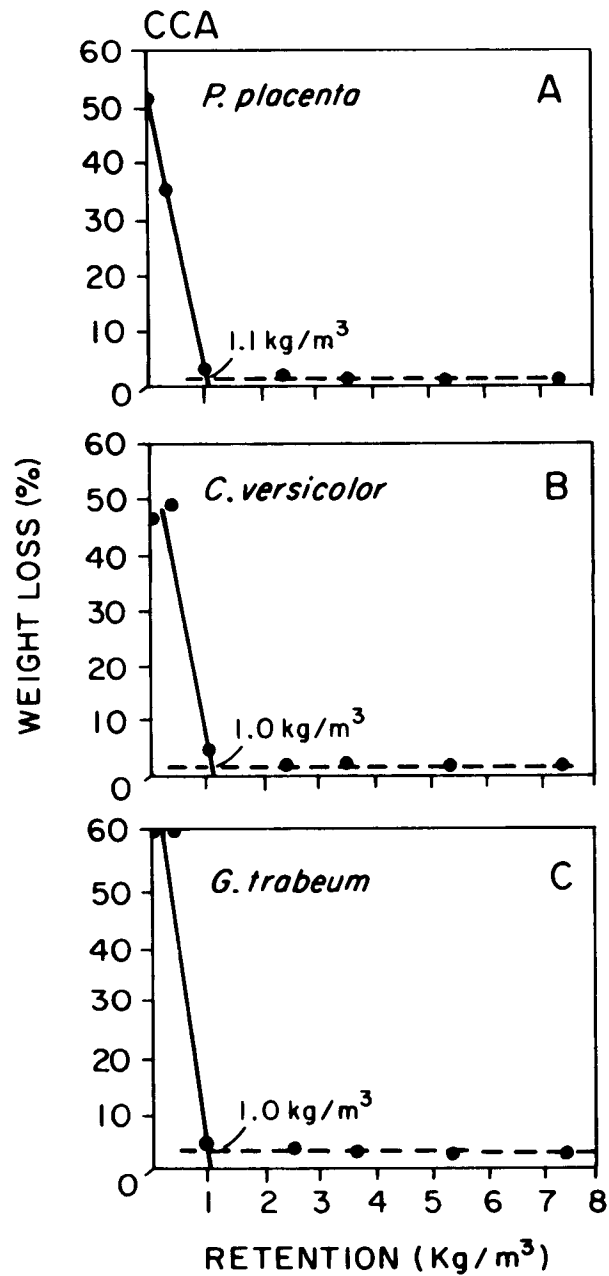Of the remaining chemicals, TCMTB and ZN provided about the same level

Fig. 1. Ability of CCA to protect red alder cubes against (a) *P. placenta*, (b) *C. versicolor*, and (c) *G. trabeum* in a soil block test as measured by wood weight loss.

