CZECH MYCOLOGY

VOLUME 56
DECEMBER 2004

3–4

CZECH SCIENTIFIC SOCIETY FOR MYCOLOGY PRAHA

ISSN 1211-0981

Vol. 56, No. 3-4, December 2004

CZECH MYCOLOGY

formerly Česká mykologie

published quarterly by the Czech Scientific Society for Mycology
http://www.natur.cuni.cz/cvsm/

Czech Mycology is an international scientific journal publishing papers in all aspects of mycology. Publication in the journal is open to members of the Czech Scientific Society for Mycology and non-members.

Contributions to: Czech Mycology, National Museum, Mycological Department, Václavské nám. 68, 115 79 Praha 1, Czech Republic.

SUBSCRIPTION. Annual subscription is Kč 650,– (including postage). The annual subscription for abroad is US $ 86,– or EUR 83,– (including postage). The annual membership fee of the Czech Scientific Society for Mycology (Kč 500,– or US $ 60,– for foreigners) includes the journal without any other additional payment. For subscriptions, address changes, payment and further information please contact **The Czech Scientific Society for Mycology, P.O. Box 106, 111 21 Praha 1, Czech Republic. http://www.natur.cuni.cz/cvsm/**

This journal is indexed or abstracted in:
Biological Abstracts, Abstracts of Mycology, Chemical Abstracts, Excerpta Medica, Bibliography of Systematic Mycology, Index of Fungi, Review of Plant Pathology, Veterinary Bulletin, CAB Abstracts, Rewiew of Medical and Veterinary Mycology.

Czech Mycology Vol. 56, No. 1-2 appeared on August 12, 2004

CZECH MYCOLOGY
Publication of the Czech Scientific Society for Mycology

Volume 56 December 2004 Number 3–4

This number of Czech Mycology is dedicated to Olga Fassatiová to her 80th birthday

To the 80th birthday of Olga Fassatiová

Alena Kubátová

On 17th October 2004, Doc. RNDr. Olga Fassatiová, CSc. completed in good health the 80^{th} year of her life (*17. 10. 1924 in Prague). Our journal, Czech Mycology, wishes to send her its best regards and express thanks for her work in the editorial committee (1993–1999) and in the field of microscopic fungi.

Doc. Olga Fassatiová on the occasion of her visit to the Department of Botany, Charles University, Prague in October 2004 (photo K. Prášil).

In 1985, her sixtieth birthday was commemorated by Vlasta Čatská, and a list of her papers was published by Vladimír Skalický (Čatská and Skalický, Česká Mykologie, Praha, 39: 119–123). Now, I would like to point to several moments in her scientific and educational activities which contributed to the advancement of mycological knowledge.

Olga Fassatiová worked for several decades (since 1951 to her retirement in 1991) at the Department of Botany, Faculty of Science, Charles University, Prague as a teacher, lecturer and scientist.

Her research was focused both on taxonomy and ecology of saprotrophic hyphomycetes important for people (toxigenic micromycetes on foods and feeds, medically important fungi, i.e. opportunistic and allergenic fungi) and also on diversity of microfungi in natural substrates (e.g. in soil of our nature reserves).

I met her in 1980 and under her guidance I started learning about the fantastic world of microscopic fungi. During her time at the Department she trained many diploma students in diverse mycological topics. Her enthusiasm was an inspiration to the students; she always had an encouraging word or advice for us. Olga Fassatiová is often remembered not only by her former students but also by graduate workers in food, hygienic, veterinary or medical laboratories who took part in mycological courses in which she acted as the main organiser for many years. These courses were focused on systematics of fungi and also on identification of micromycetes important from the hygienic point of view.

Olga Fassatiová summarised her experience with microscopic fungi in the book "Moulds and filamentous fungi in technical microbiology", which was published in Czech and later also in Polish, Hungarian and English, and remained a very useful manual for a long time, not only for students but also for people in practice.

The Culture Collection of Fungi (CCF), which was established by O. Fassatiová in 1964, forty years ago, has had great importance in scientific as well as teaching activities. During the following years O. Fassatiová played an active role in the formation of the Federation of Czechoslovak Collections of Microorganisms (FCCM) and supported the role of the FCCM as an "umbrella society" for culture collections. Under her guidance, the CCF joined the World Federation of Culture Collections (WFCC) in 1972, and in 1985 also the European Culture Collection Organization (ECCO).

For her great experience in many aspects of the life of microscopic fungi, she was often invited to collaborate with colleague mycologists or other specialists. Her friendly nature and goodwill made it easy for others to work with her. Her collaboration with foreign mycologists, mainly from the Centraalbureau voor Schimmelcultures (CBS), The Netherlands was very important.

The genus *Penicillium* was one of the main research topics of Olga Fassatiová. She was one of the first mycologists who, in the 1970s, pointed to the unsatisfactory situation in the taxonomy of the genus *Penicillium*, especially in the group of asymmetric penicillia.

Her detailed study of micromycetes resulted in the description of several new species (e.g. *Sagenomella bohemica* Fassatiová et Pěčková 1990).

A cross-section of her scientific work in mycology can be found in her habilitation thesis "Filamentous micromycetes in natural and anthropogenic biocenoses" (1991).

Her rich bibliography has strongly increased during the past twenty years (see below). Although many of her articles were not published in "impact journals", her papers have a high quoting rate, as one can see on the Internet's ISI Web of Science. Up to now, Olga Fassatiová is the author or co-author of more than 60 original scientific papers (over 30 were published in Česká Mykologie and later in Czech Mycology), author of the book on micromycetes (several editions) and also of chapters in several textbooks.

Teaching activities (including mycological courses and other lectures for the mycological community), research in the field of microscopic fungi and culture collection as the base for this work originated into the creation of an important educational and research centre for microscopic fungi in our country, which is one of the essential merits of Olga Fassatiová.

Olga Fassatiová is known as a very kind, friendly, and extremely arduous woman and a well-known specialist in micromycetes. We offer our congratulations to Olga and wish her good health in the coming years.

Bibliography of Olga Fassatiová since 1984

1984

Fassatiová O. (1984): Penészek és fonalasgombák az alkalmazott mirkobiológiában. – 225 p. + 27 tab. Budapest. [Hungarian translation by M. Sipiczky]

Fassatiová O. (1984): Ramirez C.: Manual and atlas of Penicillia. Amsterdam 1982. – Čes. Mykol. 38: 20. [book rewiew]

1985

Fassatiová O. (1985): Dosavadní studium taxonomie čeledi Moniliaceae v ČSSR a jeho současný stav. – In: Šebek S. (ed.), Dosavadní vývoj, současný stav a perspektivy studia mikromycetů v ČSSR, p. 11–17, Praha.

