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# Ability of isolates of *Confertobasidium olivaceo-album* to stain and decay wood[1]

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Ten isolates of *Confertobasidium olivaceo-album* (Bourd. & Galz.) Jülich (*Corticium fuscostratum* Burt) were tested to determine optimum temperature for growth and capability to stain and decay wood. Optimum growth temperature for the majority of the isolates was 22°C. Decay rates for all isolates were uniformly low, and after 12 weeks of incubation, weight loss was never more than 5%. Decay was greater in pine heartwood than in sapwood, averaging 3.7–3.9% and 2.2–2.3%, respectively. Little or no difference in decay rate occurred between soil-block tests at 22°C and at 27°C. Two of the 10 isolates caused a golden-orange stain in pine heartwood.

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Dix isolats de *Confertobasidium olivaceo-album* (Bourd. & Galz.) Jülich (*Corticium fuscostratum* Burt) ont été testés afin de déterminer à quelle température leur croissance et leur capacité pour colorer et carier le bois étaient maximum. La température optimum était de 22°C pour la majorité des isolats. Dans tous les cas, le taux de carie était faible: après 12 semaines d'incubation, la perte de poids n'avait guère dépassé 5%. Dans du bois de pin, le pourcentage de carie était plus élevé dans le bois de cœur que dans le bois d'aubier: 3.7–3.9% et 2.2–2.3% respectivement. Peu ou pas de difference fut observée dans le taux de carie a 22°C et 27°C. Deux des isolats ont causé une coloration orange dorée dans le bois de cœur.

[Traduit par le Journal]

## Introduction

*Confertobasidium olivaceo-album* (Bourd. & Galz.) Jülich, with synonyms of *Corticium olivaceo-album* Bourd. & Galz., *C. fuscostratum* Burt, *Athelia fuscostrata* (Burt) Donk, and *A. olivaceo-alba* (Bourd. & Galz.) Donk (Jülich 1972), has been found to cause a golden-orange stain in heartwood of lodgepole pine (*Pinus contorta* Dougl. ex Loud.) utility poles and lumber (Eslyn 1979). In addition, soil-block tests showed this fungus could induce only minor weight losses in pine sapwood and heartwood. Because these stain and decay-capability tests were based on only one isolate (ME-21) of C. *olivaceo-album*, the study reported here was initiated, utilizing 10 different isolates of this species, to determine if the earlier findings were characteristic. Temperature–growth relationships of *C. olivaceo-album* and the effect of temperature on decay capability were also investigated.

## Materials and methods

*Test fungi*

Ten isolates of C. *olivaceo-album* were obtained from the Center for Forest Mycology Research, Forest Products Laboratory (FPL), Madison, Wisconsin, for use in this work, and include the following: ME-21, from golden-orange-stained heartwood of *Pinus contorta* Dougl. ex Loud., Colorado; RS-6, from orange-red stain and root rot of living *P. strobus* L., Syracuse, New York; White-Sp., from red heart stain in *P. strobus* L., Barry's Bay, Ontario, Canada; Colo. 55-104-1, from *Picea engelmannii* Parry ex Engelm., Slaughterhouse Gulch, Gunnison National Forest, Colorado; Mill. 107-1-3-R, from salmon-pink stain in *Pinus strobus* L. lumber, Millford, New Hampshire; HHB-8985-Sp., from *Acer saccharum* Marsh., Michigan; FP-104100-Sp., from a rotted log near a cypress swamp, Prince Frederich, Maryland; FP-105007-R., from red stain in butt of *P. strobus* L., Mt. Alto, Pennsylvania; FP-105106-Sp., from conifer wood, Red Feather Lake, Roosevelt National Forest, Colorado; FP-105619-R., from gold-colored stain in wood at base of living *Pinus contorta* Dougl. ex Loud., Taylor Basin, Colorado.

*Temperature–growth relations*

Each of the 10 test isolates was inoculated into 12 dam tubes (Scheffer 1935) containing malt agar. The fungi were incubated for 5 days at 27°C and 80% relative humidity (RH), then removed, and the extent of fungal growth delineated. Two tubes of each fungus were then placed into incubators maintained at 20, 22, 24, 26, 28, and 30°C. Measurements of linear mycelial growth were taken every 3–4 days for 2 weeks.

*Decay-capability tests*

Sapwood and heartwood blocks, each 2.54 × 2.54 × 0.94 cm (1 × 1 × 3/8 in.) with the 0.94-cm dimension in the

[1]This article was written and prepared by a U.S. Government employee on official time and it is therefore in the public domain.

