



United States
Department of
Agriculture

Forest Service

Pacific Northwest
Forest and Range
Experiment Station

Research Note
PNW-363
June 1960

Preliminary Test of Two Stump Surface Protectants Against *Fomes annosus*

E. E. Nelson and C. Y. Li¹

Abstract

Two materials, monolaurin (at two concentrations) and an unidentified species of the genus *Streptomyces*, were tested along with borax for ability to protect freshly cut stump surfaces of western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) from colonization by *Fomes annosus*. Protectants were significantly ($P < 0.01$) better than no treatment. The most effective treatments were borax (no treated stumps were infected) and the higher concentration of monolaurin (only 5.9 percent of treated stumps were infected).

Keywords: Fungus control/prevention, root rot, *Fomes annosus*.

Introduction

Fomes annosus (Fr.) Karst. causes extensive mortality and butt rot of conifers in temperate regions of the world. In western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) forests, trees are seldom killed by the fungus although some mortality results from windthrow of trees with weakened root systems. Other infected trees tolerate the disease but at the expense of wood volume lost to decay in the valuable butt log (Morrison and Wallis 1976).

Fomes annosus is commonly spread when airborne spores land on open wounds or freshly cut surfaces. The fungus spreads from these primary infections to neighboring trees through root contacts. Incidence of colonization of stump surfaces varies by location and season. Nearly 100-percent colonization of stump surfaces can occur at times (Edmonds 1968).

Where the fungus is absent or uncommon, incidence of *Fomes annosus* in coniferous forests can be minimized by preventing the invasion of stumps and tree wounds (Morrison and Wallis 1976). Biological agents, such as *Peniophora gigantea*, have

^{1/}E. E. Nelson is principal plant pathologist and C. Y. Li is research plant pathologist at the Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station, Corvallis, Oregon.

been used successfully to protect pine stumps in England (Rishbeth 1963) but have not proved successful on hemlock. Borax, an effective preventive treatment of pine stumps, has not been widely accepted for hemlock. Control seems to vary with season and depends on several factors, including heavy rains washing the material from the stump surface (Edmonds et al. 1969, Russell et al. 1973). Zinc chloride and ammonium sulphamate can be effective but are toxic to animal life and costly (Wallis and Morrison 1975).

Two promising materials for protection of stumps have been identified through research at the Pacific Northwest Forest and Range Experiment Station (Li and Kabara 1978, Rose et al. 1980). One, monolaurin, is an ester of lauric acid and glycerol; the other is a species of *Streptomyces* resembling *S. griseolobus* isolated from root nodules of snowbrush (*Ceanothus velutinus* Dougl.). The success of these materials against *Fomes annosus* under laboratory conditions prompted this test on hemlock stumps under field conditions.

Methods and Materials

We selected a dense, young stand of western hemlock in the Siuslaw National Forest about 4 miles²/ inland from the Pacific Ocean and about 5 miles southeast of Waldport, Oregon, (longitude 124°1', latitude 44°22'N). Elevation is about 900 feet above sea level. The stand occupies a ridgetop and relatively gentle upper slope in the western part of the Coast Ranges. The stand, which was scheduled for commercial thinning, had an estimated average diameter at breast height (d.b.h.) in excess of 12 inches and was 41 years old. No previous cutting had occurred.

One hundred western hemlock trees were selected with a minimum d.b.h. of 6 inches and no basal wounds or obvious defects in the lower bole. These trees were felled in mid-February 1979, leaving high stumps. Stumps were then cut at 1 foot above the ground with a chain saw, leaving a relatively smooth, level surface. The 4-inch section adjacent to the stump was brought to the laboratory to determine whether or not *F. annosus* was present in the tree at stump height. Disks were wrapped in wet newspaper and observed after 20 and 30 days for characteristic *Oedocephalum* conidiophores and conidia. In addition, five wood chips were removed from within each disk at points near the center and along four perpendicular radii and placed on a selective agar medium containing 190 p/m PCNB (pentachloronitrobenzene) (Kuhlman and Hendrix 1962). If either method produced the *Oedocephalum* stage of *F. annosus* stump was dropped from the test.

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Metric equivalents are on page 5.

