Using isolates of decay fungi from field test samples for durability tests under laboratory conditions

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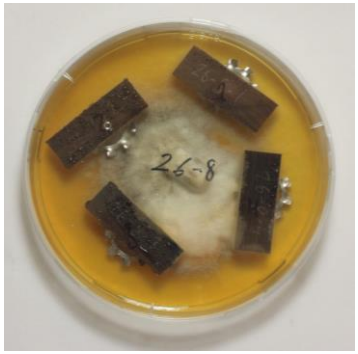
Background



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→ Standard test fungi are not necessarily the same species provoking decay in the field.

Objectives & Experimental

- Investigate the possibility to use isolates from in and above ground specimens for laboratory resistance tests
- Compare results with standard test fungi

→ More than 30 isolates incubated on malt agar

→ Screening mini-block test, 2 wood species

→ 11 isolates (ML > 3 %) used for testing 15 wood-based materials

→ Additional DNA analysis

Results

- Majority of the species was identified at least on genus level
- Severe brown rot causing fungus decay (*Leucogyrophana* sp.) difficult to colonize on malt agar
- Most isolated fungi showed equal or more severe decay compared to commonly used standard test fungi

→ Additional references in laboratory decay tests

USING ISOLATES OF DECAY FUNGI FROM FIELD TEST SAMPLES FOR DURABILITY TESTS UNDER LABORATORY CONDITIONS

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Abstract: Within the Swedish research program 'WoodBuild' comparative field and laboratory durability studies have been carried out by the Technical Research Institute of Sweden SP and Leibniz University Hannover. One objective was to improve test methods as well as evaluation systems in order to facilitate the use of (field) testing for service life prediction and to verify the suitability of different test methods for estimating the durability of wood under different exposure conditions. In addition to moisture performance and durability under field conditions, the resistance of all materials was assessed in the laboratory by conducting 'mini-block' tests. These tests were carried out using different standard test fungi. However, besides this standard test fungi a huge variety of ascomycetes and basidiomycetes can be regarded as potential wood-destroyers so that the species used for laboratory decay tests are not necessarily the same species provoking decay or even failure of wood in the field and on structures in service. Therefore this study aimed on testing the possibility to use isolates taken from in and above ground specimens exposed in the field for laboratory resistance test. In a second step a direct comparison with cultures of standard test fungi was carried out. In the frame of a STSM fungal isolates were sampled for identification and reproduction under laboratory conditions from field test samples exposed in Borås, Sweden, and Hannover, Germany. At both test sites approx. 40 different native, chemically and thermally modified as well as preservative treated wood-based materials were under test for a period of three years; 17 of these materials have been tested in this study.

Background & Objectives

Apart from standard test fungi a huge variety of ascomycetes and basidiomycetes can be regarded as potential wood-destroyers. The decay patterns and preferences of the different fungal species may differ significantly between laboratory and different outdoor exposure conditions. Furthermore, the susceptibility of certain bio-based building materials to particular decay types influences the transferability of laboratory test results to real life hazard. Consequently laboratory tests allow more defined and reproducible conditions and benefit from shorter test durations compared to field tests, but suffer from a poorer comparability to real life situations. Therefore this study aimed on testing the possibility to use isolates taken from in and above ground specimens exposed in the field for laboratory resistance test.

Experimental

In- and above-ground test samples were selected by macroscopic infestation characteristics like fruiting bodies, occurrence of mycelium and appearance of the wood surface. Afterwards borehole cuttings were taken by drilling a hole into the specimen to a depth of approx. 5 mm using a sterilized borer and adhering borehole cuttings were removed and sampled with a sterilized scalpel (Figure 1). The fungi were then cultivated by putting the isolates on malt agar. After 16 days of incubation, the test fungi were selected by their growth velocity and optical appearance. In total, more than 30 isolates were incubated on malt agar. A screening mini-block test was started with untreated beech and Scots pine sapwood to evaluate the ability of the different fungi to degrade wood under laboratory conditions. Based on this test in total 11 fungal isolates which caused mass loss > 3 % were used for testing 15 different wood-based materials. Furthermore, the different species were identified with a DNA analysis using PCR, sequencing of the internal transcribed spacer of nuclear ribosomal DNA (nrDNA-ITS) and comparison with reference data from a gene bank database.

