Can Wood-Rot Fungi Degrade Cellulose *Without* Other wood Constituents?

Terry L. Highley

Abstract

To develop new methods of controlling wood decay, a study was conducted to determine if a representative white-rot fungus and a representative brown-rot fungus could degrade cellulose if wood were not present. The white-rot fungus, *Coriolus versicolor,* readily degraded cellulose in the absence of wood. However, the brown-rot fungus, *Poria monticola,* did not degrade cellulose in the absence of wood. Thus, there may be an inducer of some sort in wood, which is absent in cellulose, that permits brown-rot fungi to break down cellulose in wood.

BROWN-ROT FUNGI, exemplified by *Poria monticola,* rapidly depolymerize cellulose during early stages of wood decay, whereas white-rot fungi, exemplified by *Coriolus versicolor,* depolymerize cellulose in wood more slowly.' In a study in which cellulose filter paper was substituted for wood feeder blocks in soil-block tests, the white-rot fungus, *Coriolus versicolor,* grew abundantly whereas the brown-rot fungus, *Poria monticola,* had only slight growth.[2] In a recent study[3] three brown-rot fungi exhibited only trace amounts of growth in liquid cultures with cellulose as the whole source of carbon, and culture filtrates did not contain enzymes that could break down microcrystalline cellulose. In contrast, three white-rot fungi grew on cellulose as the sole source of carbon in liquid cultures, and filtrates contained enzymes that could break down cellulose. The objective here was to determine if a representative white-rot fungus and a representative brown-rot fungus could break down cellulose if wood were not present.

Schleicher and Schuell filter paper (597), cut into 1-inch squares (1 mm thick), was the source of cellulose. Susceptibility of the cellulose to fungal attack was determined in chambers patterned after the standard ASTM soil-block procedure[4] employing the brown-rot fungus, *Poria monticola* (Murr.) (Madison 698), and the white-rot fungus, *Coriolus versicolor* (L. ex Fr.) Quel (Madison 697), for comparison. The cellulose was exposed to brown-rot attack by three methods: 1) placing the cellulose directly on the soil, 2) soaking the cellulose in a sterile 1 percent solution of glucose prior to placement on the soil, and 3) placing the cellulose on a previously inoculated sweetgum (*Liquidambar styraciflua* L.) feeder block over soil. Cellulose was exposed to the white-rot fungus by the first and third methods. The cellulose was inoculated with a plug of the fungus growing on malt-agar. Percentage weight loss, the measure of cellulose degradation, was calculated from conditioned air-dry weights before and after exposure to the decay fungi.

Table 1 shows the weight loss (average of three replications) of cellulose from attack by *P. monticola* and *C. versicolor.* The degradation of cellulose alone in cultures agrees with that obtained in liquid cultures.[3] *P. monticola* grew only slightly on the cellulose and

Table 1. - WEIGHT LOSSES OF CELLULOSE FROM WHITE-ROT FUNGUS CORIOLUS VERSICOLOR AND BROWN-ROT FUNGUS PORIA MONTICOLA

	Cellulose weight loss			
	C. versicolor	*P. monticola*		
Incubation time (weeks)	Cellulose on soil (%)	Cellulose on soil (%)	Cellulose and wood on soil (%)	Cellulose and glucose on soil (%)
4	41	0	6	0
0	55	0	37	0
10	70	0	50	0
16	88	0	05	0

[1]Cowling, E. B. 1961. Comparative biochemistry of the decay of sweetgum sapwood by white-rot and brown-rot fungi. USDA Forest Serv. Tech. Bull. 1258. 79 pp.

[2]Highley T. L., and Scheffer, T. C. 1970. A need for modifying the soil-block test for testing natural decay resistance to white rot? Mater. und Organismen 5(4):281-292.

[3]Highley, T. L. 1973. Influence of carbon source on cellulase activity of white-rot and brown-rot fungi. Wood and Fiber 5(1):50-58.

[4]American Society for Testing and Materials. 1971. Method for accelerated laboratory test of natural decay resistance of wood. ASTM Desig. D 2017. *In* Annual ASTM Standards. Philadelphia, Pa.

The author is Plant Pathologist, USDA Forest Service, Forest Prod. Lab., Madison, Wis. %is paper was received for publication in January 1975.

produced no weight loss, whereas the white-rot fungus, *C. versicolor*, readily degraded the cellulose. Glucose added to the cellulose permitted more growth of *P. monticola* over the cellulose, but the cellulose was not degraded. Cellulose in contact with wood, however, suffered significant weight loss by *P. monticola. C. versicolor* also degraded cellulose in contact with wood but weight losses are not shown because of difficulty in separating mycelium, cellulose, and wood.

Thus, there may be an inducer of some sort in wood, which is absent in cellulose, that permits brown-rot fungi such as *P. monticola* to break down cellulose in wood. Perhaps the presence of other materials such as hemicelluloses and lignin in the complex wood substrate induces the synthesis of cellulose-degrading enzymes. Basu and Ghose,[5] for instance, found that several nonwood-decaying fungi produced cellulose on jute holocellulose (cellulose plus hemicellulose), but not on pure cellulose. If the factor permitting breakdown of cellulose in wood by brown-rot fungi were discovered, it could be a significant breakthrough in developing new methods to control wood decay. Investigations are underway at the Forest Products Laboratory to determine the factors involved in inducing depolymerization of cellulose by brown-rot fungi.

[5]Basu, S. N., and S. N. Ghose. 1960. The production of cellulose by fungi on mixed cellulosic substrates. Can. J. Microbiol. 6:265-282.