Fassatiová O. (1985): Evaluation of some morphological features of asymmetric penicillia of different media. – In: Samson R. A. and Pitt J. I. (eds.), Advances in Penicillium and Aspergillus systematics, p. 105–111, New York and London.

Veselý D., Veselá D., Fassatiová O. and Neumannová V. (1985): Produkce sekalonové kyseliny D kmeny Penicillium oxalicum a její toxické účinky na kuřecí zárodek. – Veter. Med. 30: 571–575.

1986

Beranová M., Veselý D., Veselá D. and Fassatiová O. (1986): Mikromycety znehodnocující některé tuzemské sýry. – Čs. Hyg. 31: 159–166.

Fassatiová O. (1986): Moulds and filamentous fungi in technical microbiology. – 233 p. Amsterdam etc. [English translation by J. Spížek]

Lýsek H., Fassatiová O. and Nigenda-Lopez G. (1986): Autodehelminthizing capacity of soils in two Mexican localities. – Helminthologia 23: 237–241.

1987

Fassatiová O., Kubátová A., Prášil K. and Váňová M. (1987): Mikroskopické houby v archivním prostředí. – Čes. Mykol. 41: 8–15.

Prnková E. and Fassatiová O. (1987): Mykoflora sušených práškových potravin. – In: Sborník Československé společnosti mikrobiologické, komise potravinářské mikrobiologie, seminář "Nové laboratorní přístupy v mikrobiologii potravin", p. 75–79, Liblice.

1988

Fassatiová O. (1988): Thermofilní druhy mikromycetů, které mohou napadat potraviny. – In: Zkušenosti s novými laboratorními přístupy v mikrobiologii potravin, p. 81–84, Praha.

Fassatiová O. (1988): Toxinogenní druhy rodu Penicillium Link a klíč k určení běžněji se vyskytujících zástupců v Čechách. – Čes. Mykol. 42: 12–22.

Novotná J. and Fassatiová O. (1988): Tři druhy rodu Penicillium Link izolované z cyst Globodera rostochiensis Woll. v Československu. – Čes. Mykol. 42: 90–96.

1989

Fassatiová O. (1989): Metodika a problematika určování zástupců rodu Penicillium. – In: Prášil K. (ed.), Problematika a metodika determinace některých skupin mikroskopických hub, p. 28–33, Praha.

Fassatiová O., Klán J., Prášil K., Skalický V. and Urban Z. (1989): Houby. – In: Křísa B. and Prášil K. (eds.), Sběr, preparace a konzervace rostlinného materiálu. Ed. 2., p. 51–148, Praha.

Fassatiová O. and Kubátová A. (1989): Evaluation of the diagnostical features of some Penicillium species of section Divaricata. – In: Second International Penicillium and Aspergillus NATO Workshop, May 8–12, 1989, Programme and Abstracts, p. 13–14, Baarn.

Pěčková M. and Fassatiová O. (1989): Die Mikromyceten in den böhmischen Peloiden. – Balneol. Bohem. 18(1): 10–21.

1990

Fassatiová O. (1990): V. I. Bilaj and E. E. Koval, Aspergilly. Kiev 1988. – Čes. Mykol. 44: 190. [book rewiew]

Fassatiová O. (1990): Soil micromycetes. – In: Osbornová J. et al. (eds.), Succession in abandoned fields, p. 53–54, Dordrecht etc.

Fassatiová O. and Kubátová A. (1990): Evaluation of the diagnostic features of some species of Penicillium section Divaricatum. – In: Samson R. A. and Pitt J. I. (eds.), Modern concepts in Penicillium and Aspergillus classification, p. 149–157, New York and London.

Fassatiová O. and Pěčková M. (1990): Sagenomella bohemica Fassatiová et Pěčková sp. n. (Moniliales). – Čes. Mykol. 44: 240–242.

1991

Fassatiová O. (1991): K šedesátinám RNDr. Ludmily Marvanové, CSc. – Čes. Mykol. 45(3): 123–127.

Fassatiová O., Kubátová A., Prášil K. and Váňová M. (1991): Catalogue of strains. Ed. 3. – 100 p. Praha.

Fassatiová O., Pěčková M., Prášil K. and Váňová M. (1991): Rare micromycetes findings from Bohemian peloids. – Novit. Bot. Univ. Carol. 6/1990: 21–31.

Fassatiová O. (1991, oppon. 1992): Vláknité mikromycety v přirozených a antropogenních biocenosách. – Ms., 443 p. [Habilit. thesis, depon. in: Library Dep. Bot., Charles University, Prague]

1993

Fassatiová O. and Kotlaba F. (1993): In memoriam of Dr. Věra Holubová-Jechová (1936–1993). – Čes. Mykol. 47(1): 81–88.

Fassatiová O., Prášil K. and Váňová M. (1993): Appendix 4. Ergebnisse der Analyse von Mikromyzelien im Material frühmittelalterlicher Gräber. – In: Staššíková-Štukovská D., Neue Erkenntnisse zur Dekomposition menschlicher Skelette am Beispiel des frühmittelalterlicher Gräberfeldes von Borovce, Slowakei. – Praehist. Zeitschrift 68(2): 261.

1994

Fassatiová O. (1994): Federace československých sbírek mikroorganismů – historie a dnešní stav. – Bull. Čs. Spol. Mikrobiol. 35(3): 167–175.

Fassatiová O. (1994): Micromycetes in archives and in depots of libraries in Czech Republic. – In: 7th international congress of bacteriology and applied microbiology division, 7th international congress of mycology division, Prague, Czech Republic, July 3rd-8th, 1994, Abstract book, p. 475.

Fassatiová O. and Kálalová S. (1994): Federation of culture collections of microorganisms (FCCM). – In: 7th international congress of bacteriology and applied microbiology division, 7th international congress of mycology division, Prague, Czech Republic, July 3rd-8th, 1994, Abstract book, p. 524.

Fassatiová O., Klán J., Prášil K., Skalický V. and Urban Z. (1994): Houby. – In: Křísa B. and Prášil K. (eds.), Sběr, preparace a konzervace rostlinného materiálu. Ed. 3., p. 46–125, Praha.

Fassatiová O. and Prášil K. (1994): Doc. RNDr. Vladimír Skalický has passed away... – Czech Mycol. 47(2): 171–172.

1995

Fassatiová O. (1995): Micromycetes in archives and book depositories in the Czech Republic. – Czech Mycol. 48(1): 77–86.

Fassatiová O. (1995): Úvodní slovo. – In: Kubátová A. and Prášil K. (eds.), Současný stav, využití moderních metod a perspektivy studia rodu Penicillium, p. 1–2, Praha.

