TAXONOXY AND NOMENCLATURE OF *PHELLINUS WEIRI* IN NORTH AMERICA

Michael J. Larsen and Frances F. Lombard

Center for Forest Mycology Research
U.S Department of Agriculture, Forest Service
Forest Products Laboratory
One Gifford Pinchot Drive
Madison, WI 53705–2398
U.S.A.

SUMMARY

The concept of *Phellinus weiri* in the Pacific Northwest of the United States and Canada is apparently composed of two recognizable entities. In the past, the question of the existence of two taxa has been raised, and referred to as the "cedar form" and the "Douglas–fir form." However, it is a question that was never adequately pursued. *Phellinus weiri* was originally described from western redcedar in northern Idaho, and later identified as causing mortality in Douglas–fir and other conifer species throughout northwestern United States and western Canada. We recognize the fungus that is the principal cause of "*weiri* root–rot'' of Douglas–fir as a separate taxon.

We present evidence derived from examination of various aspects of their life–cycles and cultural characteristics for separating these two taxa. They may be identified on the basis of size of setal hyphae, spore germination characteristics, degree of host specificity, apparent differences in the development of the pathogen in the host, and gross characters in culture.

KEY WORDS: *Phellinus weiri*

INTRODUCTION

Phellinus weiri (Murr.) Gilb. was originally described by Murrill (1914) from a fungal collection on *Thuja plicata* Donn. forwarded by J. R. Weir from Priest River, Idaho. Overholts (1931) indicated that the fungus may be confined to *T. plicata*, and Hubert (1931) cited *T. occidentalis* L. as an additional host. Mounce *et al.* (1940) were the first to report *E. weiri* attacking *Pseudotsuga menziesii* (Mirb.) Franco, and concluded from their study that the

fungus on Douglas-fir was conspecific with P. weiri on western redcedar. Bier and Buckland (1947) extended the host range of the fungus to additional species of Abies, Picea, Pinus and Tsuga. Nobles (1948). while studying P. weiri isolates from Douglas-fir, western hemlock, and western redcedar, made no distinction between those occurring on western redcedar and those occurring on other conifers.

Buckland et al. (1954), after an extensive study of P. weiri isolates from Douglas-fir and western redcedar, designated isolates from Douglas-fir as "annual P. weirii" and "perennial P. weirii." respectively. Their recognition of these two forms was based on culture characteristics, whether the fruiting bodies were annual or perennial, and host specificity. Furthermore, Mounce et al. (1940) noted that average diameters of setae (?setal hyphae) in sporophores from T. plicata were slightly greater than those from P. menziesii, being 6-13.5 µm and 4-10 µm, respectively. In addition, they reported setal hyphae in culture as 4.5-6(-7) µm diameter for P. menziesii and 3-5 µm diameter for T. plicata. Of further interest were the experiments of Brickland et al. (1954), in which they paired Douglas-fir isolates in Petri dish cultures and also paired Douglas-fir isolates with cedar isolates. Confrontations of only Douglas-fir isolates showed no sign of antagonism, but when Douglas-fir isolates were confronted with cedar isolates, zone lines of (assumed) antagonism developed.

Clark (1958) conducted an extensive study of these two forms, and, based on 131 isolates (35 from cedar, 62 from Douglas-fir, and 34 from other coniferous hosts) concluded that there are two recognizable forms in culture and designated them as cedar isolates and non-cedar isolates. Cedar isolates were mostly confined to cedar. However, three cedar isolates were obtained from other hosts. Non-cedar isolates were never isolated from cedar.

The purpose of this communication is to provide additional evidence for the existence of two recognizable taxa, focusing on various aspects of the life cycles of the two.

MATERIALS AND METHODS

Basidiospore germination

Basidiospores were collected either in the field on small strips of aluminum foil attached directly below the fruiting body or on 2% malt-agar (w/v) from pieces of poroid hymenophores. Spores were placed in suspension in distilled water with 0.01% Tween 80 (v/v). Polysporus isolates were isolated in test tubes from these suspensions. Suspensions were further diluted to a suitable concentration on flooded Petri dishes containing 2% malt agar and streptomycin (30 ppm). Petri dishes flooded with spore

suspensions were used to obtain single spore isolates and used also as a means for observing the nature of spore germination. Photomicrographs of basidiospores germinating on an agar surface were prepared with the aid of a Leitz Orthomat and Orthomat camera in conjunction with Panatomic-X film (ASA 64).