Results and Discussion

Of the original 100 inoculated stumps, 11 were eliminated from the test because the disks examined appeared to contain *F. annosus* when the trees were cut. The remaining 89 stumps, except those treated with borax (which showed no *F. annosus* at all), were subjected to analysis of variance as a randomized complete block design to determine if significant differences occurred among treatments in frequency and amount of infection as determined from the chips sampled from each stump. Individual treatments were compared by the Tukey test.

Results are summarized in table 2. Analysis of variance, with the borax treatment excluded, showed highly significant ($P<0.01$) differences among treatments and no significant ($P<0.05$) block effect. This held true whether data for stumps or cultures were used in the analysis. Tukey tests using either stump or culture data showed treatments 1, 2, and 3 to be significantly different ($P<0.01$ from the control, but not from one another. Treatment 4 was excluded from statistical analysis since in no case was *F. annosus* isolated from any stumps so treated. Borax and the higher level of monolaurin were most effective.

Table 2—Colonization of hemlock stump surfaces by *Fomes annosus* after treatment with protectants

Treatment	Number of stumps	<i>Fomes annosus</i> present			
		Stumps ^{1/}		Cultures ^{2/}	
		Number	Percent	Number	Percent
1. Monolaurin (high) ^{3/}	17	1	5.9a	2	2.4a
2. Monolaurin (low) ^{4/}	19	4	21.1a	5	5.3a
3. <i>Streptomyces</i>	16	5	31.3a	7	8.8a
4. Borax	17	0	—	0	—
5. Control	20	15	75.0 b	34	34.0 b

^{1/}Results followed by different letters differ significantly from one another ($P<0.01$).

^{2/}Five attempts were made to recover *F. annosus* by culture from each stump.

^{3/}65 mg/cm²

^{4/}76.5 mg/cm².

The fact that borax, as we applied it, was so effective in preventing invasion of hemlock stumps by *Fomes annosus* supports work of Russell et al. (1973) who found borax about 98 percent effective overall; however, in some months at some locations over 50-percent infection occurred in stumps treated with borax. Careful application to flat, horizontal stump surfaces is important for successful control during months of high precipitation.

In most cases when *F. annosus* did not develop on the selective medium, no other organism was apparent either, but in some cases unidentified fungi and streptomycetes did appear. One isolate of *Streptomyces*, differing from that applied as a protectant, strongly inhibited *F. annosus* on malt agar. Further investigation will be necessary to identify the organism and determine its potential as a biological control agent.

It has not been demonstrated that monolaurin and *Streptomyces* are effective in other locations, nor that they are more effective or easier to apply than borax. We have shown, however, that either can be effective in protecting the surface of hemlock stumps from invasion by *F. annosus*. We encourage others to consider these materials in tests of protectants.

Metric Equivalents

1 mile = 1.6 kilometers

1 foot = 0.3048 meter

1 inch = 2.54 centimeters

Diameters of stump tops varied between 6 and 15 inches. Stumps were arrayed in order by diameter and divided into 20 consecutive groups (blocks) of 5. As soon as the 1-foot stumps were cut, one of each of five treatments (table 1) was randomly applied to each stump surface until each treatment was represented within a diameter group. When all 100 stumps were treated, an aqueous suspension of *F. annosus* conidia was applied liberally to each stump surface.

We chose February for the test because heavy precipitation is normal in coastal Oregon then. In the 10 days following treatment, 5.6 inches of precipitation occurred.

All stumps were severed in mid-June 1979 (4 months after inoculation), and the 3-inch top disk was taken to the laboratory where isolations were attempted by splitting the disks and removing five chips from each as described earlier. Growth of mycelium with *Oed. ocephalum* conidia from chips on the PCNB agar medium was regarded as proof of *F. annosus* in the inoculated stumps.

Table 1—Treatments applied to protect western hemlock stumps from *Fomes annosus*

Protectant	Concentration	Application
1. Monolaurin	65 mg/cm ²	Brushed on as paste
2. Monolaurin	6.5 mg/cm ²	Brushed on as paste
3. <i>Streptomyces</i> spores	^{1/} 67x10 ³ /cm ²	Atomized
A. Borax	To whiten surface	Sprinkled as a dry powder
5. Control	No treatment	--

^{1/}Spores were produced in still culture in actinomycetes broth (DIFCO—mention of companies or products does not constitute an endorsement by the U.S. Department of Agriculture). Spores were applied in the broth.

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