Fassatiová O. (1995): Nomen conservandum u rodu Penicillium. – In: Kubátová A. and Prášil K. (eds.), Současný stav, využití moderních metod a perspektivy studia rodu Penicillium, p. 15–17, Praha.

1998

Fassatiová O. (1998): Historie Federace českých a slovenských sbírek mikroorganismů (FCCM) a její dnešní stav. – In: Ebringer et al. (eds.), Kapitoly z historie československé mikrobiologie, p. 81–99, Praha.

Fassatiová O. (1998): Sbírky živých mikroorganismů. – Živa 46(4): LXVI-LXVII.

2000

Kubátová A., Váňová M., Prášil K. and Fassatiová O. (2000): Microfungi contaminating foods with low water content. – Novit. Bot. Univ. Carol., 13/1999: 13–25.

CZECH MYCOL. 56 (3–4), 2004

The arachnogenous fungus Gibellula leiopus – second find from the Czech Republic

ALENA KUBÁTOVÁ

Department of Botany, Faculty of Science, Charles University,
Benátská 2, 128 01 Praha 2, Czech Republic
kubatova@natur.cuni.cz

Kubátová A. (2004): The arachnogenous fungus Gibellula leiopus – second find from the Czech Republic. – Czech Mycol. 56: 185–191

The microfungus *Gibellula leiopus* (*Clavicipitaceae*, Hypocreales, Ascomycota) known from spiders was found after a long period for the second time in the Czech Republic. The first find was recorded by O. Fassatiová in 1959. Both Czech specimens have whitish synnemata with conidiophores. The teleomorph (*Torrubiella leiopus*) was not observed. A short description of microscopic features and photographs is given. The specimens are deposited at the Herbarium of Department of Botany, Charles University, Prague (PRC).

Key words: micromycetes, Ascomycota, *Torrubiella*, anamorphic fungi, *Gibellula leiopus*

Kubátová A. (2004): Arachnogenní houba Gibellula leiopus – druhý nález v České republice. – Czech Mycol. 56: 185–191

Mikroskopická houba *Gibellula leiopus* (*Clavicipitaceae*, Hypocreales, Ascomycota) vyskytující se na pavoucích byla podruhé po delší době nalezena v České republice. První nález byl zaznamenán O. Fassatiovou v roce 1959. Oba české nálezy se vyznačují bělavým zbarvením synnemat s konidiofory. Teleomorfa *(Torrubiella leiopus)* nebyla pozorována. Položky jsou uloženy v herbáři katedry botaniky Univerzity Karlovy v Praze (PRC).

INTRODUCTION

Gibellula is a hyphomycete genus belonging (after Kirk et al. 2001) to the anamorphic *Clavicipitaceae* (Hypocreales, Ascomycota). It was described by Cavara (1894). Other important publications on *Gibellula* species are those by Petch (1932), Mains (1950), Samson and Evans (1977, 1992), Kobayashi and Shimizu (1982), Humber and Rombach (1987) and Tzean et al. (1997a, 1998). A dichotomic key to 10 species based on morphological features was published by Samson and Evans (1992). In the database IndexFungorum (The CABI Bioscience and CBS Database of Fungal Names), 36 records of species and variety names were mentioned in June 2004. Currently, about 16 species are accepted (Hodge 2003). About half of *Gibellula* species are connected with a *Torrubiella* teleomorph, a pyrenomycetous ascomycete with perithecia. *Gibellula* forms usually synnemata bearing aspergilloid or penicillate conidiophores with phialidic conidiogenous cells.

Some species form a polyblastic synanamorph named *Granulomanus* (Evans and Samson 1987). All species are considered to be pathogenic for spiders.

The morphologically similar genus *Pseudogibellula* (Samson and Evans 1973, Samson et al. 1989) differs in conidial ontogeny (the conidia are produced singly and sympodially) and ecology (occurrence not only on spiders but also on ants, froghoppers and other insects).

Gibellula leiopus (Vuill. ex Maubl.) Mains is associated with the teleomorph *Torrubiella leiopus* (Mains) Y. Kobayasi et D. Shimizu (Kobayasi and Shimizu 1982). It is considered a common *Gibellula* species (together with *G. pulchra* (Sacc.) Cavara) in temperate regions (Hodge 2003), but compared with other microfungi it is somewhat rare. From the Czech Republic (a part of former Czechoslovakia) it was published for the first time by Fassatiová (1960). The present record of *G. leiopus* in Karlík valley (Central Bohemia) is considered to be the second one in the Czech Republic.

The aim of this brief paper is to present the morphology and ecology of our specimen.

Materials and Methods

A minute cadaver of an arthropod (identification of the host was not possible) with whitish synnemata was collected on 22^{nd} May 2002 in leaf litter in a mixed forest near the village of Karlík, c. 20 km SW of Prague, central Bohemia, Czech Republic (49°56'15"N, 14°15'30"E). The specimen is deposited in the Herbarium of the Department of Botany, Charles University, Prague (PRC).

Microscopic features were observed in lactic acid with cotton blue. Photographs were taken on an Olympus BX-51 microscope using Nomarski contrast.

Results and Discussion

Gibellula leiopus (Vuill. ex Maubl.) Mains

Gibellula arachnophila f. *leiopus* Vuill. ex Maubl., Bull. Soc. Mycol. Fr. 36: 42, 1920