of protection. ZN produced a threshold of 3.9 kg/m³ (as Zn) for *C. versicolor* and 1.0 kg/m³ for both *G. trabeum* and *P. placenta* (Fig. 2). This chemical is used for dip treatments to protect ammunition boxes from decay and for pressure treatments of logs in some log cabins (Barnes 1987). Zinc is generally considered to
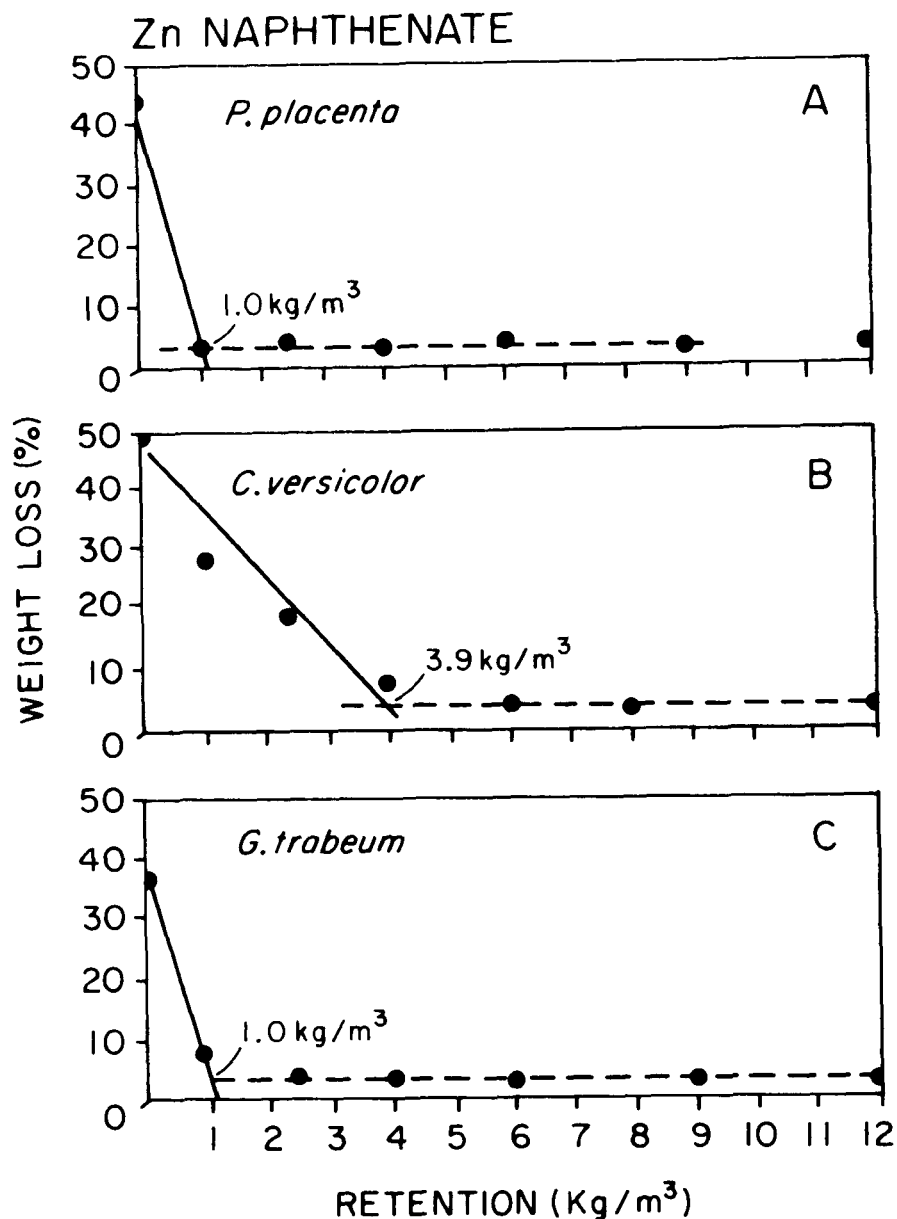
Zn NAPHTHENATE

Fig. 2. Ability of zinc naphthenate to protect red alder cubes against (a) *P. placenta*, (b) *C. versicolor*, and (c) *G. trabeum* in a soil block test as measured by wood weight loss.

