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Effects of Water Logging on Spore Productivity of Selected Lignicolous Basidiomycetes

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數種의 木材腐蝕性 擔子菌類의 胞子生産性에 浸水가 미치는 影響

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Abstract Spore production mechanism of selected lignicolous basidiomycetes was inhibited by soaking their sporocarps in water for varying periods. Depending on the duration of immersion, some species resumed spore discharge, while in others it was completely ruined. This was related to the nature and consistency of these sporocarps. All the species studied absorbed water quite readily into their sporocarps. The loss of this water through dehydration was more rapid in smaller and delicate species than the bulky and robust ones.

Keywords: Spore production, Lignicolous basidiomycetes, Spore discharge, Water absorbing capacity.

Wood rotting basidiomycetes are of great economic importance to man and they have been investigated by many workers. Their general importance has been reviewed by Gilberton (1980). They are mostly found on logs in woodlands and are most active during summer and autumn when they are at their seasonal peaks. The perenial species like *Genoderma applanatum*, *Fomes annosus* and many others (which persist through winter in active state) are common in the woods almost throughout the year.

Timber of all types represents a major bulk source of nutrients for both macro- and micro-fungi and the abundance of lignicolous fungi makes them a major source of fungal spores. Degroot (1968) carrying out a sampling programme for airborne fungus spores in a mixed hardwood-conifer forest, observed basidiospore populations which he concluded had originated from the forest community. Also Adams and Williams (1969) comparing the basidiospore content in the air of an urban area (Cardiff) and rural area (Resolven), found much higher basidiospore concentration in the air of the latter than in the former. The high count of spores in Resolven was attributed to the wood in the vicinity.

The water relations of these basidiomycetes have been sparingly studied as far as their spore discharge is concerned. Ingold (1971) reported that the basidia need to be highly turgid before spore discharge can occur even in xerophytes like *Schizophyllum commune*. He further observed that while high humidity must apparently be maintained at the hymenial surface of a discharging basidiocarp, liquid water has a ruinous effect. In the majority of fungi, in contrast to vascular plants, there is little provision for translocation of water, hence spore discharge is usually dependent on an immediately available supply of external water. This in practice means dependence on rain or heavy snow (Ingold, 1978).

Most logs bearing these basidiomycetes occur on forest floors. During prolonged wet periods such substrates, and possibly the fungi growing on them may be subject to water logging. The effect, this might have on spore production and release, has not been extensively investigated and hence the present experiments were devised to explore such effects in selected species.

Materials and Methods

Logs bearing sporocarps of the test fungi were collected from Taironen (ST13831) in South Wales and cut into 30 cm length bearing a particular sporocarp.

The logs bearing the sporocarps were immersed in water at room temperature (18±4°C) for successive periods of 6, 24, and 48h. After each of these periods of immersion, the specimens were placed in front of a Hirst trap and sampled for spores, for 3~4 days. The time spore release began was noted from the spore band. The following fungi were investigated, *viz.*, *Coriolus versicolor* Fr., *Stereum hirsutum* Fr., *Dacrymyces deliquences* Duby, *Trametes betulina* Fr., *Auricularia auricula* Berk., *Piptoporus betulinus* Fr.

Determination of Water Loss/Gain in a Sporocarp

Three fresh sporocarps of each of five species (excluding *D. deliquescens*) were detached from their logs. Each was weighed and then soaked in water at room temperature (18±4°C) for three separate periods of 6, 24 and 48 h, separated by 3 days of drying. The weight of each fruit before and immediately after each period of soaking was determined. At the end of each soaking period, sporocarps were placed on a plain piece of wood (15×20 cm) on moist peat inside a humid chamber in conditions identical to those during normal spore sampling with undetached sporocarps. The sporocarps were weighed daily, on three consecutive days, before the next period of soaking.

Results

D. deliquescens showed the most limited powers of recovery in that after 24 and 48h soaking, no sporulation was recorded up to the termination of the experiment (Table I). Of the rema-

Table I. Time of resumption of spore discharge after soaking sporocarps in water.

Species	Period of soaking (hours)	Time delay (hours) before resumption of spore discharge
Coriolus versicolor Fr.	6	18
	24	12
	48	48
Stereum hirsutum (Wild) Fr.	6	6
	24	9
	48	73
Dacrymyces deliquescens Duby	6	9
	24	00*
	48	00*
Trametes betulina Fr.	6	10
	24	12
	48	33
Piptoporus betulinus Fr.	6	7
	24	24
	48	27
Auricularia auricula Berk.	6	8
	24	10
	48	13

* No further spore discharge

Table II. Water absorbing capacities* of sporocarps.**

Species	Wt before 6 h soaking (g)	% Increase in weight	Weight before 24 h soaking (g)	% Increase in weight	Weight before 48 h soaking (g)	% Increase in weight
C. versicolor	3.8	24.0	3.5	35.5	3.3	11.2
T. betulina	9.1	21.4	6.3	107.3	7.2	77.1
P. betulinus	155.5	43.3	202.2	13.3	211.6	8.6
S. hirsutum	0.8	21.5	0.5	80.1	0.5	70.7
A. auricula	6.3	30.5	5.0	92.2	6.8	76.4

* Data are averages of three replicates
** Same sporocarps were used for the three periods of immersion.

Table III. Weight losses of sporocarps after different periods of immersion in water during air drying.