Gibellula leiopus (Vuill. ex Maubl.) Mains, Mycologia 42: 313, 1950

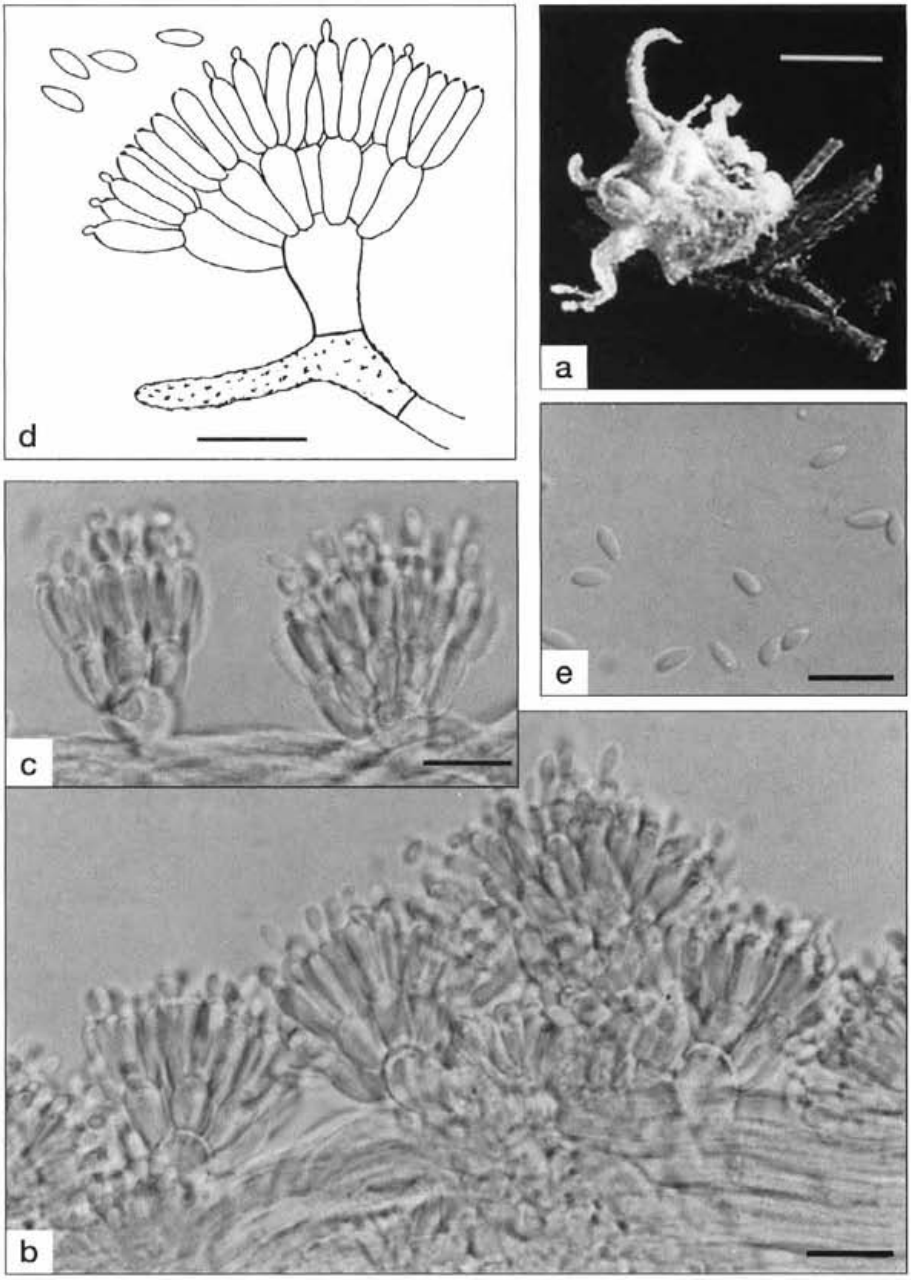

Fig. 1. *Gibellula leiopus;* a – herbarium specimen (PRC), short synnemata growing from remains of arthropod cadaver (bar = 1 mm); b – aspergilloid conidiophores densely growing from the middle part of the synnema; c – single aspergilloid conidiophores arising laterally on the terminal part of the synnema; d – conidiophore on roughened hypha; e – conidia (b-e: bar = 10 μm).

Morphological characteristics of our specimen and distinguishing features

The remains of the host body are covered with white mycelium from which several whitish conical to cylindrical synnemata 1–2 mm long arise (Fig. 1a). The conidiophores (Fig. 1b, c, d) are very short, septate, growing from verrucose, arched hyphae. The terminal part of the conidiophores is broadened to a vesicle, 6–10 μm diam., bearing metulae (also prophialides) on the upper part. The metulae are broadly clavate, often swollen, 7–10 × 4–6 μm. Each metula bears several phialides. These are cylindrical, 7–11 × 2–2.4 μm, thickened at the apex. Conidia (Fig. 1e) are ellipsoidal to clavate, 4–5 × 1.8–2 μm, produced in chains. All conidiophore structures are hyaline. The teleomorph and polyblastic state were not observed.

Very short conidiophores and absence of a polyblastic state are characteristic of this species. The similar species *G. globoso-stipitata* Kobayasi et Shimizu and *G. clavata* Samson et H. C. Evans also have short conidiophores (Kobayasi and Shimizu 1982, Samson and Evans 1992), however the former forms globose metulae and the latter forms a polyblastic state in addition. Four other species lack the polyblastic state: *G. alata* Petch, *G. globosa* Kobayasi et Shimizu, *G. mainsii* Samson et H. C. Evans and *G. pulchra* (Sacc.) Cavara. They also differ from *G. leiopus* by long conidiophores (Petch 1932, Kobayasi and Shimizu 1982, Samson and Evans 1992, Tzean et al. 1997a).

The microscopic characters in our specimen are in general agreement with those seen by Fassatiová (1960), Samson and Evans (1973), Bałazy (1979) and Tzean et al. (1997a,b). However, some difference was observed in the colour of the synnemata. Samson and Evans (1973) pointed at the characteristic deep lilac colour of the synnemata in this species, however Tzean et al. (1997a) mentioned a white to pale orange colour of the synnemata. For comparison we observed the specimen of Fassatiová found in south Bohemia in 1959 and deposited in PRC (Prague). It has whitish synnemata with a pale orange tint. Fassatiová (1960) considered her record as a possibly white variant of *G. leiopus*. Another explanation could be that our specimens are not fully mature; the absence of the teleomorph suggests that.

Notes on ecology and distribution

The host of our specimen is too small, so it was not possible to determine if it belongs to a spider or an insect. Generally, *Gibellula leiopus* is considered to be an arachnogenous fungus. Due to the parasitic life style it is not able to grow on common media. An attempt of the author to cultivate this fungus failed just as in the case of Samson and Evans (1973) and Bałazy (1970). Only one

strain (CBS 602.75) is known to be maintained in a culture collection (CBS Fungi database 2004).

Gibellula leiopus is known from many regions of the world, but it has been recorded rarely. It was found in North America: USA (Mains 1950), South America: Trinidad (Evans and Samson 1987), in Europe: Czech Republic (Fassatiová 1960), Poland (Bałazy 1970), France (in 1975, CBS Fungi database 2004), Sweden (Lundquist 1998), Greece (Scheuer 2000), in Africa: Ghana (Samson and Evans 1973), and in Asia: Kuril Islands (Koval' 1974) and Taiwan (Tzean et al. 1997a,b).

ACKNOWLEDGEMENTS

This study was supported by the Ministry of Education of the Czech Republic (MSM 113100004).

REFERENCES

BAŁAZY S. (1970): Gibellula leiopus (Vuillemin in Maublanc) Mains – the fungus pathogenic for spiders. – Acta Mycol. 6: 71–76.

CAVARA F. (1894): Ulteriore contribuzione alla micologia Lombarda. – Atti Ist. Bot. Univ. Pavia Ser. II, 3: 313–350.

CBS Fungi database (2004). http://www.cbs.knaw.nl

EVANS H. C. and SAMSON R. A. (1987): Fungal pathogens of spiders. – The Mycologist 1: 152–159.

