

Fungi on bryophytes, a review

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Fungi on bryophytes, a review

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Abstract

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Literature about fungi living on bryophytes is reviewed. In most cases the observation of fungi on bryophytes was coincidental, and no systematic survey has been carried out. Many questions about the association of fungi with bryophytes are not yet answered. A very limited geographical area, mainly Europe, was surveyed for fungi associated with bryophytes. Little is known about what morphological and/or physiological characteristics make a bryophyte a good host.

1. Introduction

Little is known about the distribution of even the very common fungi on plants (Ellis & Ellis 1985). Some fungi are plurivorous, but are either host-limited or show marked preferences for particular plants in either a living or dead state. Rusts, smuts, downey and powdery mildews and many other microfungi grow on living plants, but others are only found on moribund tissues, the age and condition of which can be crucial. The presence of fungi on bryophytes is a relatively neglected field of study, although spectacular features of this association, namely, the fairy rings in moss beds, are well known (Fenton 1983, Longton 1973, Pegler et al. 1980). There has been one large account of bryophilous fungi which was completed in 1939, but publication was delayed until 1959 (Racovitza 1959). Pyrenocarp and imperfect fungi on gametophytes and sporophytes are described. A high proportion of infections of dead sporophytes is mentioned, whereas in more recent publications, this habitat was rarely mentioned for bryophilous fungi. Several species of fungi in the genera *Galerina*, *Psilocybe*, *Omphalina*, and others could be found repeatedly in moss beds and never elsewhere. Although some of these associations are constant enough to be used as taxonomic identification guides, e.g. for *Galerina* (Smith & Singer 1964), the peculiarity of the dependence of fungi on specific mosses has remained unexplored (Redhead 1981). For large groups of fungi associated with bryophytes, parasitism is not obvious from field observations.

At the beginning of the present study of bryophilous fungi there was the assumption, that this association is rare and that there is something special in this relationship with respect to the biochemical and physiological interactions. It was intended to use this knowledge for the development of new measures against phytopathogenic fungi on

higher plants. It turned out, that bryophilous fungi are not rare and that most publications are descriptive, which did not serve the original goal of the project. Instead of putting all the literature collected into an archive, it is summarized in this review. It mainly addresses bryologists, who showed much interest in such a literature collection. An attempt is made to summarize the knowledge about the importance of the morphology of the bryophyte for colonization by fungi, and about the biochemical and nutritional interactions between bryophytes and fungi. In future studies it may be useful to investigate not only the colonization of bryophytes by fungi, but to include other organisms as well. Studies of small ecosystems, where fungi, bryophytes, algae, bacteria, infusorians, nematodes and insects are able to coexist, are rare (Bogdanov 1976). The association of bryophytes with algae (Granhall & Hofsten 1976), lichens (Döbbeler et al. 1985, Hafellner 1983 & 1984, Poelt 1985), the triangle symbiosis moss-fungus-alga (Hein et al. 1971), diatoms (Geitler 1977), tardigrades (Pohlad & Bernard 1978) and beetles (Sedlag 1975) have been described. Nothing is known about the association of viruses with bryophytes (Horvath 1977). Coevolution of bryophytes and fungi is rarely mentioned (Döbbeler 1979 d, 1985 b & 1987) and should be studied further. *Polytrichum*-like mosses are a very ancient group and should be at the base in the evolution of *Musci*; they have offered, through time, the necessary criteria for many fungi to evolve dependence on them as hosts (Döbbeler 1987).

Mosses were classified according to Wijk et al. (1959–1969), liverworts according to Grolle (1983), Sphagnidae according to Isoviita (1966), and fungi according to Ainsworth (1973). Names of fungi and bryophytes mentioned in the literature were used without critical taxonomic reevaluation. It can well be, that the same fungus appears under different names. As explained by Döbbeler (1979 d) for one example, this cannot only be attributed to ignorance, obligate parasitism leads frequently to a split into morphologically similar or equal species, which can be distinguished by their specificity for a host.

2. Association of fungi with bryophytes

Many fungi have been described as parasites or as very close associates of bryophytes (Table 1). Caution is required in claiming damage since the same fungi can occasionally be found on living as well as dead bryophyte tissue. Circumstantial evidence can be misleading because it is frequently difficult to say whether a fungus lives on dead tissue or whether dead tissue is the result of parasitism (Smith 1972). Fruiting bodies on mosses do not prove parasitism. Moss and fungus could also live together because they require similar environmental conditions. Intracellular mycelium is an indication of parasitism. Intercellular or superficial mycelium usually does not cause damage (Döbbeler 1986 a). It was also observed that the invasion of moss cells by fungi is not always lethal because the moss cell can protect itself by engulfing the fungal hyphae with a membrane (Racovitza 1959). The potential for mild parasitism or saprophytism has been suggested for vascular-arbuscular mycorrhizal fungi in an Alberta peat bog (Dowding 1959) and in tropical ecosystems (Went & Stark 1968).

A definite answer about the degree of dependence can be obtained when pure cultures of fungi and bryophytes are combined and studied. This was only done in a few cases (Redhead 1981, Simon 1987, Untiedt & Müller 1985). From an ecological point of view, it could be interesting to determine why bryophytes tend to survive after a serious fungal infection in nature but not under axenic conditions (Simon 1987).

Tab. 1. Fungi on bryophytes. Bryophytes are listed according to their classification. Each bryophyte is followed by an alphabetical list of fungi found on it and by a list of references. An asterix (*) following the name of a fungus points to a close association to the host.

Bryophyta	Fungus	References
Hepaticae		
<i>Marchantiales</i>		
<i>Lunularia</i> sp.	<i>Mycosphaerella hepaticarum</i>	Döbbeler 1978
<i>Marchantia polymorpha</i>	<i>Didymosphaeria marchantiae</i> *	Döbbeler 1978 & 1984
	<i>Octospora ithacaensis</i> *	Döbbeler 1979 d
	<i>Synchytrium macrosporum</i> *	Karling 1974
<i>Preissia quadrata</i>	<i>Epibryon hypophyllum</i>	Döbbeler 1979 c
<i>Targionia hypophylla</i>	<i>Didymosphaeria marchantiae</i>	Döbbeler 1978
<i>Ricciales</i>		
<i>Ricciaceae</i>		
<i>Riccia</i> sp.	<i>Neottiella ricciaecola</i>	Döbbeler 1979 d
	<i>Olpidiopsis ricciae</i>	Karling 1966
<i>R. crozalsii</i>	<i>Didymella hepaticarum</i>	Döbbeler 1978
<i>R. cruciata</i>	<i>Achaetomium macrosporum</i>	Wadhvani 1981
	<i>Aspergillus flavus</i>	ibid.
	<i>A. niger</i>	ibid.
	<i>A. sydowi</i>	ibid.
	<i>A. terreus</i>	ibid.
	<i>Chaetomium globosum</i>	ibid.
	<i>Mucor alternans</i>	ibid.
	<i>Paecilomyces varioti</i>	ibid.
	<i>Phoma hibernica</i>	ibid.
	<i>Thielavia sepedonium</i>	ibid.
<i>R. gangetica</i>	<i>Phaeosphaerella ricciae</i>	Döbbeler 1978
<i>R. himalayensis</i>	<i>P. ricciae</i>	ibid.
<i>R. melanospora</i>	<i>P. ricciae</i>	ibid.
<i>R. michelii</i>	<i>P. ricciae</i>	ibid.
<i>R. nigrella</i>	<i>P. ricciae</i>	ibid.
<i>Ricciocarpos natans</i>	<i>Didymella hepaticarum</i>	ibid.
<i>Jungermanniales</i>		
<i>Adelanthaceae</i>		
<i>Adelanthus decipiens</i>	<i>Punctillum hapaticarum</i>	ibid.
<i>Blepharostomaceae</i>		
<i>Blepharostoma</i> sp.	<i>Epibryon bryophilum</i>	ibid.
<i>B. trichophyllum</i>	<i>Barbeyella minutissima</i>	Stephenson & Studlar 1985
	<i>Pleosphaeria lophoziae</i>	Döbbeler 1978
	<i>Dactylospora heimerlii</i>	Döbbeler & Triebel 1985
	<i>Mniaecia nivea</i>	Henderson 1972
<i>Calypogeiaceae</i>		
<i>Calypogeia</i> sp.	<i>Epibryon bryophilum</i>	Döbbeler 1978
<i>C. muelleriana</i>	<i>Mniaecia jungermanniae</i>	Strijbosch 1972
<i>C. neesiana</i>	<i>Dactylospora heimerlii</i>	Döbbeler & Triebel 1985
<i>C. suecica</i>	<i>Pleosphaeria lophoziae</i>	Döbbeler 1978

Tab. 1. (continued).

Bryophyta	Fungus	References
Cephaloziaceae		
<i>Cephalozia</i> sp.	<i>Bryopelta variabilis</i>	Döbbeler 1978
	<i>Pyrenophora sphagnoeceticola</i>	ibid.
	<i>Thyronectria inconspicua</i>	ibid.
<i>C. bicuspidata</i>	<i>Mniaecia jungermanniae</i>	Strijbosch 1982
	<i>Barbeyella minutissima</i>	Stephenson & Studlar 1985
<i>C. leucantha</i>	<i>Pleosphaeria lophoziae</i>	Döbbeler 1978
Cephaloziellaceae		
<i>Evansia fimbriata</i>	<i>Sphaerella evansiae</i>	ibid.
Frullaniaceae		
<i>Frullania</i> sp.	<i>Pseudonectria brongniartii</i> *	ibid.
	<i>P. hemicrypta</i>	ibid.
<i>F. dilatata</i>	<i>Calonectria frullaniae</i> *	ibid.
	<i>Epibryon perrumpens</i> *	Döbbeler 1982
	<i>Pseudonectria brongniartii</i> *	Döbbeler 1978
	<i>Hypobryon perforans</i>	Döbbeler 1983
	<i>Muellerella frullaniae</i>	Döbbeler & Triebel 1985
	<i>M. rubescens</i>	ibid.
	<i>Octosporella urosperma</i>	Döbbeler 1980 a
	<i>Punctillum perforans</i>	Döbbeler 1979 c
<i>F. tamarisci</i>	<i>Epibryon casaresii</i>	Döbbeler 1978
	<i>E. hepaticola</i>	ibid.
	<i>Muellerella rubescens</i>	Döbbeler & Triebel 1985
	<i>Nectria frullaniicola</i>	Döbbeler 1979 c
	<i>Pseudonectria suboperculata</i>	Döbbeler 1978
<i>F. teneriffae</i>	<i>Hypobryon validum</i>	Döbbeler 1983
Jungermanniaceae		
<i>Jungermannia</i> sp.	<i>Calonectria duplicella</i>	Döbbeler 1978
	<i>Epibryon bryophilum</i>	ibid.
<i>J. atrovirens</i>	<i>Pleosphaeria haploziae</i>	ibid.
<i>J. confertissima</i>	<i>Epibryon bryophilum</i>	ibid.
<i>J. crenulatum</i>	<i>Coleroa bryophila</i>	Henderson 1972
<i>J. gracillima</i>	<i>Epibryon bryophilum</i>	Döbbeler 1978
<i>J. hyalina</i>	<i>E. bryophilum</i>	ibid.
<i>J. leiantha</i>	<i>Dactylospora heimerlii</i>	Döbbeler & Triebel 1985
	<i>Nectria praetermissa</i>	Döbbeler 1978
<i>Nardia</i> sp.	<i>Epibryon bryophilum</i>	ibid.
<i>N. scalaris</i>	<i>Coleroa bryophila</i>	Henderson 1972
	<i>Epibryon bryophilum</i>	Döbbeler 1978
<i>Nowellia</i> sp.	<i>E. bryophilum</i>	ibid.
<i>Plectocolea hyalina</i>	<i>Coleroa bryophila</i>	Henderson 1972
Lejeuneaceae		
<i>Lejeunea flava</i>	<i>Trichonectria pellucida</i>	Döbbeler 1978
<i>Leptolejeunea coryne-</i> <i>phora</i>	<i>Nectria egens</i>	ibid.
Lepidoziaceae		
<i>Bazzania</i> sp.	<i>Epibryon bryophilum</i>	ibid.
	<i>E. polyphagum</i>	ibid.
<i>B. spiralis</i>	<i>Bryorella marginis</i>	Döbbeler 1982