Species		Weight loss* after soaking (gm)								
		6 h			24h			48 h		
	Days	1	2	3	1	2	3	1	2	3
C. versicolor		1.8	1.6	.8	2.0	1.6	1.5	1.8	1.6	1.5
S. hirsutum		1.1	1.0	0.5	1.1	0.9	0.7	0.6	0.5	0.3
T. betulina		17	15	11	16	14	13	16	14	12
A. auricula		7	6.5	5	10	7	6	14	12	4
P. betulinus		20	19.5	18	21	20.5	19.6	22	21.0	19.8

* These are averages of three replicates.

ining species, *S. hirsutum* recovered in 73 h after 48 h immersion, whereas *A. auricula*, recovered very quickly in 13 h, after the same period of immersion. In *C. versicolor* and *P. betulinus* immersion had the effect of stimulating spore release 4~5 after 48 h immersion. On born occasions spore deposits obtained were too dense to count.

The water retaining or absorbing abilities of all the species show that they rapidly absorb water when soaked(Table II). Apart from *P. betulinus* the percentage increase per unit weight was highest immediately after 24 h immersion in all the species. However in *P. betulinus* percentage increase per unit weight was highest after 6h immersion. The figures indicate that the initial rapid absorption of water is followed by a much reduced rate of absorption more prolonged immersion. There was variation in the time of reaching the saturation point among the species. The more robust *P. betulinus* absorbed water quickly. Thereby reaching its saturation point in 6 h of immersion, while the more delicate, more exposed and softer species, *C. versicolor*, *S. hisutum*, *T. betulina* and *A. auricula* reached their saturation point during 24 h of immersion in water.

All the species lost water through drainage and evaporation. The rate of water loss was very rapid with the sporocarps of *S. hirsutum* and *A. auricula*, while relatively slower in *P. betulinus T. betulina* and *C. versicolor* (Table III).

Discussion

In general terms, the results of this investigation show that the longer the period of soaking in water the longer it takes the fruits to resume spore production. This confirms the view of early workers that the presence of liquid water on the surface of an hymenium ruins its spore discharge mechanism (Corner, 1932; Ingold, 1971). The recovery or resumption of active sporulation must depend on a number of factors, like the time it takes the hymenium to develope fresh basidia and the confirming influence of environmental factors such as relative humidity and temperature. Although the exact mechanism whereby spore production was accelerated in *C. versicolor* and *P. betulinus* is not known, the water retained in both the sporocarps and the host tissues must have played the role in ensuring the turgidity of the basidia.

The abilities of the species to absorb water directly into their sporocarps show that surface water can directly enter the sporocarps by inbibition or capillarity (Buller, 1922). However the water absorbing capacities of these species most certainly relate to their construction and hyphae system. Thus the bulky species like *P. betulinus*, absorb water very quickly through the interhyphae spaces in its sporocarps and becomes saturated within 6 h. of immersion. In the rather more rigid and delicate species, *C. versicolor*, *S. hirsutum* and *T. bulina* with a *trimitic* hyphae systems and little air spaces in their tissues (Corner, 1932a; 1932b), their saturation point is reached within 24 h of immersion in water. The system of water absorption in *A. auricula* is by inbibition through the gelatinous matrix in which are embedded the living hyphae (Ingold, 1959). This system allows water absorption up to a limit when the sporocarp becomes saturated with water within 24 hrs.

The gradual loss of water by the sporocarp, leading eventually to complete dehydration shows that they need a prolonged water supply from their host. Buller (1971) observed that fruit bodies of many hymenomycetes after a period of transpiration are able to take water in rapidly through the membrane covering the Pileus. He maintained that such water stored in the capillary spaces of the pileus flesh is drawn upon by the gills during the discharge of spores.

In the small and delicate species, *i.e. C. versicolor*, and *S. hirsutum*, the rate of dehydration was rapid (Table Ⅲ). They lack internal water storage mechanism like that of bigger species. However they possess hairs on top of their sporocarps which help to retain surface water which can easily evaporate in a dry atmosphere. Thus for survival in nature they ultimately have to depend on water supply from their host tissues through the transpiration stream (Ingold, 1971).

In *A. auricula* there was also a rapid loss of water from its sporocarp, as a result of the drying up of the jelly which is the main water reservoir in this fungus. In nature, however, *i.e.* when on its host, the jelly acts as an efficient means of absorbing and storing surface water quite readily by inbibion, a system which makes it suited for lignicolous habitat (Buller, 1922). In the bigger species, *P. betulinus* and *T. betulina*, the rate of water loss was relatively slow showing that they are more resistant to desication due perharps to their better water reserves. These investigations agree with those of Rockett and Kramer (1974) who found that larger sporocarps, *e.g. Dacrymyces pululahuana* dry much more slowly after soaking than small species like *Calocera cornea* and *D. pulunatus* that dry out rapidly after soaking.

摘　要

몇가지 木材腐蝕性 擔子菌類의 胞子를 시간별로 水中에 담그는 方法을 사용하여 胞子를 發芽시켜본 結果

한가지 균주에서 포자 발아가 억제 되었다. 浸水時間을 증가시킬수록 포자 발아가 增加된 균주는 5種이었으며 포자발아가 전혀 일어나지 않는 균주는 1種이었다. 이것은 胞子의 원래 性質 및 恒常性과 관계가 깊었다. 모든 시험균주는 浸水 直後가 最大 水分 吸水率을 나타내었으며 침수시간이 경과할수록 수분 흡수율은 저하하였다. 포자의 脫水速度를 비교한 결과, 2種의 포자는 신속히 수분을 상실하였으나, 3種의 포자는 완만히 수분을 상실하였다. 즉 부피가 크고 단단한 포자보다 작으면서 섬세한 포자의 脫水速度가 컸다.

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