FASSATIOVÁ O. (1960): Několik poznámek k novým nálezům některých imperfektních druhů ze skupiny Hyphomycetes (Neue Funde von imperfekten Pilzen aus der Hyphomyceten-Gruppe). – Čes. Mykol. 14(3): 193–197.

HODGE K. T. (2003): Clavicipitaceous anamorphs. – In: White J. F. Jr., Bacon Ch. W., Hywel-Jones N. L. and Spatafora J. W. (eds.), Clavicipitalean fungi. Evolutionary biology, chemistry, biocontrol, and cultural impacts, p. 75–123, New York and Basel.

HUMBER R. A. and ROMBACH M. C. (1987): Torrubiella ratticaudata sp. nov. (Pyrenomycetes: Clavicipitales) and other fungi from spiders on the Solomon Islands. – Mycologia 79: 375–382.

IndexFungorum (2004). The CABI Bioscience and CBS Database of Fungal Names. http://www.indexfungorum.org

KIRK P. M., CANNON P. F., DAVID J. C. and STALPERS J. A. (2001): Dictionary of the fungi. 9th ed. – 655 p. Wallingford.

KOBAYASI Y. and SHIMIZU D. (1982): Monograph of the genus Torrubiella. – Bull. Nat. Sci. Mus., Tokyo, Ser. B, 8: 43–78.

KOVAL' E. Z. (1974): Opredělitěl entomofil'nych gribov SSSR. – 258 p. Kiev.

LUNDQUIST N. (1998): Gibellula – a spider enemy. – Jordstjärnan 19: 15–18.

MAINS E. B. (1950): The genus Gibellula on spiders in North America. – Mycologia 42: 306–321.

PETCH T. (1932): Gibellula. – Ann. Mycol. 30: 386–393.

SAMSON R. A. and EVANS H. C. (1973): Notes on entomogenous fungi from Ghana. I. The genera Gibellula and Pseudogibellula. – Acta Bot. Neerl. 22: 522–528.

SAMSON R. A. and EVANS H. C. (1977): Notes on entomogenous fungi from Ghana. IV. The genera Paecilomyces and Nomuraea. – Proc. Koninkl. Nederl. Akad. Wetensch., ser. C, 80: 128–134.

SAMSON R. A. and EVANS H. C. (1992): New species of Gibellula on spiders (Araneida) from South America. – Mycologia 84: 300–314.

SAMSON R. A., REENEN-HOEKSTRA E. S. VAN and EVANS H. C. (1989): New species of Torrubiella (Ascomycotina: Clavicipitales) on insects from Ghana. – Stud. Mycol. 31: 123–132.

SCHEUER CH. (2000): Alphabetical index and schedae emendatae to the exsiccata series Plantae graecenses (http://www-ang.kfunigraz.ac.at/scheuer/plagraec.htm). – Graz, Austria: Institut für Botanik der Karl-Franzens-Universität.

TZEAN S. S., HSIEH L. S. and WU W. J. (1997a): The genus Gibellula on spiders from Taiwan. – Mycologia 89: 309–318.

TZEAN S. S., HSIEH L. S. and WU W. J. (1997b): Atlas of entomopathogenic fungi from Taiwan. – 215 p. Taipei.

TZEAN S. S., HSIEH L. S. and WU W. J. (1998): Torrubiella dimorpha, a new species of spider parasite from Taiwan. – Mycol. Res. 102: 1350–1354.

CZECH MYCOL. 56 (3–4), 2004

New hyphomycete species from streams in the Šumava National Park (Bohemian Forest, Czech Republic)

LUDMILA MARVANOVÁ

Czech Collection of Microorganisms, Tvrdého 14, 602 00 Brno, Czech Republic
ludmila@sci.muni.cz

Marvanová L. (2004): New hyphomycete species from streams in the Šumava National Park (Bohemian Forest, Czech Republic). – Czech Mycol. 56: 193–202

Three new species, *Enantioptera bialata, Tricellula ornata* and *Tricladium obesum*, are described on the basis of pure cultures derived from conidia isolated from stream foam. All occur in clean, softwater streams in a temperate climate.

Key words: mitosporic fungi, new taxa, *Enantioptera, Tricellula, Tricladium*.

Marvanová L. (2004): Nové druhy hyfomycetů z potoků Národního parku Šumava. – Czech Mycol. 56: 193–202

Na bázi čistých kultur izolovaných z pěny na potocích jsou popsány tři nové druhy hyfomycetů: *Enantioptera bialata, Tricellula ornata* a *Tricladium obesum*. Všechny se vyskytují v mírném pásmu v čistých potocích s měkkou vodou.

INTRODUCTION

Biodiversity studies of freshwater hyphomycetes in the temperate zone usually reveal at least several unknown spores, very probably belonging to undescribed fungi. In spite of the fact that in waters on the European continent the freshwater mycobiota is relatively well known, authors publishing lists of taxa collected in foam usually report and illustrate tens of undescribed species (e.g. Descals et al. 1995, Descals 1998, Voglmayr 1996, Marvanová and Gulis 2000, Marvanová 2001). The following formal descriptions presented here should diminish the number of some "unknowns" reported several times by various authors. These new species were isolated from running waters in the Šumava National Park.

MATERIALS AND METHODS

Foam samples were collected into glass jars. Inoculations were performed in the field or the same day after return to the laboratory. The foam was smeared on thin layers of 0.1 % malt agar (MA, Difco), on object slides. After incubation at c. 10 °C for 1–2 days, the agar layers were scanned under low power of a compound

microscope. Germinating conidia were cut out with a flamed needle together with a piece of agar and transferred to Petri dishes with 2 % MA. All isolates were monoconidial. Descriptions of colonies are based on pure cultures on 2 % MA incubated at 15 °C. Sporulation was obtained by submerging pieces of agar cultures into standing sterile distilled water in Petri dishes, incubated at 15–18 °C in diffuse daylight.

RESULTS AND DISCUSSION

Enantioptera bialata Marvanová sp. nov. Fig. 1.

Etym.: bialatus (L.) = double-winged.

Fungi anamorphosi, hyphomycetosi. Teleomorphosis ignota.

Coloniae ad agarum maltosum albae, restrictae, mycelium aerium gossypinum, margine abrupto, parte reversa pallide brunnea. Sporulatio subaquatica. Conidiophora micronematosa. Cellulae conidiogenae breves, terminales vel intercalares, cum elongationibus sympodialibus. Conidia singularia vel usque ad tres per cellulam conidiogenam, tetraradiata. Axis cylindricus, rectus vel paulo curvatus, 18–25 × 1–2 μm, apice subulatus, basi truncatus, uniseptatus, rami typice duo, laterales, mediani, suboppositi vel paralleli, subulati, basi non constricti, 7–11 × 1–1.5 μm. Dehiscentia conidiorum schizolytica.