be a less potent fungicide than copper. Its performance in this test seems to reflect this difference. Nevertheless, in our tests ZN provided reasonable protection, and warrants further testing. TCMTB completely inhibited *G. trabeum* and produced thresholds of 2.5 and 2.9 kg/m³ for *P. placenta* and *C. versicolor*, respectively (Fig. 3). Although this chemical is not now used for pressure treatments in the United States, it is a component in some commercial Australian formulations
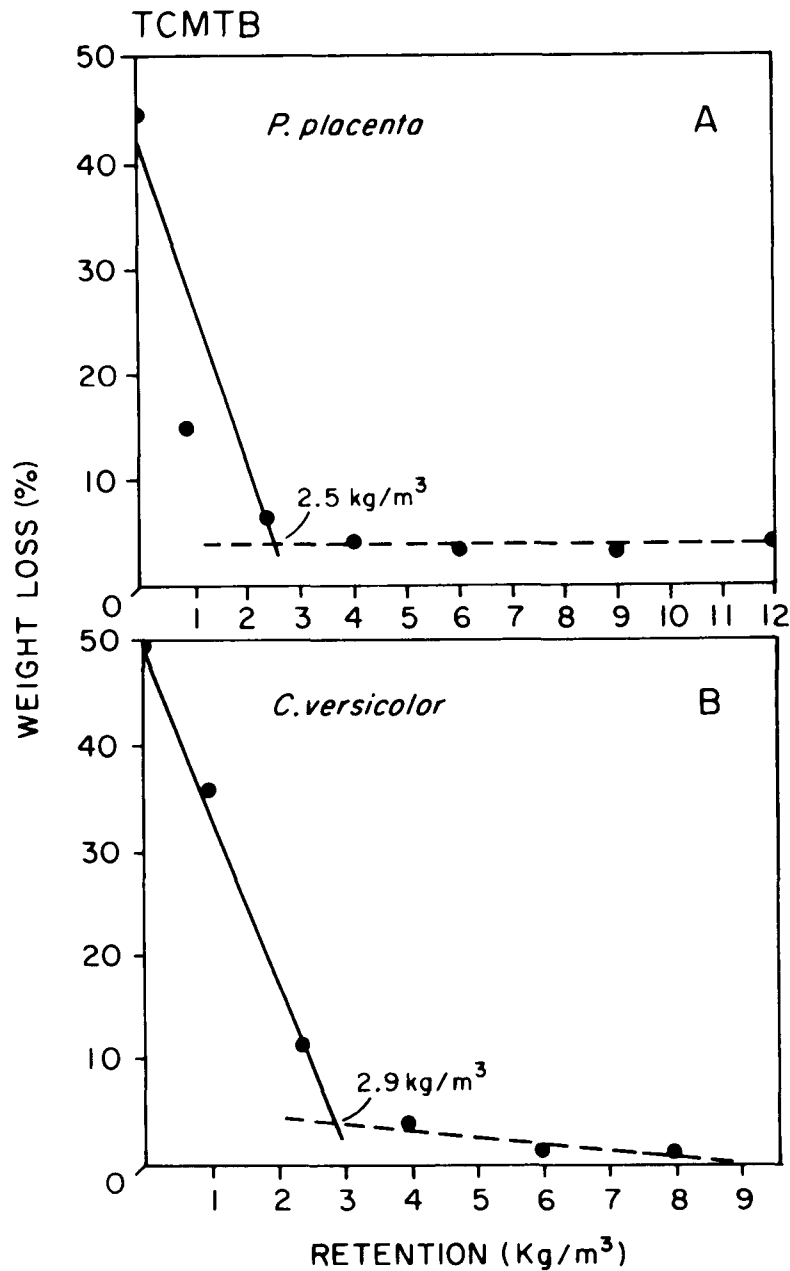
FIG. 3. Ability of TCMTB to protect red alder cubes against (a) *P. placenta*, (b) *C. versicolor*, and (c) *G. trabeum* in a soil block test as measured by wood weight loss.

(Cookson et al. 1981). Tests in progress in North America suggest that it will provide adequate protection for wood not in contact with the ground (J. J. Morrell and D. J. Miller unpublished data).