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>B. trilobata</i>	<i>Cortinarius brunneus</i>	Seidel 1983
	<i>Epibryon arachnoideum</i> *	Döbbeler 1978
	<i>E. diaphanum</i>	Döbbeler 1979c
	<i>E. intercellulare</i>	ibid.
	<i>Nectria praetermissa</i> *	Döbbeler 1978
	<i>Russula ochroleuca</i>	Seidel 1983
<i>Lepidozia</i> sp.	<i>Epibryon bryophilum</i>	Döbbeler 1978
<i>L. reptans</i>	<i>Russula</i> sp.	Seidel 1983
<i>Tritomaria exsecta</i>	<i>Epibryon casaresii</i>	Döbbeler 1978
<i>T. quinquedentata</i>	<i>E. hepaticola</i>	ibid.
Lophocoleaceae		
<i>Chiloscyphus</i> sp.	<i>E. bryophilum</i>	ibid.
<i>Lophocolea bidentata</i>	<i>Pseudonectria jungermanniarum</i>	ibid.
<i>L. cuspidata</i>	<i>P. jungermanniarum</i>	ibid.
<i>L. heterophylla</i>	<i>Fomitopsis annosa</i>	Seidel 1983
	<i>Pleospora hepaticola</i>	Döbbeler 1978
	<i>Teichospora jungermannicola</i>	ibid.
<i>L. lucida</i>	<i>Punctillum hepaticarum</i>	ibid.
<i>L. minor</i>	<i>Teichospora jungermannicola</i>	ibid.
<i>L. pallida</i>	<i>Punctillum hepaticarum</i>	ibid.
Lophoziaaceae		
<i>Anastrepta</i> sp.	<i>Epibryon bryophilum</i>	ibid.
<i>Anastrophyllum</i>	<i>Barbeyella minutissima</i>	Stephenson & Studlar 1985
<i>michauxii</i>	<i>Licea hepatica</i>	Kowalski 1972
<i>Barbilophozia</i> sp.	<i>Bryochiton perpusillus</i>	Döbbeler 1978
<i>B. attenuata</i>	<i>Pleosphaeria lophoziae</i>	ibid.
<i>B. barbata</i>	<i>Teichospora jungermannicola</i>	ibid.
<i>B. floerkei</i>	<i>Epibryon casaresii</i>	ibid.
<i>B. hatcheri</i>	<i>E. casaresii</i>	ibid.
<i>B. lycopodioides</i>	<i>Bryochiton perpusillus</i>	ibid.
	<i>Bryorella semiimmersa</i>	ibid.
<i>Gymnocolea inflata</i>	<i>Pleosphaeria lophoziae</i>	ibid.
<i>Leiocolea muelleri</i>	<i>Teichospora jungermannicola</i>	Henderson 1972
<i>Lophozia</i> sp.	<i>Bryopelta variabilis</i>	Döbbeler 1978
	<i>Bryorella semiimmersa</i>	ibid.
	<i>Epibryon bryophilum</i>	ibid.
<i>L. collaris</i>	<i>E. bryophilum</i>	ibid.
<i>Sphenolobus minutus</i>	<i>Bryomyces velenovskyi</i>	ibid.
	<i>Bryorella gregaria</i>	ibid.
<i>Tritomaria exsecta</i>	<i>Epibryon casaresii</i>	ibid.
<i>T. quinquedentata</i>	<i>Dactylospora heimerlii</i>	Döbbeler & Triebel 1985
Marsupellaceae		
<i>Gymnomitrium</i> sp.	<i>Epibryon bryophilum</i>	Döbbeler 1978
<i>G. apiculatum</i>	<i>Bryochiton microscopicus</i> *	ibid.
<i>G. concinnum</i>	<i>B. microscopicus</i> *	ibid.
	<i>Bryomyces gymnomitrii</i> *	ibid.
<i>G. corallioides</i>	<i>Bryochiton microscopicus</i> *	ibid.
	<i>Bryomyces gymnomitrii</i> *	ibid.
<i>G. crenulatum</i>	<i>B. microscopicus</i> *	ibid.
<i>G. obtusum</i>	<i>B. microscopicus</i> *	ibid.

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>Marsupella</i> sp.	<i>Epibryon bryophilum</i>	ibid.
<i>M. emarginata</i>	<i>E. bubakii</i>	ibid.
<i>Marsupidium surculosum</i>	<i>Dactylospora heimerlii</i>	Döbbeler & Triebel 1985
	<i>Epibryon marsupidii</i>	Döbbeler 1979c
Plagiochilaceae		
<i>Mylia</i> sp.	<i>E. bryophilum</i>	Döbbeler 1978
<i>M. anomala</i>	<i>Bryopelta variabilis</i>	ibid.
	<i>Epibryon casaresii</i>	ibid.
<i>M. taylorii</i>	<i>Coleroa bryophila</i>	Henderson 1972
	<i>C. casaresii</i>	ibid.
	<i>Dactylospora heimerlii</i>	Döbbeler & Triebel 1985
	<i>Epibryon bryophilum</i>	Döbbeler 1978
	<i>E. casaresii</i>	ibid.
	<i>Pleosphaeria lophoziae</i>	ibid.
<i>Pedinophyllum truncatum</i>	<i>Dactylospora heimerlii</i>	Döbbeler & Triebel 1985
<i>Plagiochila asplenioides</i>	<i>Barbeyella minutissima</i>	Stephenson & Studlar 1985
	<i>Belonioscyphella hypnorum</i> *	Döbbeler 1986a
	<i>Dactylospora heimerlii</i>	Döbbeler & Triebel 1985
	<i>Epibryon endocarpum</i>	Döbbeler 1980b & 1984
	<i>E. muscicola</i> *	Döbbeler 1978
	<i>E. plagiochilae</i> *	Döbbeler 1978, 1980b, 1981a & 1985a
	<i>Epicoccum plagiochilae</i>	Döbbeler 1986b
	<i>Octosporaella jungermanniarum</i> *	Döbbeler 1979d
	<i>Phoma plagiochilae</i>	Döbbeler 1981a
	<i>Pseudonectria jungermanniarum</i>	Döbbeler 1978
	<i>Teichospora jungermannicola</i>	Henderson 1972
<i>P. porelloides</i>	<i>Bryomyces hemisphaericus</i>	Döbbeler 1978
	<i>Bryorella erumpens</i>	ibid.
	<i>Epibryon muscicola</i>	ibid.
	<i>E. plagiochilae</i> *	ibid.
	<i>Nectria hirta</i>	ibid.
	<i>N. racovitzae</i>	ibid.
	<i>Pseudonectria jungermanniarum</i>	ibid.
<i>P. tridenticulata</i>	<i>Epibryon hypophyllum</i>	Döbbeler 1985a
Porellaceae		
<i>Porella</i> sp.	<i>Bryochiton perpusillus</i>	Döbbeler 1978
	<i>Epibryon hypophyllum</i>	Döbbeler 1979c
	<i>E. muscicola</i>	Döbbeler 1978
	<i>Leptosphaeria porella</i>	ibid.
	<i>Nectria racovitzae</i>	ibid.
	<i>Pseudonectria metzgeriae</i>	ibid.
	<i>P. perforata</i>	ibid.
	<i>Punctillum poeltii</i>	ibid.
<i>P. arboris-vitae</i>	<i>Hypobryon bicolor</i>	Döbbeler 1983
<i>P. cordaeana</i>	<i>H. poeltii</i>	ibid.
<i>P. platiphylla</i>	<i>Epibryon muscicola</i>	Döbbeler 1978
	<i>Hypobryon poeltii</i>	Döbbeler 1983

Tab. 1. (continued).