Anamorphic fungi, hyphomycetes, teleomorph unknown.

Colonies on MA 2 % white, restricted, reaching 12 mm diam. after 19 days at 12 °C, aerial mycelium low, cottony, margin abrupt, reverse beige. Sporulation after submergence, under water. Conidiophores micronematous. Conidiogenous cells short, terminal or intercalary with a lateral peg, sympodial, elongations few. Conidia single or in groups of up to 3 per conidiogenous cell, tetraradiate. Axis cylindrical, straight, arcuate or slightly bent at branch insertion, 18–25 × 1–2 μm, with a single septum between the branches, subulate above the branches, base truncate or rounded. Branches typically two, lateral, median, synchronous, subopposite, in one plane or divergent, sometimes unilateral and then either parallel or appearing crossed when seen in preparations, subulate, 7–11 × 1–1.5 μm, insertion unconstricted. Conidial secession schizolytic.

Holotype: PRM 901637 (preparation from the culture CCM F-23899), Czech Republic, South Bohemia, Šumava National Park, foam on the left branch of the stream Křemelná, near the road from the perished settlement Zhůří to Stará Huť, above the confluence with the right branch, c. 850 m alt., 19–10–1998 coll. and isol. L. Marvanová.

Detached conidia of this species were relatively frequently encountered in foam on streams of the catchment areas of the upper Vltava and upper Otava rivers (Marvanová 2001).

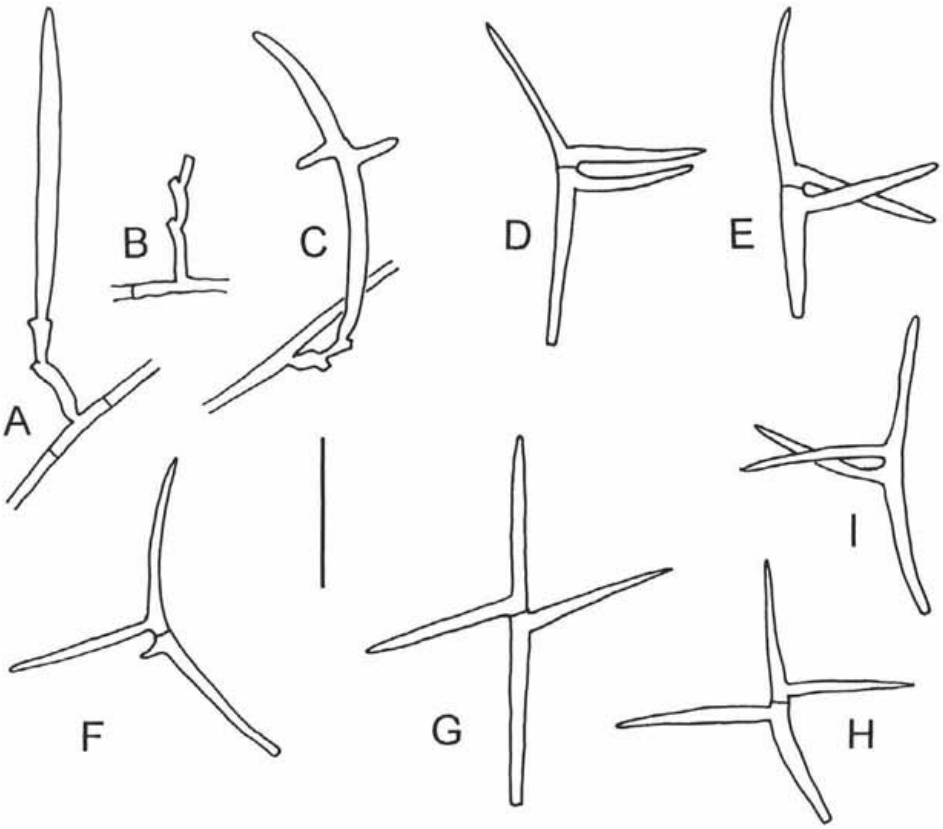

Fig. 1. *Enantioptera bialata* CCM F-23899. A. Conidial primordium. B. Spent conidiophore. C. Young conidium developing two lateral branches. D-I. Detached conidia. Some appear with unilateral branching (D-F, I), the rest has subopposite arms. Scale bar = 10 μm.

Conidia of *Enantioptera bialata* are similar to those of *E. tetraalata* Descals, the type and so far the only species of the genus. The latter differs by typically two parallel laterals on both sides of the conidial axis which is longer: 30–38 μm given in the protologue (by Descals and Webster 1983), but in their Fig. 2S according to the scale bar it reaches 47 μm. The generic character of *Enantioptera*, i.e. two opposite pairs of laterals perpendicularly attached to the conidial axis is very unique among hyphomycetes. Adding a species with just a single pair of laterals seems inappropriate at first sight. However, *E. tetraalata* itself is very variable, often producing conidia with one pair of laterals missing.

Conidia strongly resembling those of *E. bialata* were depicted by Regelsberger et al. (1987: Fig. $3C_1$-C_6 , as 'close to *Taeniospora*') and by Marvanová and Gulis (2000: Fig. 3H, with longer axis and branches, as unknown) from the Ysper

stream in Austria. The fungus isolated in Canada (Marvanová and Bärlocher 1988: Fig. 6A-L) in pure culture and considered a monocaryon of *Taeniospora descalsii* Marvanová et Stalpers was very probably *E. bialata*. The white colony with low cottony mycelium supports this opinion. Unfortunately the Canadian culture is no more viable and therefore no comparison of colony character of both isolates is possible at the moment.

Enantioptera bialata conidia are somewhat similar to those of *Arborispora paupera* Marvanová et Bärl., but here the conidial branches are sequential, branch bases are obconic and hence the insertion is very narrow (Marvanová and Bärlocher 1989). *Descalsia cruciata* A. Roldán et Honrubia has sequential conidial branches which are subopposite, never unilateral.

Tricellula ornata Marvanová sp. nov. Fig. 2.

Etym.: ornatus (L.) = decorated.

Fungi anamorphosi, hyphomycetosi. Teleomorphosis ignota.

Coloniae ad agarum maltosum albidae, restrictae, pars reversa isabellina. Hyphae in substrato 1–7 μm latae. Sporulatio subaquatica. Conidiophori laterales, curti, ramosissimi, ad septa constricti. Cellulae conidiogenae polyblasticae, acrogenae vel pleurogenae, ellipsoideae, 5–9 × 2–3 μm. Conidia stauroformia, aggregata, acro– vel pleurogena, sequentia. Ramus primus ellipsoideus, ramum apicalem duoque ramos laterales gerens. Ramus apicalis sagittiformis, rami laterales sequentes, retrorsi, inaequilaterales, lobati; rami toti per isthmos angustos cum axe connecti. Conidia tota 11–17 μm in diam. Dehiscentia schizolytica.