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grain direction, were cut from green lodgepole pine logs. The blocks were conditioned at 27°C and 80% RH, weighed, steamed for 20 min at 100°C, then subjected to the standard soil-block method for testing natural decay resistance of wood (American Society for Testing and Materials 1980). *Confertobasidium olivaceo-album* isolates were used in place of the test fungi normally used in the standard method. Madison test isolate Mad-698 (*Poria placenta* (Fr.) Cke.) was incorporated in the test as a reference fungus. Also, half of the tests were incubated at 27°C and half at 22°C; in the present temperature–growth tests, 22°C was found optimum for growth of the *C. olivaceo-album* test isolates.

*Stain-capability tests*

In the earlier work of Eslyn (1979), the isolate ME-21 was found to cause golden-orange staining in the heartwood of lodgepole pine but not in the sapwood. To determine if this finding would be similar for all the isolates, sticks each approximately 0.5 × 3.5 × 20 cm long (0.2 × 1.4 × 6.9 in.) were cut from heartwood and sapwood of green lodgepole pine. The sticks were steam sterilized, then placed in autoclaved tubes with reservoir tips containing either distilled water or malt extract. Each stick was then inoculated with one of the test isolates after which the isolates were incubated (Fig. 1) for 4 months at 22°C.

To determine effect of pH on stain formation, plates of malt agar with the media adjusted to pH 3.2, 4.0, 4.5, 5.0, 5.5, 6.0, and 7.4 were used. Sterile pieces of lodgepole pine sapwood were placed on the media. The media were then inoculated with isolate ME-21 and were incubated until fungal growth covered the wood.

## Results

*Temperature–growth relationship*

Effect of temperature on growth of each of the 10 test isolates is shown in Fig. 2. Optimum temperature for growth on malt agar was 22°C for the majority of the isolates. Growth decreased rapidly for nine isolates when incubation temperatures were increased from 24 to 26°C. Growth of isolate Mill. 107-1-3-R decreased rapidly above 26°C. At 30°C, growth ceased entirely for two isolates and was minimal (below 0.2 mm/day) for three others. Isolate FP-105007-R grew most rapidly of all isolates, whereas Mill. 107-1-3-R grew most slowly, at least at lower (optimum) temperatures.

*Decay-capability tests*

Percent weight losses in lodgepole pine wood for each of the test isolates are given in Table I. The reference fungus, *Poria placenta,* caused weight losses of 65–66% at both 22 and 27°C, which are in the range expected of this efficient wood destroyer. Average weight losses caused by *C. olivaceo-album* isolates were uniformly low, and never exceeded 5%. Weight losses were consistently slightly higher in pine heartwood than in sapwood. When decay rates at 22 and 27°C were compared, however, little or no difference was noted.

*Stain-capability tests*

Two isolates, ME-21 and FP-105619-R, caused a golden-orange stain in the heartwood of lodgepole pine, but not in the sapwood. The color would be detected with a hand lens as early as 3 days after inoculation. Comparison of the color of the stained wood while wet with colors in the ISCC-NBS Color-Name Chart (Kelly 1965) indicated the closest match was No. 66, "vivid orange-yellow." Staining did not occur in either heartwood or sapwood of pine inoculated with any of the eight remaining isolates even though the mycelium of each isolate grew into the wood.

No staining occurred using isolate ME-21 inoculated into sapwood pieces placed on malt agar media adjusted to different pH's. Growth, however, apparently was slightly favored by exposure to pH 5.5

## Discussion

*Confertobasidium olivaceo-album* has been variously described: in white pine as causing a red stain that ultimately develops into a powdery brown rot (White 1953); in jack pine as an associate of brown sap rot (Basham 1957) and as causing a brown cubical rot (Basham and Morowski 1964). It has also been found associated with white rots in eastern white pine and red pine (Basham and Morowski 1964), in white firs (Gilbertson *et al.* 1975), and in conifer and hardwood logs and slash (Gilbertson *et al.* 1974; Lindsey and Gilbertson 1978). In the culture collections of the Center for Forest Mycology Research (FPL), *C. olivaceo-album* has been noted to have been isolated from red-stained eastern white pine and lodgepole pine trees and lumber and from, presumably, nonstained southern pine, ponderosa pine, Engelmann spruce, hemlock, balsam fir, northern white cedar, and sugar maple. Based on present decay studies and on the strong phenol oxidase reaction (Davidson *et al.* 1938) exhibited by this fungus when grown on tannic acid media, *C. olivaceo-album* is thought to be a member of the white-rot group of basidiomycetes.

