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Effect of Temperature on Growth and Survival of High- and Low-Elevation Isolates of Phellinus (Poria) weirii

Abstract

Isolates of *Phellinus weirii* (Murr.) Gilbertson (*Poria weirii*) from above 1,675-m elevation did not differ significantly from those below 488 m in growth or survival under various temperature regimes. The fungus generally survived from −5° to 32° C for up to one year. Linear growth was generally best at 25° C, followed by 20°, 15°, 30°, 10°, and 5° C.

Introduction

Phellinus weirii (Murr.) Gilbertson (*Poria weirii*) causes a severe root disease of western conifers in diverse habitats. Recent measurements of rate of disease development at elevations exceeding 1,524 m in Oregon's Cascade Range showed a radial extension of infection centers averaging 34 cm per year (Nelson and Hartman, 1975). This is somewhat greater than that estimated for Douglas-fir at lower elevations (Childs, 1970).

To determine if differences existed between high- and low-elevation isolates of *P. weirii* in their ability to grow and survive in the laboratory over a range of temperatures, we tested five isolates of the fungus from above 1,675 m and five isolates from elevations between 137 and 488 m.

Methods and Materials

Isolates of *P. weirii* were obtained from Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) in the Cascade Range and Olympic Peninsula of western Washington (T-isolates) and from Mountain hemlock (*Tsuga mertensiana* [Bong.] Carr) in the Cascade Range of western Oregon (W-isolates).

Isolate number	*Elevation*	*Location*
T-55	488 m	near Randle, Wash.
T-65	335 m	near Carson, Wash.
T-102	137 m	near Elma, Wash.
T-122	380 m	near Quilcene, Wash.
T-125	380 m	near Quilcene, Wash.
W-1, W-4, W-9, W-12, W-13	1,675-1,677 m	Willamette National Forest near Waldo Lake, Oregon

All W-isolates had been held in culture on malt agar at 2° C for nearly two years. T-isolates had been held similarly for more than ten years. All isolates were grown on malt agar in petri plates.

Linear Growth Study

From the leading edge of colonies of each isolate growing on malt agar, 4-mm-diameter disks were taken with a cork borer and transferred to centers of petri plates containing 30 ml of the same growth medium. Three replicate plates were incubated at 5°, 10°, 15°, 20°, 25°, and 30° C and colony diameters measured to the nearest millimeter at daily or less frequent intervals, depending upon rate of growth at a particular temperature. Growth of each isolate over time was plotted for each temperature, and rates of growth (over the linear portion of the curve) were compared.

Survival Study

Each isolate was grown on autoclaved red alder disks (6 to 8 mm in diameter and about 3 mm thick) loosely arranged over gravel and water in 60 ml-capacity French Square bottles. Forty disks were placed in each bottle, and three bottles for each isolate were incubated at –20°, –15°, –10°, –5°, 2°, 25°, 30°, 32°, and 34° C. After 0, 1, 2, 4, and 8 days and 2, 4, 8, 16, 24, 32, 42, and 52 weeks of incubation, three disks were removed from one of the bottles for each isolate at each temperature and plated on malt agar at room temperature to determine viability of the fungus. The two remaining bottles for each isolate at each temperature were used only if the first became contaminated or dried out, or to substantiate loss of viability when it occurred in the first bottle.

Results and Discussion

Linear Growth Study

Growth of all isolates was best at 25°, followed by 20° and 15° C. For the remaining three temperatures, growth was best in seven of 10 isolates at 30° followed by 10° and 5° C; three isolates grew best at 10° followed by 5° and 30° C (T- 55, W-4, and W-12). Li *et al.* (1967), using a single isolate of *P. weirii,* found no growth at 30° C and optimum growth at 20° C as compared with optima of 25° C in this study. Average growth rate of low-elevation isolates was better than that of high-elevation isolates except at 5° C (Table 1), but there were no statistically significant differences in growth between the two groups ($p = .05$) when compared by analysis of variance at each temperature or by regression.

TABLE 1. Average daily increase in colony diameter of high- and low-elevation isolates of *Phellinus weirii* on malt agar.

Elevation group	Incubation temperature (Centigrade)					
	5°	10°	15°	20°	25°	30°
	mm					
Low (T)	3.42	4.86	12.52	15.34	19.04	5.60
High (W)	3.82	4.76	11.98	14.58	18.52	4.90

Survival Study

Phellinus weirii survived in all cases for a year at temperatures from –5° to 30° C and to 32° C in all but one clone (T-55). Survival among clones of the fungus varied little at other temperatures and times observed. Most of that variation occurred at –20°, –15°, and –10° C, and survival at these temperatures did not exceed four weeks in any case. Only one clone (W-13) failed to survive at least four days at –20° C. There appeared to be no difference in survival between high- and low-elevation clones at the times and temperatures observed. Survival was somewhat poorer than that reported earlier for another clone of *P. weirii* in larger alder stem sections (Nelson and Fay, 1974).

The two groups of isolates of *P. weirii* tested here were from diverse habitats (different latitudes, elevation ranges, soil origins, and hosts) and had been held in storage for different lengths of time. Even so, they appeared to have as much variation in growth and survival within groups as between them in response to the experimental conditions of time and temperature. Greater variation between groups might be difficult to explain since the fungus in general appears to grow and survive over a wide range of temperatures as well as in a diversity of soils, host species, and geographic and climatic extremes.

Literature Cited

Childs, T. W. 1970. Laminated root rot in western Oregon and Washington. USDA For. Serv. Res. Pap. PNW-102, 27 p., illus. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

Li, C. Y., K. C. Lu, J. M. Trappe, and W. B. Bollen. 1967. Effect of pH and temperature on growth of *Poria weirii* in vitro. USDA For. Serv. Res. Note PNW-66, 6 p. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

Nelson, E. E., and H. Fay. 1974. Thermal tolerance of *Poria weirii*. Can. J. For. Res. 4: 288-290.

————, and T. Hartman. Estimating spread of *Poria weirii* in a high elevation, mixed conifer stand. J. For. 73(3):141-142.

Received March 18, 1975.
Accepted for publication May 7, 1975.