Bryophyta	Fungus	References
Ptilidiaceae		
<i>Ptilidium</i> sp.	<i>Epibryon bryophilum</i>	Döbbeler 1978
<i>P. ciliara</i>	<i>Bryochiton perpusillus</i>	ibid.
	<i>Epibryon diaphanum</i>	Döbbeler 1979c
	<i>E. polysporum</i>	Döbbeler 1978
<i>P. pulcherrimum</i>	<i>Bryochiton perpusillus</i> *	Döbbeler 1978
	<i>Epibryon diaphanum</i>	Döbbeler 1979c
	<i>E. hepaticola</i>	Döbbeler 1978
	<i>E. intercapillare</i>	Döbbeler 1979c
	<i>Leptomeliola ptilidii</i> *	Döbbeler 1978
Radulaceae		
<i>Radula complanata</i>	<i>Epibryon craspedum</i>	Döbbeler 1982
	<i>E. muscicola</i>	Döbbeler 1978
	<i>E. hypophyllum</i>	Döbbeler 1979c & 1985a
	<i>E. perrumpens</i> *	Döbbeler 1982
	<i>Octosporella ornithocephala</i> *	Döbbeler 1980a & 1984
	<i>Pseudonectria metzgeriae</i>	Döbbeler 1978
Scapaniaceae		
<i>Diplophyllum</i> sp.	<i>Epibryon bryophilum</i>	ibid.
<i>D. albicans</i>	<i>Bryomyces caudatus</i>	ibid.
	<i>Mniaecia jungermanniae</i>	Strijbosch 1972
	<i>M. nivea</i>	Henderson 1972
<i>D. taxifolium</i>	<i>Bryomyces caudatus</i>	Döbbeler 1978
<i>Scapania</i> sp.	<i>Dactylospora heimerlii</i>	Döbbeler & Triebel 1985
	<i>Epibryon bryophilum</i>	Döbbeler 1978
	<i>E. muscicola</i>	ibid.
<i>S. aequiloba</i>	<i>E. bryophilum</i>	ibid.
	<i>E. casaresii</i>	ibid.
	<i>E. muscicola</i>	ibid.
	<i>E. scapaniae</i>	ibid.
	<i>Teichospora jungermannicola</i>	ibid.
<i>S. bolanderi</i>	<i>Barbeyella minutissima</i>	Stephenson & Studlar 1985
<i>S. compacta</i>	<i>Epibryon casaresii</i>	Döbbeler 1978
<i>S. gracilis</i>	<i>Coleroa casaresii</i>	Henderson 1972
	<i>Epibryon casaresii</i>	Döbbeler 1978
<i>S. nemorea</i>	<i>E. casaresii</i>	ibid.
	<i>Leptomeliola scapaniae</i>	ibid.
	<i>Teichospora jungermannicola</i>	ibid.
<i>S. spitsbergensis</i>	<i>Bryochiton perpusillus</i>	ibid.
<i>S. undulata</i>	<i>Bryomyces scapaniae</i> *	ibid.
	<i>Coleroa casaresii</i>	Henderson 1972
	<i>Epibryon bryophilum</i>	Döbbeler 1978
	<i>E. casaresii</i>	ibid.
	<i>Teichospora jungermannicola</i>	Döbbeler 1978, Henderson 1972
Schistochilaceae		
<i>Schistochila aligera</i>	<i>Bryomyces jungermanniae</i>	Döbbeler 1978
	<i>Epibryon intracellulare</i>	ibid.

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>Metzgeriales</i>		
<i>Aneuraceae</i>		
<i>Aneura</i> sp.	<i>Cladochytrium aneurae</i>	Karling 1966
<i>Riccardia</i> sp.	<i>Bryopelta variabilis</i>	Döbbeler 1978
<i>Blasiaceae</i>		
<i>Blasia pusilla</i>	<i>Gerronema pseudo-grisella</i> *	Redhead 1981
<i>Metzgeriaceae</i>		
<i>Apometzgeria pubescens</i>	<i>Bryosphaeria bryophila</i>	Döbbeler 1978
	<i>Epibryon hepaticola</i>	ibid.
	<i>E. metzgeriae</i> *	ibid.
<i>Metzgeria</i> sp.	<i>E. bryophilum</i>	ibid.
<i>M. conjugata</i>	<i>E. hepaticola</i>	ibid.
<i>M. furcata</i>	<i>E. hepaticola</i>	ibid.
	<i>Pseudonectria metzgeriae</i>	ibid.
<i>M. pubescens</i>	<i>Epibryon metzgeriae</i>	Döbbeler 1985 a
<i>Pelliaceae</i>		
<i>Pellia endiviifolia</i>	<i>Pseudonectria jungermanniarum</i>	Döbbeler 1978
Musci		
<i>Andreaeales</i>		
<i>Andreaeaceae</i>		
<i>Andreaea</i> sp.	<i>Bryodiscus arctoalpinus</i> *	Döbbeler & Poelt 1974
	<i>Epibryon bryophilum</i>	Döbbeler 1978
<i>A. gainii</i>	<i>Simocybe antarctica</i>	Pegler & al. 1980
<i>A. obovata</i>	<i>Bryochiton monascus</i>	Döbbeler 1978
<i>Sphagnidae</i>		
<i>Sphagnaceae</i>		
<i>Sphagnum</i> sp.	<i>Amaurochaete trechispora</i>	Eliasson 1977
	<i>Bryorella gregaria</i>	Döbbeler 1978
	<i>Diachaea caespitosa</i>	Farr 1979
	<i>Endogone pisiformis</i>	Berch & Fortin 1983
	<i>Epibryon bryophilum</i>	Döbbeler 1978
	<i>E. casaresii</i>	ibid.
	<i>E. turfosorum</i> *	Döbbeler 1978 & 1984
	<i>Galerina</i> sp.	Singer 1975
	<i>G. paludosa</i>	Watling 1978
	<i>Helotium schimperi</i> * (= <i>Discinella schimperi</i>)	Chau 1979
	<i>Lasiosphaeria sphagni</i>	Döbbeler 1978
	<i>L. sphagnorum</i>	ibid.
	<i>Lizoniella sphagni</i>	ibid.
	<i>Monascostroma sphagnophilum</i>	Döbbeler 1978 & 1984
	<i>Psathyrella paludosa</i>	Smith 1972
	<i>Russula claroflava</i>	Watling 1978
	<i>Tephroclybe palustre</i> *	ibid.
<i>S. capillaceum</i>	<i>Lyophyllum palustre</i> *	Redhead 1981
	<i>Galerina paludosa</i> *	ibid.
<i>S. fallax</i>	<i>Lyophyllum palustre</i> *	Untiedt & Müller 1985, Simon 1987

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>S. fuscum</i>	<i>Epibryon</i> sp.	Döbbeler 1978
<i>S. nemoreum</i>	<i>Lasiosphaeria sphagnorum</i>	ibid.
<i>S. recurvum</i>	<i>Lactarius sphagneti</i>	Dörfelt 1972
<i>S. squarrosum</i>	<i>Discinella schimperi</i> *	Redhead & Spicer 1981
	<i>Lasiosphaeria muscicola</i>	Döbbeler 1978
<i>S. subsecundum</i>	<i>L. sphagnorum</i>	ibid.
<i>S. teres</i>	<i>L. sphagnorum</i>	ibid.
<i>Polytrichales</i>		
<i>Polytrichaceae</i>		
<i>Atrichum</i> sp.	<i>Epibryon bryophilum</i>	ibid.
<i>A. obtusulum</i>	<i>Fuligo intermedia</i>	Pant & Tewari 1982
<i>A. undulatum</i>	<i>Inocybe destriata</i>	Seidel 1983
	<i>Leptomeliola muscorum</i>	Döbbeler 1978
	<i>Mycena cinerella</i>	Hildebrand & al. 1978
	<i>Octospora melina</i>	Dennis & Itzerott 1973
<i>Dawsonia beccarii</i>	<i>Bryochiton perpusillus</i>	Döbbeler 1981 b
	<i>Epibryon pogonati-urnigeri</i>	ibid.
	<i>Vezdaea dawsoniae</i>	ibid.
<i>D. grandis</i>	<i>Bryorella compressa</i>	ibid.
	<i>B. crassitecta</i>	Döbbeler 1978 & 1981 b
	<i>Calonectria biseptata</i>	Döbbeler 1981 b
	<i>C. phycophora</i>	ibid.
	<i>Dawsicola neglecta</i>	ibid.
	<i>Dawsomyces subinvisibilis</i>	ibid.
	<i>Dawsophila callichroma</i>	ibid.
	<i>Epibryon notabile</i>	ibid.
	<i>E. odontophilum</i>	ibid.
	<i>E. pogonati-urnigeri</i>	ibid.
	<i>Hymenoscyphus erythropus</i>	ibid.
	<i>Vezdaea dawsoniae</i>	Döbbeler 1978 & 1981 b
	<i>V. obscura</i>	Döbbeler 1981 b
<i>D. longiseta</i>	<i>Bryochiton perpusillus</i>	ibid.
	<i>Epibryon pogonati-urnigeri</i>	ibid.
	<i>Hymenoscyphus erythropus</i>	ibid.
<i>D. papuana</i>	<i>Calonectria biseptata</i>	ibid.
	<i>Dawsophila callichroma</i>	ibid.
	<i>D. pygmaea</i>	ibid.
	<i>Epibryon notabile</i>	Döbbeler 1978 & 1981 b
	<i>E. odontophilum</i>	Döbbeler 1981 b
<i>D. polytrichoides</i>	<i>Bryochiton perpusillus</i>	ibid.
	<i>Bryorella compressa</i>	ibid.
	<i>B. conspecta</i>	ibid.
	<i>Dawsomyces subinvisibilis</i>	ibid.
	<i>Dawsophila callichroma</i>	ibid.
	<i>Epibryon interlamellare</i>	ibid.
	<i>E. pogonati-urnigeri</i>	ibid.
	<i>Hymenoscyphus erythropus</i>	ibid.
<i>D. superba</i>	<i>Bryochiton perpusillus</i>	ibid.
	<i>Bryorella complanata</i>	ibid.
	<i>B. compressa</i>	ibid.

Tab. 1. (continued).

Bryophyta	Fungus	References
	<i>B. crassitecta</i>	ibid.
	<i>Dawsicola neglecta</i>	ibid.
	<i>Dawsomyces mirabilis</i>	ibid.
	<i>Dawsophila callichroma</i>	ibid.
	<i>D. pygmaea</i>	ibid.
	<i>Epibryon dawsoniae</i>	ibid.
	<i>E. elegantissimum</i>	ibid.
	<i>E. interlamellare</i>	ibid.
	<i>E. notabile</i>	ibid.
	<i>E. pogonati-urnigeri</i>	ibid.
	<i>Hymenoscyphus erythropus</i>	ibid.
	<i>Vezdaea obscura</i>	ibid.
<i>Oligotrichum</i> sp.	<i>Epibryon bryophilum</i>	Döbbeler 1978
	<i>Leucoscypha rutilans</i>	Benkert 1976
<i>O. aligerum</i>	<i>Lizonia baldinii</i>	Döbbeler 1978
<i>Pogonatum</i> sp.	<i>Epibryon bryophilum</i>	ibid.
	<i>Glomus tenuis</i>	Rabatin 1980
	<i>Lizonia</i> sp.	Döbbeler 1978
<i>P. aloides</i>	<i>Fuligo intermedia</i>	Pant & Tewari 1982
	<i>Octospora humosa</i> *	Döbbeler & Itzerott 1981, Itzerott 1981
<i>P. dentatum</i>	<i>Epibryon pogonati-urnigeri</i>	Döbbeler 1985 a
<i>P. nanum</i>	<i>Epibryon bryophilum</i>	Döbbeler 1978
<i>P. urnigerum</i>	<i>Bryorella cryptocarpa</i>	ibid.
	<i>Coleroa bryophila</i>	Henderson 1972
	<i>C. casaresii</i>	ibid.
	<i>Epibryon bryophilum</i>	Döbbeler 1978
	<i>E. casaresii</i>	ibid.
	<i>E. pogonati-urnigeri</i> *	Döbbeler 1978 & 1985 a
<i>Polytrichum</i> sp.	<i>Bryochiton perpusillus</i>	Döbbeler 1978
	<i>Bryorella cryptocarpa</i>	ibid.
	<i>Calonectria biseptata</i>	ibid.
	<i>Cyphellostereum laeve</i>	Breitenbach & Kränzlin 1984, Eriksson & Rywarden 1975, Maurer & al. 1983
	<i>Diachaea caespitosa</i>	Farr 1979
	<i>Epibryon bryophilum</i>	Döbbeler 1978
	<i>Leucoscypha rutilans</i>	Benkert 1976
	<i>L. vivida</i>	ibid.
	<i>Octospora humosa</i>	Dennis & Itzerott 1973, Itzerott 1974 & 1981
<i>P. alpinum</i>	<i>Bryochiton perpusillus</i>	Döbbeler 1978
	<i>Bryorella cryptocarpa</i>	ibid.
	<i>Epibryon interlamellare</i> *	ibid.
	<i>Lizonia</i> sp.	ibid.
<i>P. commune</i>	<i>Bryochiton monascus</i>	ibid.
	<i>Epibryon cryptosphaericum</i>	Döbbeler 1979 c
	<i>E. interlamellare</i> *	Döbbeler 1978
	<i>Lizonia emperigonia</i> *	ibid.
	<i>Trichoderma viride</i>	Scheirer & Dolan 1983