In these studies, *C. olivaceo-album* isolates were found to vary in their ability to cause reddish stains in wood. Where staining did occur (isolates ME-21 and FP-105619-R), it was confined, at least in lodgepole pine, to the heartwood of the stem, which agrees with the one isolate used (ME-21) in an earlier test (Eslyn 1979). Stain-causing strains of this fungus may be of use in differentiating heartwood–sapwood boundaries in pines. Investigation is planned to determine the fungal metabolite responsible for staining.

Optimum temperatures for growth of wood-destroying fungi on agar cultures vary from 20 to 36°C (Boyce 1961). The optimum temperature for growth of C. *olivaceo-album* isolates on similar cultures is about 22°C, a temperature somewhat on the low end of the

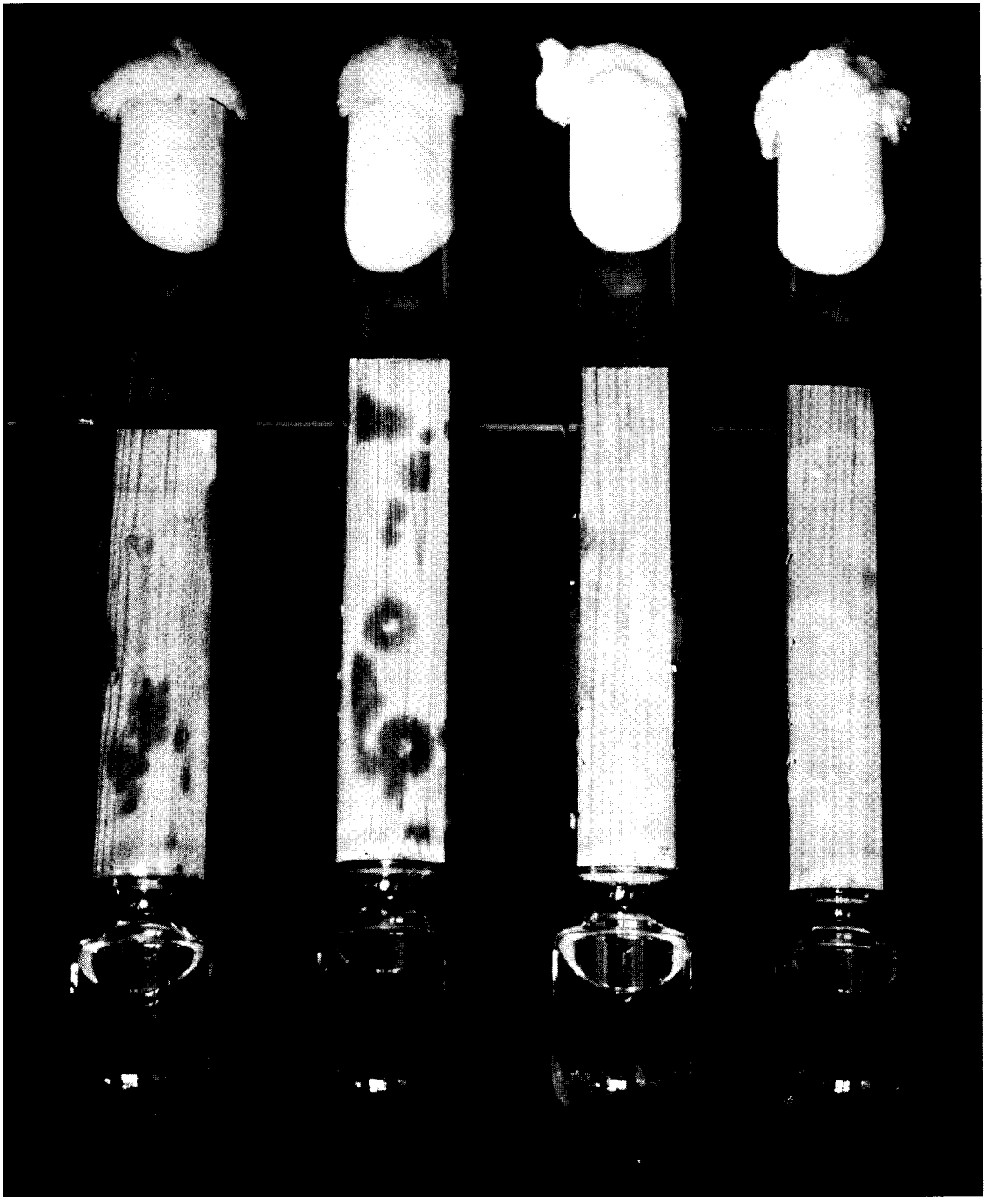

FIG. 1. Apparatus for determining stain capability of *Confertobasidium* olivaceo-album isolates. Tubes shown above, 10 days after inoculation with isolate ME-21, contain, from left to right, lodgepole pine heartwood and water, heartwood and malt extract, sapwood and water, and sapwood and malt extract. Darkened areas shown here are golden-orange staining on heartwood sticks.

