Survival of Poria weirii in Wood Buried in Urea-Amended Forest Soil

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ABSTRACT

Poria weirii failed to survive in buried wood cubes when urea was mixed with the surrounding soil or broadcast on the soil surface. Survival was closely associated with zone lines formed inside the cubes. If urea similarly can reduce survival of the fungus in colonized roots of stumps and dead trees, it could be an effective control of *P. weirii* on harvested forest lands.

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Poria weirii (Murr.) Murr. causes the most important root disease of conifers in the Pacific Northwest. All conifers are susceptible, perhaps none more than is Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco. Losses in the Douglas-fir region of Washington and Oregon are estimated at nearly a million cubic meters annually. Persistence of the fungus in rotted wood in soil allows it to remain on the site for many years, attacking conifers when their roots contact inoculum (1). No practical control measure has been developed, but research in some areas offers promise. One such area is the use of nitrogenous fertilizers (2).

Either ammonium or nitrate salts under laboratory conditions was effective in reducing survival of *P. weirii* in buried wood. Under field conditions, however, survival of the fungus in similar wood samples was not affected by either salt broadcast on the soil surface. Warm, dry weather following application probably kept the nitrogen, applied in solution, from reaching the vicinity of the buried wood (2). The following experiment tests whether urea is effective under modified field conditions when the nitrogen reaches the desired site of action. Urea was selected because of its wide application in forest fertilization, its high N content (46%), and because earlier work (2) showed either NO_3^- or NH_4^+ are effective in reducing *P. weirii* survival under laboratory conditions.

MATERIALS AND METHODS.—Survival of *P. weirii* was tested in 5.1-cm wood cubes cut from the moderately decayed lower bole of a Douglas-fir and stored for 3 months at 2 C. Twenty-four plots 91-×91-cm were established at 518-m elevation on the north slope of Mary's Peak in the Coast Ranges west of Corvallis, Oregon. The site is forested with Douglas-fir 50-100 cm in diameter with scattered understory western hemlock, *Tsuga heterophylla* (Raf.) Sarg. The soil is of the Preacher series, a Typic Haplumbrept fine loamy mixed mesic. Of these plots, 12 were randomly chosen as "broadcast" plots and 12 as "mix" plots. On each broadcast plot, nine cubes were buried by driving a 10-cm diameter stainless steel tube to a depth of 23-cm, extracting the core, placing a cube at the bottom of the hole, and replacing the core. Urea was broadcast over the plot surface and surrounding 30-cm buffer strip at a rate of 674 kg N/hectare on six plots. The other six were left untreated.

On each "mix" plot, nine cubes were similarly buried at 23-cm depth in holes 25-cm deep. Soil collected nearby from 15- to 25-cm depth was screened through a 0.5-cm sieve and mixed with powdered urea at rates of 220 g N/m^3 and about 1,000 cm^3 of the mixture was placed in the hole surrounding the dube before the upper portion of the core was replaced. This represents an equivalent of 674 kg N/hectare to a depth of 30 cm. Six of these plots received urea mixed with soil, and six plots received mixed soil only.

Before burial, 10 cubes were chosen at random and split to sample viability of *P. weirii* and stage of zone line development. Cubes were considered to contain viable *P. weirii* if the fungus developed in culture from any of four sampled areas on a split face or on the split face itself when incubated in a moist chamber at room temperature (23 C) for 1 week. Mycelium was identified as that of *P. weirii* if characteristic setal hyphae were found. All cubes were buried in April and removed after 6.5 months to determine presence of viable *P. weirii* and zone lines.

TABLE 1. Zone line formation and *Poria weirii* survival in wood cubes buried in forest soil

Cubes (%)	Method of urea application			
	broadcast		mixed	
	treated	untreated	treated	untreated
with zone lines	11	69	0	39
with viable *P. weirii*	2	48	0	31

RESULTS AND DISCUSSION.—All of the 10 cubes split at time of burial had viable *P. weirii*. Zone lines were not yet visable or were in incipient stages of development. In cubes buried 6.5 months, zone lines formed frequently in untreated "broadcast", less-frequently in untreated "mix" and treated "broadcast," and not at all in treated "mix" cubes (Table 1). Survival of *P. weirii* was best in untreated plots because "defensive" zone lines were formed in more cubes in these plots than in treated plots. Antagonistic microflora were apparently stimulated by the urea to invade the *Poria*-colonized cubes before zone lines could be formed. The fungus did not survive in cubes without zone lines.

Occasional rainfall in the first 8 days after fertilization was about 3.5-cm and in the following 8 days, 3.3-cm, probably sufficient to bring urea to the 23-cm soil depth.

The importance of soil nitrogen in *P. weirii* root disease has been suggested previously by Nelson (2). It now appears that surface application of urea can affect survival of the fungus in wood in soil at depths to 23-cm. Although the presence of urea in the soil will raise pH levels, and may result in higher levels of ammonia (3), survival of *P. weirii* is probably not directly affected. More likely the stimulation of antagonists of *P. weirii* by the presence of available nitrogen, and perhaps pH changes as well, allows them to compete successfully with the fungus. The effectiveness of urea when *P. weirii* exists in larger root residues or in residues incased in thick bark or in resin pockets must be proven if urea is to be considered an attractive control alternative. Fertilization could be combined with other control measures, such as use of more resistant species or stump removal and soil scarification.

LITERATURE CITED

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