Figure 1: Sampling of isolates from in and above ground specimens exposed in the field

Results & Discussion

Different basidiomycetes such as *Trametes hirsuta* and *Gloeophyllum trabeum* were identified. *T. hirsuta*, a typical white rot causing basidiomycete (Rypáček, 1966) showed high similarities to *T. versicolor* with respect to optical appearance and conditions of living (Bavendamm, 1969). However, the fungus causing the most severe brown rot decay in the field and which had previously been identified as *Leucogyrophana* sp. (most likely *L. pinastri*) was found to be difficult to colonize on malt agar. All isolates taken from field samples apparently infested by this basidiomycete suffered from little growth activity and infection by mould fungi occurred. The highest mass loss was caused by the fungi *T. hirsuta* and *G. trabeum* (Figure 2). In the main trial also the ascomycete *Hypoxylon* sp. caused remarkably mass loss on maple and ash. Generally it was found that a high growth activity of mycelium can not be equated with a high degradation of wood substrate. As can be seen from Figure 3 the mass loss was less than 3 % although the fungus was able to overgrow all specimens.

Figure 2: Mycelium activity and mean mass loss (ML) of a) *T. hirsuta* and b) *G. trabeum* after eight weeks of incubation on beech

Figure 3: Mycelium activity and mean mass loss (ML) of a) *Fusarium sp. and b) Trichoderma sp.* after eight weeks of incubation on beech

For a durability classification the x-values were calculated as the quotient of mass loss of the different species and the references (x-value, EN 350-1, 1994). Furthermore, results from EN 252 (1989) in-ground tests as well as horizontal double layer tests were used to determine the durability and compared with those based on mini-block tests (Table 1). Since not all specimens failed, the mean decay rate was considered for preliminary durability classification. The results showed that the results obtained from tests with the three isolated fungi coincided quite good with the results of the two standard test fungi *C. puteana* and *T. versicolor*. The isolates taken from field test samples therefore seem to be suitable for laboratory decay tests. The transferability of the laboratory test results with isolated cultures to field tests was surprisingly good for the tested hardwoods, but insufficient for the softwoods.

Table 1: Durability classification for different wood species tested in laboratory as well as different field test.

Wood species	Test fungus										Field test results**		
	C.p.		*T. v.*		*T. h.*		*G. t.*		*H. sp.*		EN 252 (1989)	HDL	DIN EN 350-2 (1994)
	x	DC	x	DC	x	DC	x	DC	x	DC	DC	DC	DC
Oak	0.19	2	0.26	2	0.55	3	0.02	1	0.27	2	1	2	2
Black locust	0.20	2	0.02	1	0.01	1	0.00	1	0.03	1	n.a.	n.a.	1-2
Ash	0.37	3	0.73	4	0.04	1	0.78	4	0.63	4	4	2	5
Maple	0.04	1	1.06	5	0.92	5	0.08	1	0.78	4	5	5	5
Scots pine heartwood	0.65	4	0.03	1	0.06	1	1.65	5	n.a.*	n.a.*	4	4	3-4
Douglas fir sapwood	0.43	3	0.60	3	0.09	1	0.10	1	n.a.*	n.a.*	-	-	3-4
Douglas fir heartwood	0.12	1	0.03	1	0.06	1	0.02	1	n.a.*	n.a.*	1	4	3-4
Spruce	0.78	4	0.62	4	0.01	1	1.82	5	n.a.*	n.a.*	5	5	4
Larch	0.48	3	0.08	1	0.02	1	0.64	4	n.a.*	n.a.*	1	4	3-4
SYP	0.62	4	0.69	4	0.08	1	0.35	3	n.a.*	n.a.*	n.a.	n.a.	n.a.
Furfurylated SYP	0.04	1	0.10	1	0.17	2	0.24	2	n.a.*	n.a.*	n.a.	n.a.	n.a.
Acetylated SYP	0.00	1	0.02	1	0.05	1	0.00	1	n.a.*	n.a.*	n.a.	n.a.	n.a.
Ash OHT	0.03	1	0.06	1	0.08	1	0.00	1	0.13	1	n.a.	n.a.	n.a.
Spruce OHT	0.00	1	0.03	1	0.06	1	0.00	1	n.a.*	n.a.*	n.a.	n.a.	n.a.
Scots pine TMT	0.00	1	0.03	1	0.00	1	0.00	1	n.a.*	n.a.*	n.a.	n.a.	n.a.

*mass loss of reference was less than 3 % **preliminary classification based on mean decay rate

Conclusions & Outlook

The test results showed that fungi provoking decay in field tests can be isolated and used for laboratory resistance tests. Various decay fungi as well as mould and other wood-inhabiting fungi were easily isolated from different field test samples and incubated on malt agar. The majority of species was identified at least on genus level. However, the decay activity of most isolates was less than expected when submitting them to a mini-block test with different wood-based materials. Tests with three of the isolated fungi (*T. hirsuta, G. trabeum and Hypoxylon* sp.) resulted in equal or in some cases even lower durability compared to the commonly used standard test fungi and might therefore be considered as additional references in laboratory decay tests.

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Thanks to…

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