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>P. decipiens</i>	<i>Epibryon interlamellare</i> *	Döbbeler 1978
<i>P. formosum</i>	<i>Bryochiton perpusillus</i>	ibid.
	<i>Bryomyces microcarpus</i>	ibid.
	<i>Epibryon cryptosphaericum</i>	Döbbeler 1979c
	<i>E. interlamellare</i> *	Döbbeler 1978
	<i>Lizonia baldinii</i> *	ibid.
	<i>Nectria cuneifera</i>	ibid.
	<i>Rickenella swartzii</i>	Kost 1984
<i>P. hyperboreum</i>	<i>Bryochiton perpusillus</i>	Döbbeler 1978
<i>P. juniperinum</i>	<i>B. perpusillus</i> *	ibid.
	<i>Massarina immersa</i>	ibid.
	<i>Octospora rustica</i>	Itzerott 1981
	<i>O. rutilans</i>	Dennis & Itzerott 1973, Itzerott 1974
	<i>O. vivida</i>	Dennis & Itzerott 1973
<i>P. longisetum</i>	<i>Epibryon cryptosphaericum</i>	Döbbeler 1979c
	<i>E. interlamellare</i> *	Döbbeler 1978
	<i>Lizonia baldinii</i>	ibid.
<i>P. piliferum</i>	<i>Bryochiton monascus</i>	ibid.
	<i>B. perpusillus</i> *	ibid.
	<i>Lizonia polytrichi-pilosi</i> *	ibid.
	<i>Massarina immersa</i>	ibid.
	<i>Octospora rutilans</i>	Dennis & Itzerott 1973
	<i>O. vivida</i>	Dennis & Itzerott 1973, Itzerott 1974 & 1981
<i>P. sexangulare</i>	<i>Bryochiton heliotropicus</i> *	Döbbeler 1978 & 1987
	<i>B. perpusillus</i>	ibid.
	<i>Gloeopeziza interlamellaris</i>	Döbbeler 1987
	<i>Hymenoscyphus norvegicus</i>	ibid.
	<i>Lizonia sexangularis</i> *	Döbbeler 1978 & 1987
	<i>Protothelenella polytrichi</i>	Döbbeler 1987
Funariales		
Funariaceae		
<i>Funaria</i> sp.	<i>Lamprospora dictyodiola</i>	Benkert 1976
	<i>L. tuberculata</i>	ibid.
	<i>Leucoscypha hetieri</i>	ibid.
	<i>Octospora leucoloma</i>	Dennis & Itzerott 1973
	<i>O. roxheimii</i>	Benkert 1976
	<i>O. rustica</i>	Dennis & Itzerott 1973
<i>F. hygrometrica</i>	<i>Glomus epigaeus</i>	Daniels & Trappe 1979, Johnson 1977, Parke & Linderman 1980
	<i>Lamprospora carbonaria</i> *	Döbbeler 1979d
	<i>L. dictyodiola</i> *	Benkert 1976, Döbbeler & Itzerott 1983
	<i>Mycena cinerella</i>	Hildebrand & al. 1978
	<i>Octospora hetieri</i> *	Dennis & Itzerott 1973, Itzerott 1974 & 1981
	<i>O. roxheimii</i>	Dennis & Itzerott 1973, Itzerott 1974 & 1981
	<i>O. rustica</i>	Itzerott 1974 & 1981

Tab. 1. (continued).

Bryophyta	Fungus	References
	<i>Phoma</i> sp.*	Marchisio 1973
	<i>Pleotrachelus wildemannii</i> *	Döbbeler & Itzerott 1983
Splachnaceae		
<i>Tetraplodon</i> sp.	<i>Octospora alpestris</i> *	Dennis & Itzerott 1973, Döbbeler 1979 d, Itzerott 1981
	<i>Pleotrachelus wildemannii</i> *	Döbbeler & Itzerott 1983
<i>T. mnioides</i>	<i>Octospora alpestris</i> *	Döbbeler 1979 d, Itzerott 1981
	<i>Pleotrachelus wildemannii</i> *	Döbbeler & Itzerott 1983
Bartramiales		
Aulacomniaceae		
<i>Aulacomnium</i>	<i>Coleroa bryophila</i>	Henderson 1972
<i>palustre</i>	<i>Epibryon bryophilum</i>	Döbbeler 1978
	<i>Rickenella aulacomniophila</i>	Kost 1984
<i>A. turgidum</i>	<i>Bryorella gregaria</i>	Döbbeler 1978
Bartramiaceae		
<i>Philonotis</i> sp.	<i>Lamprospora lutziana</i>	Benkert 1976
Bryales		
Bryaceae		
<i>Bryum</i> sp.	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
	<i>Bryosphaeria brevicollis</i>	Döbbeler 1978
	<i>Epibryon muscicola</i>	ibid.
<i>B. algens</i>	<i>Thyronectria hyperantarctica</i>	Pegler & al. 1980
<i>B. argenteum</i>	<i>Bryostroma bryi</i>	Döbbeler 1982
	<i>Lamprospora miniata</i>	Benkert 1976
	<i>Octospora coccinea</i>	Dennis & Itzerott 1973
	<i>O. leucoloma</i> *	Dennis & Itzerott 1973, Döbbeler 1979 d, Itzerott 1974 & 1981
	<i>O. tetraspora</i>	Dennis & Itzerott 1973, Itzerott 1974 & 1981
<i>B. bornholmense</i>	<i>Lamprospora miniata</i>	Benkert 1976
<i>B. caespiticium</i>	<i>Nectria muscivora</i>	Döbbeler 1978
	<i>Octospora coccinea</i> *	Itzerott 1974 & 1981
<i>B. rubens</i>	<i>Lamprospora miniata</i>	Benkert 1976
<i>Leptobryum</i> sp.	<i>Octospora leucoloma</i>	Dennis & Itzerott 1973
<i>Mniobryum</i> = <i>Pohlia</i>		
<i>Orthodontium lineare</i>	<i>Cribraria rufa</i> *	Coker 1966
<i>Pohlia</i> sp.	<i>Octospora coccinea</i>	Dennis & Itzerott 1973
	<i>O. melina</i>	ibid.
<i>P. carnea</i>	<i>O. melina</i>	Itzerott 1974 & 1981
<i>P. obtusifolia</i>	<i>Bryosphaeria pohliae</i>	Döbbeler 1978
Mniaceae		
<i>Mnium</i> sp.	<i>Epibryon bryophilum</i>	ibid.
<i>M. cuspidatum</i>	<i>Schizotrichella lunata</i>	Bowen 1968
<i>M. orthorrhynchum</i>	<i>Bryosphaeria brevicollis</i>	Döbbeler 1978
<i>M. punctatum</i>	<i>Leptomeliola mnii</i>	ibid.
	<i>Rickenella swartzii</i>	Kost 1984
<i>M. undulatum</i>	<i>Clavaria rugosa</i>	Seidel 1983
	<i>Clavulina cristata</i>	ibid.
	<i>Epibryon casaresii</i>	Döbbeler 1978

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>Plagiomnium rostratum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
Rhizogoniaceae		
<i>Rhizogonium spiniforme</i>	<i>Bryomyces microcarpus</i>	Doebbler 1978
Fissidentales		
Fissidentaceae		
<i>Fissidens</i> sp.	<i>Epibryon muscicola</i>	ibid.
<i>F. cristatus</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
	<i>Belonioscyphella hypnorum</i> *	Döbbeler 1986 a
Dicranales		
Dicranaceae		
<i>Campylopus</i> sp.	<i>Lamprospora campylopodis</i>	Benkert 1976
<i>Chorisodontium aciphyllum</i>	<i>Bryosphaeria megaspora</i> *	Fenton 1983, Pegler & al. 1980
	<i>Coleroa turfosorum</i> *	Fenton 1983
	<i>Epibryon chorisodontii</i> *	ibid.
<i>Cynodontium</i> sp.	<i>Bryomyces velenovskyi</i>	Döbbeler 1978
<i>Dicranella</i> sp.	<i>Octospora humosa</i> *	Itzerott 1981
<i>D. heteromalla</i>	<i>Helotium dicrani</i>	Henderson 1972
	<i>Octospora humosa</i>	Itzerott 1974
	<i>O. melina</i>	Dennis & Itzerott 1973
	<i>O. phagospora</i>	Itzerott 1977
<i>Dicranum</i> sp.	<i>Bryorella gregaria</i>	Döbbeler 1978
	<i>Epibryon bryophilum</i>	ibid.
<i>D. scoparium</i>	<i>Cantharellus tubaeformis</i>	Seidel 1983
	<i>Cortinarius impennis</i>	ibid.
	<i>Dermocybe semisanguinea</i>	ibid.
	<i>Epibryon dicrani</i>	Döbbeler 1978
	<i>Marasmius androsaceus</i>	Seidel 1983
	<i>Micromphale perforans</i>	ibid.
<i>D. undulatum</i>	<i>Laccaria amethystina</i>	ibid.
<i>Paraleucobryum</i> sp.	<i>Epibryon bryophilum</i>	Döbbeler 1978
Ditrichaceae		
<i>Ceratodon</i> sp.	<i>Leucoscypha hetieri</i>	Benkert 1976
	<i>Octospora melina</i>	Dennis & Itzerott 1973
	<i>O. rubens</i>	Dennis & Itzerott 1973
	<i>O. rustica</i>	Benkert 1976
<i>C. purpureus</i>	<i>O. coccinea</i>	ibid.
	<i>O. hetieri</i> *	Dennis & Itzerott 1973, Itzerott 1974 & 1981
	<i>O. melina</i> *	Itzerott 1974 & 1981
	<i>O. rubens</i> *	Itzerott 1974 & 1981, Itzerott & Döbbeler 1982
	<i>O. rustica</i>	Dennis & Itzerott 1973, Itzerott 1974 & 1981
	<i>O. vivida</i>	Itzerott 1974 & 1981
<i>Distichium</i> sp.	<i>Bryosphaeria setifera</i>	Döbbeler 1978
<i>Ditrichum</i> sp.	<i>Lamprospora modestissima</i>	Benkert 1976
<i>D. flexicaule</i>	<i>Bryostroma axillare</i>	Döbbeler 1978
<i>Pleuridium</i> sp.	<i>Octospora libussae</i>	ibid.