The final chemical tested, CU 8, is the only preservative approved by the U.S.
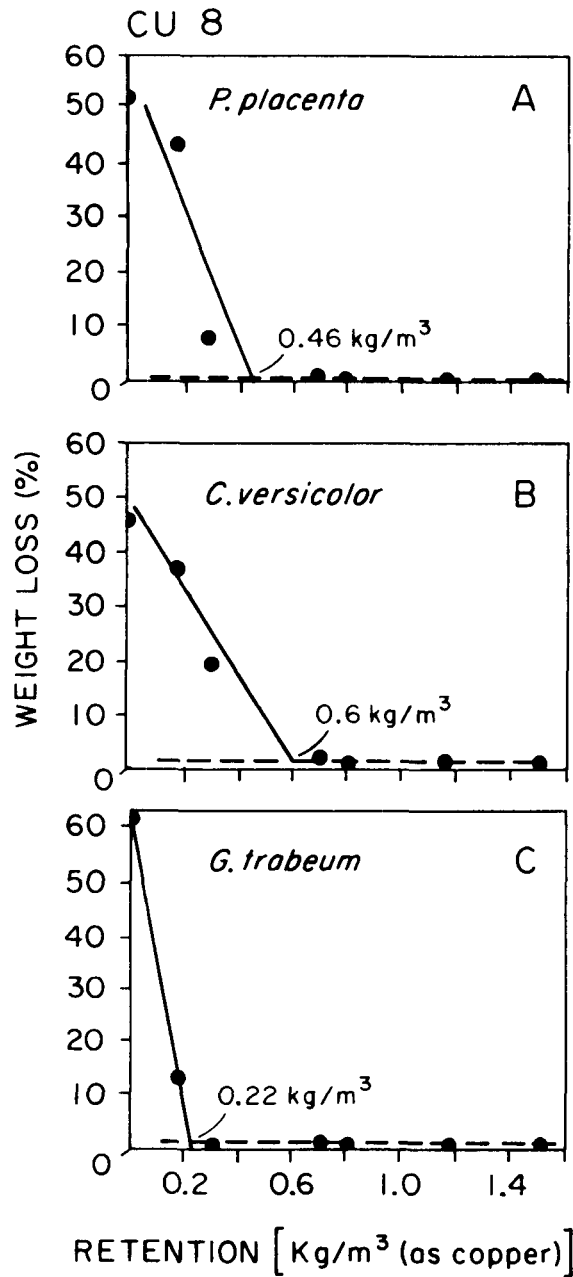
Fig. 4. Ability of CU 8 to protect red alder cubes against (a) *P. placenta*, (b) *C. versicolor*, and (c) *G. trabeum* in a soil block test as measured by wood weight loss.

Food and Drug Administration for direct contact with food. However, this formulation was less effective than the first three tested, producing thresholds of 0.46, 0.22, and 0.60 kg/m³ (as copper) for *P. placenta*, *G. trabeum*, and *C. versicolor*, respectively (Fig. 4). Since copper makes up 10% of the CU 8 in this

formulation, loading of 6 kg/m³ or greater will be required to protect alder adequately. The American Wood-Preservers' Association Standard C29-82 recommends a retention of 3.2 kg/m³ for oilborne CU 8 to protect wood near food (American Wood-Preservers' Association 1986b). The difference in these two recommendations suggests that higher retention requirements may be advisable for waterborne formulations. Since CU 8 is costly, the expense of higher loading would probably preclude extensive commercial use, except in specialty items such as storage boxes for food, where safety is of primary concern.

The decreased protection provided by CU 8 may also be due to the nature of the formulation used, which was a finely ground powder that forms a suspension and that may have settled close to the outer wood surface.

All four of the tested chemicals are waterborne formulations that are easy to apply. As well, each has certain properties that may make it more useful in certain applications. CCA is a commonly used wood preservative (Hartford 1986) that has produced excellent service life on a variety of commodities. Since it is a restricted-use pesticide, users must be certified to apply it. None of the remaining chemicals are restricted in their use, and all four may be safely used near plants. Thus, pressure-treated alder could be used in place of naturally decay-resistant species such as western redcedar for horticultural stakes, fence posts, and other nonstructural applications.

One potential problem with these applications that was not addressed in this study is that alder's resistance to soft rot damage is unknown. Many hardwoods are reported to be more susceptible to soft rot attack because of the difficulty of completely protecting the wood fibers (Dickenson 1974; Greaves 1974). To test its resistance to soft rot, alder stakes treated with the same chemicals tested in this study will soon be exposed to a fungal cellar under conditions conducive to soft rot attack.

CONCLUSIONS

CCA, ZN, and TCMTB each protected alder from Basidiomycete attack at levels below that recommended for ground contact treatment of softwood lumber with CCA (6.4 kg/m³). However, we tested only unweathered alder blocks and did not include soft rot fungi in our tests. CU 8 required higher retentions to provide adequate protection. These tests suggest that alder, an underutilized species, should perform well in ground contact when treated with preservatives. Further field tests should be undertaken.

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