Anamorphic fungi, hyphomycetes. Teleomorph unknown.

Colonies on MA 2 % off white, restricted, reaching 6 mm diam. after 16 days at 15 °C, aerial mycelium elevated in the centre, finely funiculose, margin low, exudate copious, clear, reverse isabelline. Substrate mycelium with hyphae 1–7 μm wide, some cells inflated. After submergence the colony gains a pale bluish-green tinge. Sporulation underwater, copious. Conidiophores lateral, short, profusely branched, strongly constricted at septa. Conidiogenous cells polyblastic, acrogenous and pleurogenous, in groups, ellipsoidal, 5–9 × 2–3 μm. Conidia stauroform, in groups, acrogenous or pleurogenous, closely sequential. First formed arm ellipsoidal, bearing one apical and two lateral arms, the apical one sagittate, with more or less wavy side walls, the lateral arms sequential, wing-shaped, retrorse, usually appearing lobed due to various irregularly disposed projections. All arms connected by narrow isthmi. Conidial span 11–17 μm, secession schizolytic.

Holotype: PRM 901638 (preparation from the culture CCM F-15299), Czech Republic, South Bohemia, Šumava National Park, foam on the stream Mlýnský

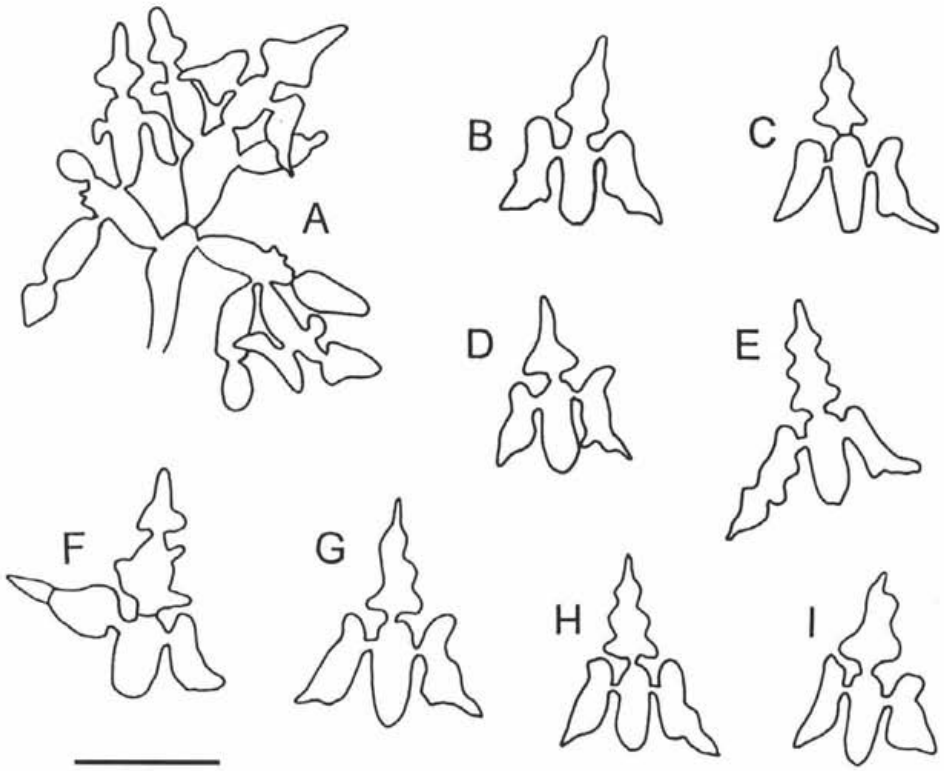

Fig. 2. *Tricellula ornata* CCM F– 15299. A. Conidiophore with conidiogenous cells and conidia in various stages of development. B-I. Detached conidia. Scale bar = 10 μm.

potok, near the bridge on the road from Prášily to Srní, near the perished settlement Velký Bor, c. 900 m alt., 19–10–1998 coll. and isol. L. Marvanová.

Besides the type locality, conidia of this species were seen only in a single foam sample from a stream in the upper Vltava river catchment area (Marvanová 2001).

This fungus has all features of a member of the genus *Tricellula*, but the colony lacks the orange pigment which is typical for the other species of this genus. Morphologically it differs from all other members of the genus by the lobed conidial arms. In permanent preparations with lactofuchsin as the mountant, the conidiogenous cells tend to swell considerably and the wavy outline of conidial elements becomes much less pronounced.

Roldán and Puig (1992: Figs. 3G and 5C,D) and Descals (1987: Fig. 5G,H; 1997: Fig. 19) illustrated very similar conidia of a *Tricellula* sp. with less lobed arms from Spain which may be conspecific. However, they did not see the conidiogenesis and the colony of Descals' fungus was described as pale orange. Matsushima (1971)

classified a fungus with very similar but larger and more symmetrical conidia tentatively as *Isthmotricladia* sp. His isolate differs from ours by the conidiogenesis: conidia arise singly on micronematous conidiophores. The accommodation in *Isthmotricladia* seems not appropriate, because the latter is characterised by conidia with a fascicle of antrorse branches on a stalk.

Tricladium obesum Marvanová sp. nov. Fig. 3.

Etym.: obesus (L.) = fat.

Fungi anamorphosi, hyphomycetosi. Teleomorphosis ignota.

Coloniae ad agarum maltosum atrae, medium celeriter crescentes, mycelium aerium copiosum, funiculosum, pars reversa nigra. Mycelium in substrato brunneum, hyphis glabris, sed nonnullis verrucosis. Sporulatio sub– vel supraaquatica.

Status macroconidialis: Conidiophora micronematosa, cellulae conidiogenae mono– vel polyblasticae, terminales vel laterales, cum conidiophoris conidiisque integratae, elongationes sympodiales vel prolificantes. Conidia singularia vel duo per cellulam conidiogenam, ramificata, ex uno axi et (1-)2 ramis consistentia. Elementa conidialia septata vel continua, cellulis inflatis, apicibus obtusis vel subulatis. Axis saepe subcurvatus, 40–63(-90) × 5–10 μm, basi truncatus vel mamillatus. Rami alternati, sequentes, raro oppositi, recti vel subcurvati; ramus proximus 5.5–40 × 4–6.5 μm, ramus distalis 5–16 × 3.5–5 μm, basi subconstricti. Dehiscentia conidiorum schizolytica.