Tab. 1. (continued).

Bryophyta	Fungus	References
Seligeriaceae		
<i>Blindia acuta</i>	<i>Bryostroma guttulatum</i>	ibid.
Leucobryaceae		
<i>Leucobryum antillarum</i>	<i>Epibryon leucobryi</i>	ibid.
<i>L. crispum</i>	<i>E. leucobryi</i>	ibid.
Encalyptales		
Encalyptaceae		
<i>Encalypta</i> sp.	<i>Bryosphaeria echinoidea</i>	ibid.
	<i>Epibryon bryophilum</i>	ibid.
	<i>E. muscicola</i>	ibid.
	<i>Lamprospora miniata</i>	Benkert 1976
<i>E. alpina</i>	<i>Lasiosphaeria encalyptae</i>	Döbbeler 1978
<i>E. vulgaris</i>	<i>Octospora coccinea</i> *	Itzerott 1974 & 1981
Pottiales		
Cinclidotaceae		
<i>Cinclidotus fontinaloides</i>	<i>Bryosphaeria cinclidoti</i>	Döbbeler 1978
Pottiaceae		
<i>Aloina</i> sp.	<i>O. crosslandii</i>	Benkert 1976
	<i>O. miniata</i>	ibid.
<i>A. rigida</i>	<i>Nectria muscivora</i>	Döbbeler 1978
<i>Barbula</i> sp.	<i>Bryostroma trichostomi</i>	ibid.
	<i>Fuligo intermedia</i>	Pant & Tewari 1982
	<i>Lachnea didymodontis</i>	Pegler & al. 1980
	<i>Nectria muscivora</i>	Döbbeler 1978
	<i>Octospora crosslandii</i> *	Itzerott 1981
	<i>O. neglecta</i>	Benkert 1976
	<i>Racovitziella endostromatica</i>	Döbbeler 1978
<i>B. acuta</i>	<i>Bryostroma axillare</i>	ibid.
<i>B. fallax</i>	<i>B. trichostomi</i>	ibid.
<i>B. recurvirostra</i>	<i>Octospora leucoloma</i>	Dennis & Itzerott 1973
<i>B. rigidula</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
	<i>Bryosphaeria cinclidoti</i>	Döbbeler 1978
	<i>B. epibrya</i>	ibid.
	<i>Bryostroma trichostomi</i>	ibid.
	<i>Octospora neglecta</i>	Itzerott 1974 & 1981
<i>B. unguiculata</i>	<i>Lamprospora miniata</i>	Benkert 1976
	<i>Nectria muscivora</i>	Döbbeler 1978
	<i>Octospora leucoloma</i>	Itzerott 1974
<i>B. vinealis</i>	<i>Epibryon muscicola</i>	Döbbeler 1978
<i>Bryoerythrophyllum</i> sp.	<i>Lamprospora miniata</i>	Benkert 1976
	<i>Octospora crosslandii</i> *	Itzerott 1981
<i>B. rubellum</i>	<i>O. neglecta</i>	Dennis & Itzerott 1973
<i>Crossidium squamigerum</i>	<i>Bryochiton monascus</i>	Döbbeler 1978
	<i>Bryosphaeria cinclidoti</i>	ibid.
	<i>Epibryon muscicola</i>	ibid.
<i>Desmatodon latifolius</i>	<i>Octospora crosslandii</i> *	Itzerott 1978 & 1981
<i>Didymodon</i> = <i>Barbula</i>		
<i>Erythrophyllum</i> =		
<i>Bryoerythrophyllum</i>		

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>Gymnostomum calcareum</i>	<i>Nectria muscicola</i>	Döbbeler 1978
<i>Hymenostylium recurvirostre</i>	<i>Julella macrospora</i>	ibid.
<i>Phascum</i> sp.	<i>Octospora axillaris</i>	Benkert 1976
	<i>O. crosslandii</i> *	Itzerott 1981
<i>P. cuspidatum</i>	<i>O. axillaris</i> *	Dennis & Itzerott 1973, Itzerott 1974 & 1981
<i>Pottia</i> sp.	<i>Octospora coccinea</i>	Dennis & Itzerott 1973
	<i>O. crosslandii</i> *	Itzerott 1981
<i>P. bryoides</i>	<i>Lamprospora miniata</i>	Benkert 1976
<i>P. intermedia</i>	<i>L. miniata</i>	ibid.
<i>P. lanceolata</i>	<i>Octospora axillaris</i> *	Itzerott 1974 & 1981
<i>P. truncata</i>	<i>Pleotrachelus wildemanii</i>	Döbbeler & Itzerott 1983, Rieth 1962
<i>Pterygoneurum</i> sp.	<i>Octospora crosslandii</i> *	Itzerott 1981
	<i>O. tetraspora</i>	Benkert 1976
<i>P. ovatum</i>	<i>Nectria muscivora</i>	Döbbeler 1978
<i>Syntrichia</i> = <i>Tortula</i>		
<i>Tortella</i> sp.	<i>Epibryon muscicola</i>	ibid.
<i>T. densa</i>	<i>E. muscicola</i>	ibid.
<i>T. flavovirens</i>	<i>Bryostroma trichostomi</i>	ibid.
<i>T. fragilis</i>	<i>Ebibryon muscicola</i>	ibid.
<i>T. inclinata</i>	<i>Bryochiton monascus</i>	ibid.
	<i>Epibryon muscicola</i>	ibid.
<i>T. nitida</i>	<i>Bryostroma trichostomi</i>	ibid.
<i>T. tortuosa</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
	<i>Belonioscyphella hypnorum</i> *	Döbbeler 1986 a
	<i>Bryomyces velenovskyi</i>	Döbbeler 1978
	<i>Epibryon muscicola</i>	ibid.
	<i>Recovitzella endostromatica</i>	ibid.
<i>Tortula</i> sp.	<i>Octospora retispora</i>	Itzerott 1974
<i>T. excelsa</i>	<i>Thyronectria hyperantarctica</i> *	Pegler & al. 1980
<i>T. filaris</i>	<i>Lamprospora miniatopsis</i>	Pegler & al. 1980, Schumacher 1986
<i>T. fuscoviridis</i>	<i>L. miniatopsis</i>	ibid.
<i>T. muralis</i>	<i>Bryosphaeria cinclidoti</i>	Döbbeler 1978
	<i>Nectria muscivora</i>	ibid.
<i>T. norvegica</i>	<i>Bryostroma trichostomi</i>	ibid.
	<i>Lamprospora miniata</i> *	Döbbeler 1979 d
<i>T. ruralis</i>	<i>Bryosphaeria bryophila</i>	Döbbeler 1978
	<i>Bryostroma trichostomi</i>	ibid.
	<i>Epibryon muscicola</i>	ibid.
	<i>Lamprospora miniata</i>	Itzerott 1978
	<i>L. retispora</i>	Itzerott & Thate 1974
	<i>Nectria muscivora</i>	Döbbeler 1978
	<i>Octospora ruralis</i>	Dennis & Itzerott 1973
<i>Trichostomum brachydontium</i>	<i>Bryostroma trichostomi</i>	Döbbeler 1978
<i>T. crispulum</i>	<i>B. trichostomi</i>	ibid.
<i>T. nitidum</i>	<i>B. trichostomi</i>	ibid.

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>Grimmiales</i>		
<i>Grimmiaceae</i>		
<i>Coscinodon calyptratus</i>	<i>Bryochiton monascus</i>	Döbbeler 1978
<i>C. cribrosus</i>	<i>B. monascus</i>	ibid.
<i>Grimmia</i> sp.	<i>Bryochiton monascus</i>	ibid.
	<i>Bryostroma necans</i>	ibid.
	<i>Octospora grimmiae</i>	Dennis & Itzerott 1973, Döbbeler 1979d, Itzerott 1974
	<i>O. melina</i>	Dennis & Itzerott 1973
	<i>O. meslinii</i>	Benkert 1976
	<i>O. musci-muralis</i>	Dennis & Itzerott 1973, Itzerott 1974
	<i>O. retispora</i>	Itzerott 1974, Itzerott & Thate 1974
<i>G. alpestris</i>	<i>Bryochiton monascus</i>	Döbbeler 1978
<i>G. donniana</i>	<i>B. monascus</i>	ibid.
	<i>Bryomyces microcarpus</i>	ibid.
<i>G. elatior</i>	<i>Bryochiton monascus</i>	ibid.
<i>G. funalis</i>	<i>B. monascus</i>	ibid.
<i>G. kerguelensis</i>	<i>Grimmicola parasiticus</i>	Döbbeler & Hertel 1983
<i>G. laevigata</i>	<i>Bryochiton monascus</i>	Döbbeler 1978
<i>G. montana</i>	<i>B. monascus</i>	ibid.
<i>G. pulvinata</i>	<i>Nectria muscivora</i>	ibid.
	<i>Octospora grimmiae</i> *	Itzerott 1981
	<i>O. melina</i>	Itzerott 1974
	<i>O. meslinii</i> *	Itzerott 1978 & 1981, Itzerott & Döbbeler 1982
	<i>O. musci-muralis</i>	Döbbeler 1979d, Itzerott 1981
<i>G. sessitana</i>	<i>Bryodiscus grimmiae</i> *	Hein & al. 1971
	<i>Bryorella retiformis</i>	Döbbeler 1978
<i>G. tergestina</i>	<i>Bryochiton monascus</i>	ibid.
<i>Rhacomitrium</i> sp.	<i>B. monascus</i>	ibid.
	<i>Epibryon bryophilum</i>	ibid.
<i>R. aciculare</i>	<i>Bryomyces microcarpus</i>	ibid.
<i>R. fasciculare</i>	<i>Julella macrospora</i>	ibid.
<i>R. heterostichum</i>	<i>Bryochiton monascus</i>	ibid.
<i>R. hypnoides</i>	<i>Stropharia alpina</i>	Lange 1980
<i>R. lanuginosum</i>	<i>Brychiton monascus</i> *	Döbbeler 1978
	<i>Bryomyces microcarpus</i> *	ibid.
	<i>Bryostroma rhacomitrii</i>	ibid.
	<i>Epibryon maculosum</i>	Döbbeler & Hertel 1983
	<i>E. polyphagum</i>	Döbbeler 1978
	<i>Nectria rhacomitrii</i>	ibid.
<i>R. microcarpon</i>	<i>Bryochiton monascus</i>	ibid.
<i>R. sudeticum</i>	<i>Leptomeliola</i> sp.	ibid.
<i>Schistidium</i> sp.	<i>Hiemsia pseudoampezzana</i>	Benkert 1976
	<i>Octospora meslinii</i>	ibid.
	<i>O. neglecta</i>	ibid.
<i>S. alpicola</i>	<i>Bryomyces microcarpus</i>	Döbbeler 1978