range of optima for wood decay fungi. The preference of this fungus for cooler temperatures is in accord with its prevalence in the northern parts of Sweden (Eriksson and Ryvarden 1973) and North America and by its

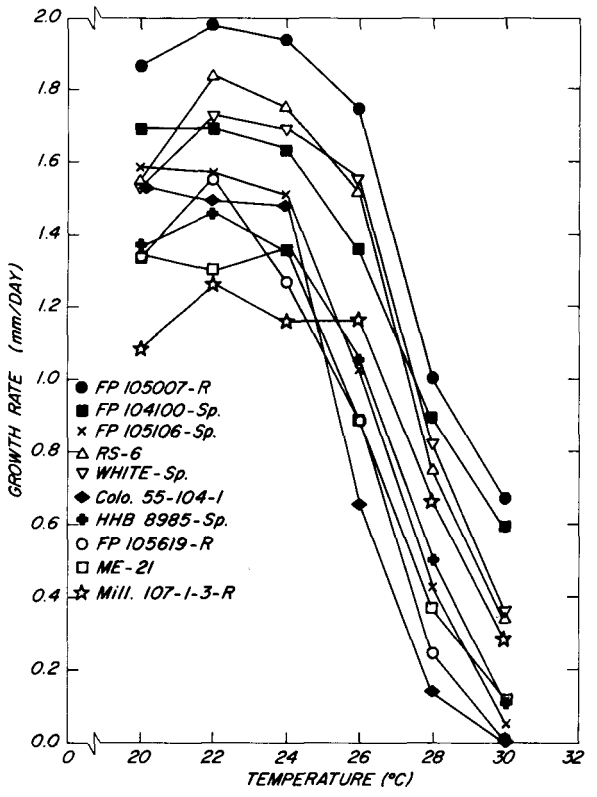


FIG. 2. .Average daily linear growth of 10 isolates of *Confertobasidium olivaceo-album* on malt agar at six temperatures.

development in snowbanks in Arizona (Gilbertson 1973).

In standard soil-block tests on lodgepole pine heartwood and sapwood, at 22° and 27°C, each of the 10 test isolates of *C. olivaceo-album* caused only minor weight loss that never averaged more than 5%. At present the inoculated pine sticks used in the stain-capability testing show no signs of decay even after 6 months of incubation. On the basis of these results, this fungus, separately, is not believed to be of concern in deterioration of wood in use. Whether or not this fungus assumes importance under a special set of environmental conditions, or contributes to product decay by other fungi, is not known. Its reported association with totally different types of decay in living trees may leave its role in tree decay suspect.

TABLE 1. Percent weight loss[a] in lodgepole pine heartwood and sapwood after 12-week exposure at 22 or 27°C to 10 isolates of *Confertobasidium olivaceo-album*

| | Exposure temperature, °C | | | |
|---|---|---|---|---|
| | Heartwood | | Sapwood | |
| Isolate | 22 | 27 | 22 | 27 |
| ME-21 | 3.8 | 3.9 | 2.2 | 2.4 |
| White-Sp. | 4.4 | 3.6 | 2.2 | 2.0 |
| HHB-8985-Sp. | 4.2 | 3.6 | 2.2 | 2.3 |
| Mill. 107-1-3-R | 3.9 | 3.0 | 2.2 | 1.8 |
| Colo. 55-104-1 | 3.2 | 3.3 | 3.1 | 2.1 |
| RS-6 | 4.2 | 4.5 | 1.9 | 2.3 |
| FP-104100-Sp. | 4.2 | 3.8 | 2.3 | 3.1 |
| FP-105007-R | 4.8 | 4.5 | 2.7 | 2.2 |
| FP-100516-Sp. | 5.0 | 4.8 | 2.3 | 2.2 |
| FP-105619-R | 1.5 | 2.3 | 1.7 | 1.9 |
| Average | 3.9 | 3.7 | 2.3 | 2.2 |
| *Poria placenta*[b] | 65.2 | — | — | 66.4 |

[a] Each value is average of six replicates
[b] Reference decay fungus.

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