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Relationships between *Nectria coccinea* and white rot fungi

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Summary

In beech stands attacked by beech bark disease, white rot fungi cause severe financial losses by destroying the wood. Amongst others *Fomes fomentarius* is of great importance in this respect. From March until the middle of July the fungus produces spores which can germinate under suitable conditions after a few hours.

Experiments *in vitro* showed that *Nectria coccinea* supports the development of *Fomes fomentarius*. The influence involves spore germination, mycelial growth and wood decomposition.

White rot fungi are to find in all beech stands where beech bark disease is present. Because these fungi are responsible for the very fast decomposition of the wood and from this for great financial losses we directed our attention on them.

In our observation areas in the Spessart near Rothenbuch *Fomes fomentarius* (L. ex Fr.) Kickx is the most important white rot fungus, followed by *Fomitopsis pinicola* (Swartz ex Fr.) Karst.. Fungi as *Bjerkandera adusta* (Willd. ex Fr.) Karst., *Trametes gibbosa* (Pers. ex Fr.) Fr., *Coriolus versicolor* (L. ex Fr.) Québ. and some others seem to appear later on broken and lying trunks and do not have the importance of *Fomes fomentarius*.

Certainly one reason for the fast attack and decomposition of damaged trees is the fact, that the fungus produces spores during a long time of the year. By the aid of a spore trap and by slides which were hanging under the fruit bodies spore production of *Fomes fomentarius* and *Fomitopsis pinicola* was registrated during 1978. *Fomes* produced spores from March to the middle of July that means for a longer time as normally it is described in the literature. Spores of *Fomitopsis* were found during the same time but until the middle of April in smaller quantities. So it might be that *Fomes* in this respect has an advantage at least before *Fomitopsis pinicola*.

The germination of basidiospores of *Fomes fomentarius* was tested on a medium which contained the « slime » which oozes out of the bark as one of the most obvious symptoms of the disease. The mean values in the following table represent the trend of several experiments.

p. 100 *Germination of* F. f. *spores after* 15-19 *hrs.* (bark 4 min in cold water)
p. 100 *germination des spores de* F. f. *après* 15-19 *h* (écorce placée 5 min dans l'eau froide)

Temperature	15 °C	20 °C	22 °C
Control (water agar)	10	33	30
Bark I + slime	28	61	47
Bark II + slime	27	63	56
Temperature	18 °C	21 °C	24 °C
Control (water agar)	6	20	54
Fresh slime	62	61	55
Bark + fresh slime	64	63	61
Bark + old slime	56	51	55

It is not very surprising that nutrients in the slime accelerate spore germination, especially at relative low temperatures. At higher temperatures the differences decrease.

Germination on extracts of healthy bark treated in the same way was in general smaller as under the influence of slime or diseased bark.

If we take into consideration that the spores of *Fomes* at 22 °C begin to germinate after only 5 hrs, it is imaginable, that the fungus on a nutrient rich substrate as bark with slime will have a good starting position for colonising beech trunks.

Further it was investigated if there are relations between *Nectria coccinea* and *Fomes fomentarius*, especially if products of the metabolism of *Nectria* have an influence on spore germination, mycelium growth and wood decomposing capacity of *Fomes*. For these experiments *Nectria coccinea* was cultivated in malt solution for different times. The culture filtrate was autoclaved with 2 p. 100 agar and used as substrate for germination and mycelium growth tests.

p. 100 *germination of* Fomes fomentarius *after* 15-19 *hrs*
p. 100 *germination de* F. fomentarius *après* 15-19 *h*

Control (1 p. 100 malt solution)	68	81	80
Filtrate of *N. c.* 1	83	86	85
Filtrate of *N. c.* 3	78	86	87
Filtrate of *N. c.* 4		88	85
Filtrate of *N. c.* 5	81	85	86
Water agar			40

Germination of *Fomes* spores was slightly promoted under the influence of *Nectria coccinea* filtrate but the differences were not significant.

Germination was very good between pH 4 and pH 6 after 24 hrs and after 90 hrs between pH 3 and pH 7 good germination was registrated. At the same time there was poor germination at pH 8 and pH 8,5.

With the same method mycelium growth was tested.