Culture comparisons

The methods employed in studying the cultures were the same as used in previous studies (Davidson et al., 1942). The Key Patterns were based on 2-wk-old cultures inoculated in the centers of Petri dishes on 1.5% malt extract agar (MEA) and incubated at 25 C. The Species Code of Nobles (1965) was based on 6-wk-old cultures inoculated at the sides of the dishes. Extracellular oxidase production was detected by the Bavendamm test described by Davidson et a1.(1938), in which the cultures are grown on malt agar containing 0.5% gallic (GAA) or tannic (TAA) acids. For the constant temperature study, cultures on MEA were placed in incubators at eight temperatures ranging from 16-44 C 24 h after plating and measured at the end of 6 da. Mat diameters are averages of three replications.

Analyses of setal hyphae dimensions

Lengths to the first septum and widths of setal hyphae were obtained from a series of dried test-tube cultures that were part of the basis of Clark's (1958) original study of cedar vs. non-cedar isolates. Approximately LO setal hyphae were measured from each dried culture. Of 66 such isolates, 24 were from cedar (and classified by Clark [1958] as cedar isolates), 22 from Douglas-fir, 11 from western hemlock, and 9 from other conifer species. Three isolates from hosts other than cedar were shown by Clark to be cedar isolates. Thus, data were grouped according to Clark's (1958) designations of cedar vs. non-cedar isolates and analyzed by the two sample T-test for significant differences.

Single spore confrontations

Isolates germinated from individual spores from separate fruiting bodies from Douglas-fir and cedar were confronted in all combinations. Confrontations were also made between single spore isolates from the two hosts and polysporus isolates of the two forms. Twenty single spore isolates of each of the two forms were used and crosses were done on 2% malt agar (w/v).

RESULTS

Basidiospore germination

Cedar isolates

Germination occurring within 12-24 hours subsequent to spore swelling, appearing initially as germ tubes near the hilar end of the spore. Following germination and production of juvenile mycelia, an additional growth is produced at the distal end at 24-36 hours. Some septa are also produced. Fusion of hyphae was not observed. Branching was not observed during the 12-24 hour period. Germ tubes and immature hyphae during this period were 2-3.5 µm diam.

Non-cedar isolates

Germination occurring within 12-24 hours subsequent to spore swelling, appearing initially as germ tubes near the hilar end of the spore. Septa are produced on juvenile hyphae within a few hours of germination with concomitant hyphal branching. Only one germ tube is produced per spore. Hyphal fusion was not observed. Germ tubes and immature hyphae during the 12-24 hour period were 4.5-6 µm diam.

Culture comparisons

Petri dish cultures of cedar type isolates grow slower and are considerably darker than non-cedar type isolates. Also, the cedar type usually develops columnar tufts, which are especially noticeable in test-tube cultures. The Species Code (Nobles, 1965) for cedar type is: 2.6.18.32.37.39.43-44.55., and for non-cedar type is: 2.6.18.32.37.39.42-43.55.

Analyses of setal hyphae dimensions

Significant differences ($P=.005$) were found for widths of setal hyphae between cedar and non-cedar isolates. Significant differences were also found for lengths of setal hyphae ($P<.0005$) between cedar isolates and non-cedar isolates (Table 1).

Table 1.--Comparison of lengths of setal hyphae between cedar and non-cedar isolates.

	Cedar isolates	Non-cedar isolates
Range	146-568	194-817
Mean	291	366
St Dev	75.7	104.11
SE Mean	4.6	6.3
N	269	269

T = 9.58 P = < .0005 DF = 489.5

95% confidence interv. for mean of cedar isolates - mean of non-cedar isolates: -86.6, -53.4

Single spore confrontations

Single spore crosses within spore populations (spore collections from single fruiting bodies) for both cedar isolates and non-cedar isolates generally led to intermingling of hyphae with some noticeable antagonism between some crosses. However, antagonism was strong when single spores of the cedar isolates were confronted with those of non-cedar isolates. Pigment production was intense and no intermingling of hyphae was observed in the confrontation zone.

DISCUSSION AND CONCLUSION

We conclude that the non-cedar type fungus that is the principal cause of mortality in Douglas-fir and other conifers (excluding western redcedar) is sufficiently different to warrant formal nomenclatural recognition. Our data substantiate in large part the earlier differentiation of physiological strains proposed by Clark (1958), and "annual" and "perennial" forms defined by Buckland (1954).

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