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>S. apocarpum</i>	<i>Acrospermum adeanum</i> <i>Bryochiton monascus</i> <i>Bryomyces microcarpus</i> <i>Bryosphaeria cinclidoti</i> <i>Hiemsia pseudoampezzana</i> <i>Octospora melina</i> <i>O. meslinii</i> <i>O. neglecta</i> <i>Racovitziella endostromatica</i> <i>Bryochiton monascus</i>	Döbbeler 1979 b Döbbeler 1978 ibid. ibid. Svrček 1969 Itzerott 1974 Itzerott 1981 Itzerott 1974 & 1981 Döbbeler 1978 ibid.
<i>S. boreale</i>		
Neckerales		
Orthotrichaceae		
<i>Orthotrichum</i> sp.	<i>Octospora meslinii</i>	Benkert 1976
<i>O. pulchellum</i>	<i>Epibryon muscicola</i>	Döbbeler 1978
<i>O. speciosum</i>	<i>Bryomyces</i> sp.	ibid.
Hedwigiaceae		
<i>Hedwigia ciliata</i>	<i>Bryomyces monascus</i>	ibid.
Leucodontaceae		
<i>Leucodon</i> sp.	<i>Bryorella acrogena</i>	Döbbeler 1984
<i>L. sciuroides</i>	<i>Acrospermum adeanum</i> <i>Bryomyces microcarpus</i> <i>Leptospora leucodontis</i> <i>Bryorella acrogena</i> <i>Hypobryon heterotropum</i>	Döbbeler 1979 b Döbbeler 1978 ibid. Döbbeler 1984 Döbbeler 1983
<i>L. secundus</i>	<i>Fuligo intermedia</i>	Pant & Tewari 1982
<i>Pterogonium gracile</i>	<i>Bryomyces microcarpus</i>	Döbbeler 1978
Neckeraceae		
<i>Neckera</i> sp.	<i>Bryorella acrogena</i>	Döbbeler 1984
<i>N. complanata</i>	<i>B. acrogena</i>	ibid.
<i>N. crispa</i>	<i>Bryomyces microcarpus</i>	Döbbeler 1978
Prionodontaceae		
<i>Prionodon bolivianus</i>	<i>Bryomyces doppelbaurorum</i> <i>Calonectria phycophora</i>	ibid. ibid.
Lembophylaceae		
<i>Isothecium</i> sp.	<i>B. acrogena</i> <i>Epibryon bryophilum</i>	Döbbeler 1984 Döbbeler 1978
<i>I. alopecuroides</i>	<i>Bryomyces acrogena</i>	Döbbeler 1984
<i>I. myosuroides</i>	<i>Epibryon diaphanum</i>	Döbbeler 1979 c
<i>I. myurum</i>	<i>Bryorella erumpens</i>	Döbbeler 1978
<i>Lembophyllum</i> sp.	<i>Rhizophagus tenuis</i>	Johnson 1977
<i>Pterigynandrum filiforme</i>	<i>Acrospermum adeanum</i> <i>Bryorella acrogena</i> <i>Bryostroma necans</i>	Döbbeler 1979 b Döbbeler 1978 ibid.
Phyllogoniaceae		
<i>Phyllogonium</i> sp.	<i>Calonectria phycophora</i>	ibid.
Thamniaceae		
<i>Thamnium alopecurum</i>	<i>Bryomyces microcarpus</i> <i>Julella macrospora</i>	ibid. ibid.

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>Hypnales</i>		
<i>Leskeaceae</i>		
<i>Leskea polycarpa</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
	<i>Bryosphaeria epibrya</i>	Döbbeler 1978
	<i>Epibryon muscicola</i>	ibid.
<i>Leskuraea</i> sp.	<i>Bryorella acrogena</i>	Döbbeler 1984
<i>L. incurvata</i>	<i>B. acrogena</i>	Döbbeler 1978
	<i>Bryosphaeria bryophila</i>	ibid.
	<i>B. cinclidoti</i>	ibid.
	<i>B. echinoidea</i>	ibid.
	<i>Julella macrospora</i>	ibid.
<i>L. plicata</i>	<i>Epibryon muscicola</i>	ibid.
<i>Pseudoleskeella</i> sp.	<i>Bryorella acrogena</i>	Döbbeler 1984
<i>P. catenulata</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
	<i>Bryochiton monascus</i>	Döbbeler 1978
	<i>Bryomyces microcarpus</i>	ibid.
	<i>Bryorella acrogena</i>	Döbbeler 1978 & 1984
	<i>Bryosphaeria cinclidoti</i>	Döbbeler 1978
	<i>Bryostroma halosporum</i>	ibid.
	<i>Epibryon muscicola</i>	ibid.
<i>P. nervosa</i>	<i>Acrospermum adeanum</i>	Döbbeler 1984
	<i>Bryorella acrogena</i>	Döbbeler 1978
	<i>Epibryon muscicola</i>	ibid.
	<i>Myxophora amerospora</i>	ibid.
<i>Thuidiaceae</i>		
<i>Anomodon attenuatus</i>	<i>Belonioscyphella hypnorum</i> *	Döbbeler 1986 a
	<i>Epibryon muscicola</i>	Döbbeler 1978
<i>A. rugelii</i>	<i>Bryosphaeria epibrya</i>	ibid.
	<i>Belonioscyphella hypnorum</i> *	Döbbeler 1986 a
<i>A. viticulosus</i>	<i>B. hypnorum</i>	ibid.
	<i>Julella macrospora</i>	Döbbeler 1978
	<i>Nectria styriaca</i>	ibid.
<i>Heterocladium</i>	<i>Bryomyces velenovskyi</i>	ibid.
<i>dimorphum</i>		
<i>Thuidium delicatulum</i>	<i>Bryomyces velenovskyi</i>	ibid.
	<i>Epibryon diaphanum</i>	Döbbeler 1985 a
<i>T. philibertii</i>	<i>Bryorella punctiformis</i>	Döbbeler 1978
	<i>Bryostroma necans</i>	ibid.
	<i>Epibryon tripartitum</i>	Döbbeler 1982
<i>T. tamariscinum</i>	<i>Armillariella mellea</i>	Seidel 1983
	<i>Bryomyces velenovskyi</i>	Döbbeler 1978
	<i>Clavaria rugosa</i>	Seidel 1983
	<i>Clavulina cristata</i>	ibid.
	<i>Epibryon diaphanum</i>	Döbbeler 1985 a
	<i>Hydnum rufescens</i>	Seidel 1983
<i>Pterigynandraceae</i>		
<i>Pterigynandrum</i> sp.	<i>Bryorella acrogena</i>	Döbbeler 1984
<i>P. filiforme</i>	<i>Belonioscyphella hypnorum</i> *	Döbbeler 1986 a
	<i>Bryorella acrogena</i>	Döbbeler 1978
	<i>Bryostroma necans</i>	ibid.

Tab. 1. (continued).

Bryophyta	Fungus	References
Cratoneuraceae		
<i>Cratoneuron falcatum</i>	<i>Bovistella paludosa</i>	Fridén 1979
<i>C. filicinum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
	<i>Myxophora amerospora</i>	Döbbeler 1978
Amblystegiaceae		
<i>Amblystegiella confervoides</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
<i>A. subtilis</i>	<i>Bryorella punctiformis</i>	Döbbeler 1978
	<i>Epibryon muscicola</i>	ibid.
<i>Amblystegium juratzkanum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
<i>A. serpens</i>	<i>Octospora wrightii</i> (= <i>Lamprospora wrightii</i>)	Benkert 1976, Dennis & Itzerott 1973, Döbbeler 1979 d, Itzerott 1974 & 1981
<i>A. varium</i>	<i>Acrospermum adeanum</i> *	Döbbeler 1979 b
<i>Calliergidium austrostramineum</i>	<i>Bryosphaeria megaspora</i> *	Fenton 1983, Pegler & al. 1980
	<i>Coleroa turfosorum</i> *	Fenton 1983
	<i>Epibryon chorisodontii</i> *	ibid.
	<i>Thyronectria hyperantarctica</i> *	Pegler & al. 1980
<i>Calliergon sarmentosum</i>	<i>Bryomyces microcarpus</i>	Döbbeler 1978
	<i>Inermisia</i> sp.	Pegler & al. 1980
	<i>Peziza varia</i>	ibid.
	<i>Thyronectria hyperantarctica</i> *	ibid.
<i>Campylium chrysophyllum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
<i>C. halleri</i>	<i>Bryorella punctiformis</i>	Döbbeler 1978
	<i>Calonectria celata</i>	ibid.
	<i>Epibryon muscicola</i>	ibid.
	<i>Myxophora amerospora</i>	ibid.
<i>C. polygamum</i>	<i>Leptoglossum salinum</i>	Høiland 1982
<i>C. protensum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
<i>C. sommerfeltii</i>	<i>Epibryon muscicola</i>	Döbbeler 1978
<i>C. stellatum</i>	<i>Bovistella paludosa</i>	Fridén 1979
<i>Drepanocladus intermedius</i>	<i>B. paludosa</i>	ibid.
<i>D. revolvens</i>	<i>Bryomyces microcarpus</i>	Döbbeler 1978
<i>D. uncinatus</i>	<i>Bryosphaeria megaspora</i> *	Fenton 1983, Pegler & al. 1980
	<i>Coleroa turfosorum</i> *	Fenton 1983
	<i>Epibryon chorisodontii</i> *	ibid.
	<i>Thyronectria hyperantarctica</i> *	Pegler & al. 1980
	<i>Peziza varia</i>	Pegler & al. 1980
	<i>Thyronectria antarctica</i>	Longton 1973
<i>Hygrohypnum ochraceum</i>	<i>Bryomyces velenovskyi</i>	Döbbeler 1978
<i>Leptodictyum riparium</i>	<i>Stemphyllum botryosum</i> *	Prior 1966
Brachytheciaceae		
<i>Brachythecium</i> sp.	<i>Bryorella punctiformis</i>	Döbbeler 1978
	<i>Bryosphaeria epibrya</i>	ibid.
	<i>Lasiosphaeria muscicola</i>	ibid.
<i>B. austrosalebrosum</i>	<i>Thyronectria hyperantarctica</i> *	Pegler & al. 1980

Tab. 1. (continued).