Mycelium growth of white rot fungi influenced by N. c. *filtrates* 2 *weeks old*
(p. 100 of the control on 2 p. 100 malt agar)

Croissance mycélienne de champignons lignivores influencée par des filtrats de cultures de N. c. *âgés de* 2 *semaines*
(en p. 100 du témoin sur maltagar 2 p. 100)

	N. c. 1	*N. c.* 2	*N. c.* 3
Bjerkandera adusta	95	94	94
Coriolus versicolor	99	100	99
Trametes hirsuta	100	102	99
Trametes gibbosa	104	103	105
Fomitopsis pinicola	102	101	104
Fomes fomentarius	113	116	114

These results are in so far remarcable as the pH of the control was about 5,5 and the pH of the filtrate was about 4,0 while the pH optimum of *Fomes* lies at about pH 6. So it could be expected that growth of *Fomes* would be rather decreased. It seems that perhaps products of the metabolism in the filtrate act stronger than an unfavourable pH.

Although there is no direct local connection between *Nectria* as a bark inhabiting fungus and *Fomes fomentarius* as a wood destroying organism, there might exist interrelations at the beginning of wood colonisation. Experiments *in vitro* showed under certain conditions an increased weight loss of wood under the influence of *Nectria coccinea* culture filtrate.

Small wood blocks were soaked with malt solution (control) or with a filtrate of *Nectria* liquid culture and then exposed to the white rot fungus for 2-3 months.

Weight loss in p. 100 of the control (filtrate 2 weeks old)
p. 100 *perte de poids par rapport au témoin* (filtrat agé de deux semaines)

	2 p. 100 malt	0,2 p. 100 malt
Malt solution (pH 5,5)	100 (control)	100 (control)
Filtrate *N. c.* 6 (buffered, pH 4,6-4,7)	102	117
Filtrate *N. c.* 6 (not buffered, pH 3,5-3,7)	117	126

It seems that wood decomposing activity depends on the age of the filtrate and on the concentration of the malt solution used.

	Filtrate of *N. c.* 6 — 7 days old			
Malt solution	0,1 p. 100	0,5 p. 100	1 p. 100	2 p. 100
Bjerkandera adusta	138	133	70	106
Fomes fomentarius	127	114	108	98

N. c. *filtrate 2 months old, 2 p. 100 malt solution* (not buffered)
Filtrat de N. c. *âgé de 2 mois, solution de malt à 2 p. 100* (non tamponné)

	N. c. 2	*N. c.* 5	*N. c.* 6
Bjerkandera adusta	87	94	81
Fomes fomentarius	102	107	118

This experiment was carried out only once and will be repeated. Some differences to the previous experiments cannot be explained.

Although there are some difficulties in explanation and interpretation of the results it seems that *Nectria coccinea* is able to do more than kill the bark of predisposed trees. It seems that the fungus has an influence on the development of *Fomes fomentarius* and perhaps on other white rot fungi. If these influences are important in connection with beech bark disease and if they can help to explain the fast decomposition of the wood are other questions.

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Résumé

Relations entre Nectria coccinea *et les champignons lignivores*

Dans les forêts où sévit la maladie de l'écorce du hêtre les champignons lignivores causent une altération du bois très rapide. En ce qui concerne la destruction des tissus ligneux, *Fomes fomentarius* est, parmi d'autres champignons, très important. Du mois de mars jusqu'au milieu de juillet. *Fomes fomentarius* produit des spores qui peuvent germer en quelques heures s'il y a des conditions favorables.

Des expériences *in vitro* ont montré que *Nectria coccinea* possède une influence positive sur le développement de *Fomes fomentarius*. L'influence est effective sur la germination des spores, la croissance du mycélium et sur la dégradation du bois.

Zusammenfassung

Einflüsse von Nectria coccinea *auf Weißfäuleerreger*

Im Gefolge der Buchen-Rindennekrose verursachen Weißfäuleerreger erhebliche finanzielle Schäden durch sehr rasche Zersetzung des Holzes. Dabei spielt der Zunderschwamm, *Fomes fomentarius*, neben anderen eine wichtige Rolle. *Fomes fomentarius* bildet von März bis Mitte Juli Sporen, die unter günstigen Bedingungen schon nach wenigen Stunden auskeimen.

Versuche *in vitro* haben ergeben, daß *Nectria coccinea* eine fördernde Wirkung auf *Fomes fomentarius* ausübt. Diese erstreckt sich auf Sporenkeimung, Myzelwachstum und die Intensität des Holzabbaus.