Bryophyta	Fungus	References
<i>B. geheebii</i>	<i>Bryosphaeria bryophila</i>	Döbbeler 1978
<i>B. glareosum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
<i>B. laetum</i>	<i>A. adeanum</i>	ibid.
<i>B. mildeanum</i>	<i>Leptomeliola muscorum</i>	Döbbeler 1978
<i>B. plumosum</i>	<i>Bryomyces velenovskyi</i>	ibid.
<i>B. rutabulum</i>	<i>Mycena cinerella</i>	Hildebrand & al. 1978
<i>B. velutinum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
	<i>Belonioscyphella hypnorum</i> *	Döbbeler 1986 a
<i>Eurhynchium prolongum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
<i>E. striatum</i>	<i>Bryomyces microcarpus</i>	Döbbeler 1978
	<i>Hydnum rufescens</i>	Seidel 1983
	<i>Hygrophorus pustulatus</i>	ibid.
	<i>Mycena epipterygia</i>	ibid.
<i>Homalothecium</i> sp.	<i>Bryosphaeria echinoidea</i>	Doebbeler 1978
<i>Pseudoscleropodium purum</i>	<i>Lactarius aurantiacus</i>	Seidel 1983
<i>Rhynchostegium confertum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
<i>R. rotundifolium</i>	<i>A. adeanum</i>	ibid.
<i>R. rurale</i>	<i>A. adeanum</i>	ibid.
Plagiotheciaceae		
<i>Isopterygium pulchellum</i>	<i>Calonectria muscicola</i>	Döbbeler 1978
<i>Plagiothecium denticulatum</i>	<i>Fomitopsis annosa</i>	Seidel 1983
Hylocomiaceae		
<i>Hylocomium</i> sp.	<i>Bryorella acrogena</i>	Döbbeler 1984
	<i>Epibryon bryophilum</i>	Döbbeler 1978
<i>H. splendens</i>	<i>Bryomyces microcarpus</i>	ibid.
	<i>Bryorella acrogena</i>	ibid.
	<i>Bryosphaeria bryophila</i>	ibid.
	<i>Epibryon diaphanum</i>	Döbbeler 1979 c & 1985 a
	<i>Monographella abscondita</i>	Döbbeler 1978
	<i>Nectria hylocomii</i> *	ibid.
<i>H. umbratum</i>	<i>Bryorella acrogena</i>	ibid.
<i>Pleurozium schreberi</i>	<i>Bryomyces velenovskyi</i>	ibid.
	<i>Cantharellus tubaeformis</i>	Seidel 1983
	<i>Cortinarius impennis</i>	ibid.
	<i>Dermocybe semisanguinea</i>	ibid.
	<i>Epibryon diaphanum</i>	Döbbeler 1979 c & 1985 a
	<i>Gerronema fibula</i> *	Redhead 1981
	<i>Marasmius androsaceus</i>	Seidel 1983
	<i>Paxillus involutus</i>	ibid.
<i>Rhytidiadelphus loreus</i>	<i>Epibryon diaphanum</i>	Döbbeler 1979 c
	<i>Leptopodia elastica</i>	Seidel 1983
<i>R. triquetrus</i>	<i>Epibryon diaphanum</i>	Döbbeler 1979 c
	<i>Tricholoma saponaceum</i>	Seidel 1983

Tab. 1. (continued).

Bryophyta	Fungus	References
Hypnaceae		
<i>Ctenidium molluscum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
	<i>Belonioscyphella hypnorum</i> *	Döbbeler 1986 a
	<i>Bryorella punctiformis</i>	Döbbeler 1978
	<i>Cantharellus tubaeformis</i>	Seidel 1983
	<i>Cortinarius impenni</i>	ibid.
	<i>Dermocybe semisanguinea</i>	ibid.
	<i>Epibryon diaphanum</i>	Döbbeler 1979c & 1985a
	<i>E. muscicola</i>	Döbbeler 1978
	<i>Marasmius androsaceus</i>	Seidel 1983
	<i>Paxillus involutus</i>	ibid.
	<i>Protoventuria echinospora</i>	Döbbeler 1978
<i>Homomallium incurvatum</i>	<i>Acrospermum adeanum</i>	Döbbeler 1986 a
<i>Hypnum</i> sp.	<i>Bryorella acrogena</i>	Döbbeler 1984
	<i>Bryosphaeria quinquesepata</i>	Döbbeler 1978
<i>H. cupressiforme</i>	<i>Acrospermum adeanum</i>	Döbbeler 1979 b & 1984
	<i>Belonioscyphella hypnorum</i> *	Döbbeler 1986a
<i>H. revolutum</i>	<i>Bryomyces microcarpus</i>	Döbbeler 1978
	<i>B. velenovskyi</i>	ibid.
	<i>Leptomeliola hypnorum</i>	ibid.
	<i>Paxillus atrotomentosus</i>	Seidel 1983
	<i>Rickenella fibula</i>	Kost 1984
	<i>Bryosphaeria brevicollis</i>	Döbbeler 1978
	<i>B. bryophila</i>	ibid.
	<i>Calonectria celata</i>	ibid.
	<i>Bryorella acrogena</i>	ibid.
	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
<i>Platygyrium repens</i>	<i>Bryosphaeria epibrya</i>	Döbbeler 1978
	<i>Bryomyces microcarpus</i>	ibid.
<i>Ptilium crista-castrensis</i>	<i>Epibryon diaphanum</i>	Döbbeler 1979 c & 1985 a
	<i>Acrospermum adeanum</i>	Döbbeler 1979 b
<i>Pylaisia polyantha</i>	<i>Bryosphaeria epibrya</i>	Döbbeler 1978
Buxbaumiales		
Buxbaumiaceae		
<i>Diphyscium</i> sp.	<i>Epibryon bryophilum</i>	Seidel 1983
<i>D. foliosum</i>	<i>E. bryophilum</i>	ibid.

Tab. 2. List of references, where the genus or even the family of bryophytes and/or fungi are not mentioned. Fungi are listed alphabetically.

Bryophyta	Fungus	References
"on mosses"	<i>Calvatia</i> sp.	Ohenoja 1971
	<i>Candida tsuchiyae</i>	Nakase & Suzuki 1985
	<i>Chamonixia caespitosa</i>	Kers 1985
	<i>Cortinarius</i> sp.	Ohenoja 1971
	<i>C. acutus</i>	Booij 1976
	<i>C. casimiri</i>	van Waveren 1975
	<i>Dictyonema</i> sp.	Tschermak-Woess 1983
	<i>Diderma</i> sp.	Brooks & al. 1977
	<i>Endogone</i> sp.	Gerdemann 1968
	<i>Fuligo intermedia</i>	Pant & Tewari 1982
	<i>Galerina moelleri</i>	Ohenoja 1971
	<i>Hebeloma</i> sp.	ibid.
	<i>Inocybe</i> sp.	ibid.
	<i>Julella macrospora</i>	Döbbeler 1978
	<i>J. phycophila</i>	ibid.
	<i>J. tulasnei</i>	ibid.
	<i>Trichonectria rosella</i>	ibid.
	<i>Laccaria</i> sp.	Ohenoja 1971
	<i>Lactarius</i> sp.	ibid.
	<i>Leptoglossum robatum</i>	ibid.
	<i>Licea lucens</i>	Nannenga-Bremekamp 1981
	<i>Lycoperdon</i> sp.	Ohenoja 1971
	<i>Mitrula gracilis</i>	ibid.
	<i>Mniopetalum bryophilum</i>	Singer 1975
	<i>Mycenella bryophila</i>	ibid.
	<i>Octospora phagospora</i>	Itzerott 1981
	<i>Omphalina</i> sp.	Ohenoja 1971, Singer 1975
	<i>Rhodophyllus</i> sp.	Ohenoja 1971
	<i>Russula</i> sp.	ibid.
	<i>Tulostoma niveum</i>	Kers 1978
	yeasts	Goto & al. 1969
"weakened mosses"	<i>Lepista nuda</i>	Gramss 1984
"peat mosses"	<i>Collybia dryophila</i>	Czastukhin 1967
	<i>Flammulina velutipes</i>	ibid.
	<i>Laetiporus sulphureus</i>	ibid.
	<i>Penicillium funiculosum</i>	ibid.
	<i>P. spinulosum</i>	ibid.
"on liverwort"	<i>Torula convoluta</i>	ibid.
	<i>Bryodiscus hepaticarum</i>	Döbbeler & Poelt 1974
	<i>Bryomyces nigrescens</i>	Döbbeler 1978
	<i>Epibryon hepaticola</i>	ibid.
	<i>Julella tulasnei</i>	ibid.
"on mosses, probably <i>Sphagnum</i> "	<i>Massarina hepaticarum</i>	ibid.
	<i>Octosporella jungermanniarum</i>	Döbbeler 1979 d
	<i>Galerina farinacea</i>	van Waveren 1976
"on moss protonema"	<i>Octospora humosa</i>	Döbbeler & Itzerott 1981
	<i>O. libusse</i>	Döbbeler & Itzerott 1981, Itzerott 1981
	<i>O. phagospora</i>	Itzerott 1981

Tab. 2. (continued).

Bryophyta	Fungus	References
"between mosses"	<i>Psilocybe</i> sp.	Singer 1975
	<i>Gymnopilus bryophilus</i>	ibid.
<i>Aneura pinguis</i>	unknown	Pocock & Duckett 1984
<i>Anthoceros</i> sp.	various species	Kamal & Singh 1970
Bryaceae	<i>Octospora rubens</i>	Itzerott 1974
<i>Funaria</i> sp.	various species	Kamal & Singh 1970
Lepidoziaceae	swollen rhizoids	Pocock & al. 1984
<i>Marchantia berteroana</i>	phycomycetous fungi	Baylis 1970
Polytrichaceae	<i>Octospora rutilans</i>	Döbbeler 1979 d
Pottiaceae	<i>Octospora rubens</i>	Itzerott 1974
<i>Riccardia chamedryfolia</i>	unknown	Pocock & Duckett 1984
<i>R. multifida</i>	unknown	ibid.
<i>R. incurvata</i>	unknown	ibid.
<i>Riccia</i> sp.	various species	Kamal & Singh 1970
<i>Tortula muralis</i>	unspecified	Hughes 1982

Tab. 3. Mycorrhiza-like fungi on bryophytes.

Fungus	Bryophyta	References
various species	<i>Anthoceros</i> sp.	Kamal & Singh 1970, Singh 1974
	<i>Riccia</i> sp.	ibid.
	<i>Funaria</i> sp.	ibid.
	<i>Polytrichum commune</i>	Grasso & Scheirer 1983
phycomycetous mycorrhizas	<i>Marchantia berteroana</i>	Baylis 1970
swollen rhizoids	Hepaticae	Pocock & Duckett 1985 b
<i>Aneura</i> sp.	bryophytes	Harley 1959
<i>Endogone</i> sp.	bryophytes	Gerdemann 1968
<i>Glomus tenuis</i>	<i>Pogonatum</i> sp.	Rabatin 1980
<i>Mycena cinerella</i>	<i>Atrichum undulatum</i>	Hildebrand & al. 1978
	<i>Brachythecium rutabulum</i>	ibid.
	<i>Funaria hygrometrica</i>	ibid.

Tables 1 and 2 also list fungi which were found on bryophytes but were not described as parasites. It can be assumed that most associations are not obligate. Mycorrhiza-like fungi on bryophytes have also been described (Table 3). This type of interaction may be crucial for the survival of many mosses in harsh environments. An analysis of all data available shows that certain fungal families were recorded more frequently than others. This is especially true for the representatives of the Aphyllophorales, Agaricales and the subdivision Ascomycotina. As outlined by Döbbeler (1987), certain fungi can be found frequently on particular mosses, because there is an especially close relationship between the two organisms: "Presently, there are more than 40 species of ascomycetes in six orders known to inhabit the Polytrichaceae, mainly *Polytrichum* and *Dawsonia*, most of which have been treated by Dennis (1962), Döbbeler (1978, 1979 c & 1981 b) and Racovit-

za (1959). They represent quite different biological types ranging from saprophytes to necrotrophic and as highly adapted biotrophic parasites. Some destroy the antheridial cups of male plants; others are restricted to the subcuticular region of the abaxial leaf side. Several species prefer upper, marginal or lower parts of a leaf, respectively. Members of the operculate genus *Octospora* infect the subterranean rhizoids of several Polytrichaceae with complex appressoria and haustoria, sometimes inducing gemmae-like galls (Döbbeler 1979 d, Döbbeler & Itzerott 1981). El Dorado are the spaces between the longitudinal photosynthetic lamellae of the adaxial leaf blade. There is no other microhabitat in bryophytes that is more regularly occupied by fungal reproductive structures than these parts of the "pseudomesophyll", as Smith (1971) aptly calls it. Approximately 20 ascomycetes with often extremely minute and partly reduced ascocarps, which in some cases do not fit the definition of "perithecium" or that of "apothecium", have been demonstrated to grow obligately in the interspaces without inducing symptoms in any visible manner. They represent striking examples of convergent evolution in adaptation to a specific, extraordinary and stable substrate."

It has to be assumed, however, that many fungi were not described, which, however, could be present on bryophytes due to their ecological requirements. A conclusive picture of the fungal varieties associated with bryophytes is far from complete. Many species have not yet been identified, possibly because specialists of certain taxonomic groups only observe a part of all taxa. It also seems to be a problem that only a few biologists are experts in both fungal and bryophyte taxonomy.

3. Potential future research areas

Reviewing the literature about the association of fungi with bryophytes several topics for future research became evident; only a geographically limited area of the world was surveyed for the occurrence of fungi on bryophytes; fungi on the underground axis, on the protonema and on the rhizoids are rarely collected; the morphological characters of bryophytes are crucial for colonization by fungi, in certain cases even a coevolution of both organisms can be assumed; biochemical and nutritional interactions between bryophytes and fungi are barely investigated.

3.1. Origin of moss and fungal material

The association of fungi with bryophytes was investigated in a geographically very limited area. Two of the main contributors to the knowledge of these associations, collected material mainly in Europe (Racovitza 1959, and Döbbeler with several publications). If other continents with other environmental characteristics would be included, the list of fungi would probably have increased dramatically. When the bryophytes originated from areas remote from Europe, e.g. from the tropics or antarctic regions, frequently moss specimens from herbaria were analyzed for their fungal associates. Fresh material could lead to interesting new discoveries. Bryophytes should be investigated immediately after collection and in different growth periods of the year. It is also clear, that bryophytes from herbaria cannot be representative, because usually healthy looking bryophytes are collected, thus excluding many fungal parasites.

Generally gametophytes and sporophytes of bryophytes were collected, underground parts of mosses, namely axis, protonema and rhizoids, rarely attracted interest. Thus, the fungal population at these sites is not known (Pocock et al. 1984). Looking at the list of

bryophytes investigated, only a few species, usually those easy to recognize and widely distributed, were analyzed for their fungal associates. Even on well known mosses, new fungi were found frequently. Looking from the mycologist's side, other problems arise (Singer 1975): "The citation of fungi (e.g. agarics or boletes), without study of the specimen, by anybody than a first rate specialist, is not a scientific document of any weight. Reducing our material by elimination of the doubtful, we finally arrive at a point where the material begins to become so scarce that in some cases conclusions can no more be drawn."

Although this review presents many references, general conclusions about the distribution of fungi are not drawn, because a statistical analysis such as the one carried out by Seidel (1982) for a defined geographical area is not possible with a limited number of samples. It is, however, clear that bryophilous Ascomycetes are obligatory living on mosses, they do not grow on other substrates like wood. Nevertheless, it should also be kept in mind that many associations could be coincidental because fungi and bryophytes frequently occur on the same substrates, notably decaying wood and litter.

3.2. Importance of morphological characters of bryophytes for the colonization by fungi

The morphological characters in the moss gametophyte are ecologically important (Schofield 1981). Leaf and stem structure can provide niches for fungi. A rough leaf surface with numerous crevices can be a trap for airborne particles. Niches for fungi can be so stable on bryophytes, that even a reduction of the capability to reproduce is tolerated by the fungi (Döbbeler 1980a). The position of fruiting bodies, the paths of hyphae and spore release are determined by the structure of the host (Döbbeler 1980b). Polytrichaceae are good hosts; they are highly differentiated, often big, and they offer much substrate and many sites for growth, especially in the crevices of the leaves. They are long living and thus, gametophyte regeneration is slow. In this way, a stable environment for fungi is maintained (Döbbeler 1979a & 1985b). In hepatics, fungi are exclusively intracellular at least in rhizoids; the lack of spread between host cells is most likely related to the absence of intercellular spaces (Pocock and Duckett 1985a). No examples have yet been found of mycelium covering the external surface of an hepatic, nor are hyphae present in epidermal cells (Pocock & Duckett 1985a). Frullaniaceae are said to belong to the best hosts among the hepatics and even the bryophytes (Döbbeler & Triebel 1985), which can probably be attributed to the existence of a large number of Frullaniaceae species. Morphological characteristics, however, could also be a reason. A thorough investigation was not carried out and statistical data for such statements were not available. *Plagiochila* ssp. are regarded as preferred substrates for many different fungi. It could, however, also be that this genus is easy to recognize and special attention was paid to fungi on this host (Döbbeler & Triebel 1985).

3.3. Contribution of fungi to the life of bryophytes and vice versa

All fungi are heterotrophs, whereas bryophytes are auxotrophs. Bryophytes can live in nutrient deficient areas, e.g. on rocks. Fungi of the genus *Pezizales*, among them especially *Octospora* ssp., prefer small, acrocarpous mosses as substrates, which can live in areas that offer only unfavorable conditions like a rocky or hot and frequently dry surface. These sites would otherwise be excluded as habitats for fungi. An unspecified fungus promotes the degradation of a stone surface, thus allowing the penetration of rhizoids (Hughes 1982). Nutrient deficient sites can be colonized by symbiotic associations of fungi and bryophytes (Daft & Nicolson 1974). As another example, peat bogs

form a hostile environment. Although fungi degrade peat mosses slowly (Czastukhin 1967) because *Sphagnum* cell walls are especially difficult to attack (Untiedt & Müller 1985), certain fungi preferentially live in peat bogs. These bogs, however, are never completely digested by fungi, rather peat accumulation is observed (Simon 1987).

The question about the nutrient economy of hosts and fungi is not answered. It was observed that certain fungi support bryophyte growth, such as mycorrhizal fungi (Hildebrand et al. 1978). Several reports about mycorrhiza-like fungi on bryophytes exist (Table 3). Little is known about the mycorrhizal status of mosses (Rabatin 1980). A similar relationship as with higher plants can be expected. There is growing evidence that many mycorrhizal fungi are non-specific and may have alternative hosts. Maybe they are also associated with bryophytes (Pocock & Duckett 1984). The growth of numerous hyphae from the swollen rhizoids of Lepidoziaceae into the adjacent organic matter invites the conclusion that the fungi have an important absorptive role (Pocock & Duckett 1985b, Pocock et al. 1984). By analogy with mycorrhiza in vascular plants, uptake of mineral ions comes to mind first, especially in view of the nutrient deficient conditions. The bulk of the biomass of some of these Lepidoziaceae species with swollen rhizoids comprises largely achlorophyllous axes. This raises the possibility that organic matter broken down by fungi might be translocated into the hepatics. Hepatics are predisposed for partnership with fungi, because they contain soluble carbohydrates (Pocock & Duckett 1985a). Set against the knowledge that the Hepaticae already boast a total parasite (*Cryptothallus mirabilis*) and a semi-parasite (the epiphyllous species *Radula flaccida* (Berrie & Eze 1975)), the notion of partial parasitism in the Lepidoziaceae invites further investigation.

Growth promotion of moss protonema by fungi is well known (Hahn & Bopp 1972, v. Maltzahn & McQuarrie 1958, Vaarama & Taren 1959), and often growth promoting compounds could be detected. A fungus isolated from a moss could improve the competitiveness of bryophytes (Kottke et al. 1976). Many of these observations were made under artificial conditions, so it is unknown whether it is also the case in nature.

Bryophytes are also capable of supporting fungal growth by providing a good microenvironment. Humidity is especially important for Myxomycetes (Stephenson & Studlar 1985). In the interior of a moss bed or at bryophyte parts close to the substrate, humidity is higher than at the top of the plants (Parke & Linderman 1980) and a particular pH is maintained (Hildebrand et al. 1978). The protected environment in a moss bed can give rise to problems for the fungus because the dispersal of spores into the environment is hindered (Döbbeler 1979c). Fungi seem to live on those parts of a moss which allow easy release of spores (Döbbeler 1987), and particular fungi may be found at the top of a bryophyte (Döbbeler 1981b & 1987).

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