Status microconidialis: hyphomycetosus. Conidiophora semimacronematosa, terminalia, recta, ca. 2 μm lata. Cellulae conidiogenae acrogenae, aggregatae vel singulares, phialidicae, 9–17 × 2–3.5 μm, cum collare cupulato. Conidia aggregata, ellipsoidea, glabra, 3–5 × 1.5–2 μm.

Anamorphic fungi, hyphomycetes. Teleomorph unknown, probably ascomycetous.

Colonies on MA 2 % dark grey, reaching 20 mm diam. after 20 days at 15 °C, aerial mycelium hairy to funiculose, reverse blackish. Substrate mycelium brown, with thicker walls, some hyphae finely warty. Sporulation after submergence, under and above water.

Macroconidial state: conidiophores micronematous, conidiogenous cells mono– or polyblastic, terminal or lateral, integrated with conidiophores as well as with the conidia, elongations sympodial or percurrent. Conidia single or rarely two per conidiogenous cell, branched, with one axis and (1-)2 laterals. In pure culture sporulating in standing distilled water, the distal branch is often absent. Conidial elements septate or continuous, cells often inflated, apices rounded to subulate. Axis usually slightly bent, 40–63(-90) × 5–10 μm, base flat or with a teat or short conical extension. Branches single or alternate when two, appearing in acropetal

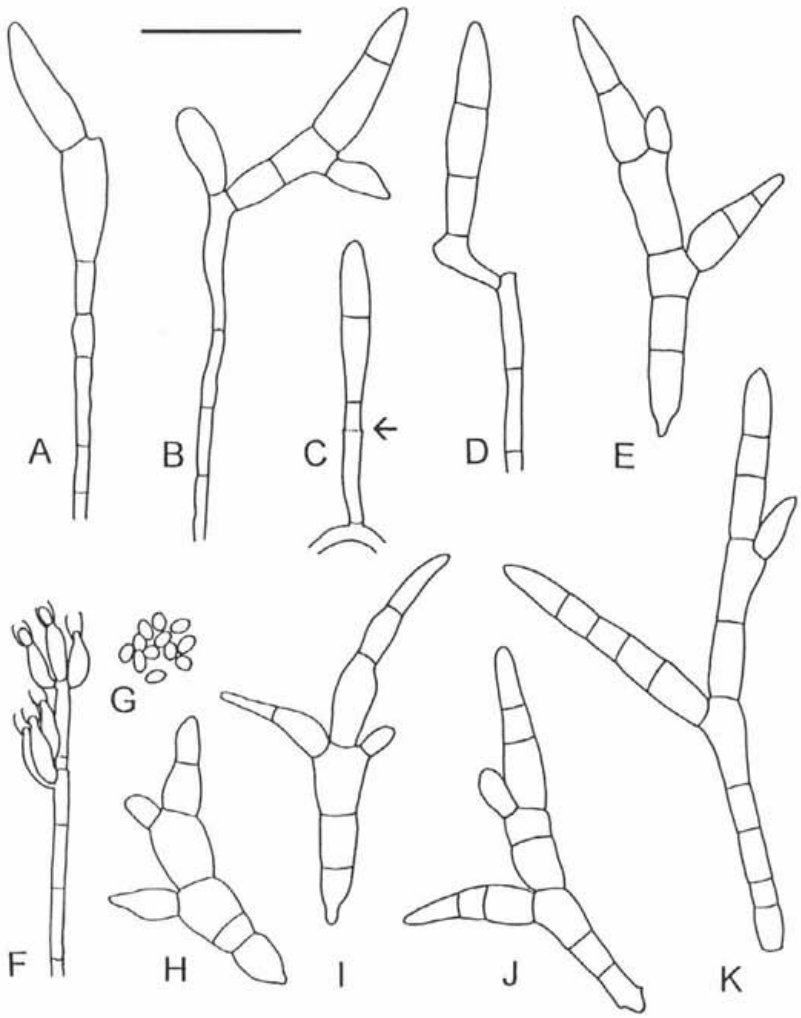

Fig. 3. *Tricladium obesum*. A-E, H-K. Macroconidial state. A. Young conidium developing on a terminal conidiophore. B. Polyblastic conidiogenous cell with two conidia in various stages of development. C. Short lateral conidiophore with percurrent elongation (arrow). D. Conidiophore with sympodial proliferation. E, H-K. Detached conidia. F,G. Microconidial state. F. Conidiophore with phialides. Note the deep collarettes. G. Group of microconidia. (A,C,D-F,K from CCM F-14598; B,H,J from CCM F-14098; I from CCM F-13798). Scale bar = 25 μm.

sequence, or rarely opposite, straight or slightly pendulous, the proximal one 5.5–40 × 4–6.5 μm, the distal one 5–16 × 3.5–5 μm, base not or only slightly constricted. Conidial secession schizolytic.

Microconidial state: hyphomycetous. Conidiophores terminal, integrated with the supporting hypha, straight, stalk c. 2 μm wide. Conidiogenous cells acrogenous, grouped, or scattered singly down the conidiophore stalk, discrete, phialidic, sometimes with a secondary septum, 9–17 × 2–3.5 μm, collarette cup-shaped, deep. Conidia in groups, ellipsoidal, glabrous, 3–5 × 1.5–2 μm.

Holotype: PRM 901639 (preparation from the culture CCM F-14598), Czech Republic, South Bohemia, Šumava National Park, foam on the right branch of the stream Křemelná in the vicinity of the perished settlement Zhůří, near a broken wooden bridge, c. 900 m alt., 19–10–1998 coll. and isol. L. Marvanová.

Other cultures examined: CCM F-13798, CCM F-13998, CCM F-14098, Czech Republic, South Bohemia, Šumava National Park, foam on the left branch of the stream Křemelná, near the road from the perished settlement Zhůří to Stará Huť, above the confluence with the right branch, c. 850 m alt., 20–10–1998 coll. and isol. L. Marvanová.

In foam samples, conidia of this species were more frequently seen in streams of the upper Otava river catchment area (Marvanová 2001).

Conidia of undoubtedly this species were reported and illustrated several times, often from soft waters on acidic bedrock: e.g. Messner and Stüve (1986: Fig. 2A, as *Tricladium* sp.); Regelsberger et al. (1987: Fig. $3B_1,B_2$, as 'the form might belong to *Tricladium*'); Roldán et al. (1987: Figs. 4P-S, as *Tricladium* sp., 'similar to *T. angulatum* Ingold, but more fat'), locality not specified; Voglmayr (1996: Fig. 13d, as unknown); Descals (1998: Fig. 4B,D,E, as ?*Tricladium* sp.), water chemistry unspecified.

The genus *Tricladium* is heterogeneous. It comprises mitosporic fungi and two ascomycete anamorphs with relatively simple conidia: axis and typically two alternate primary branches. This is a primitive branching pattern, which might be derived from a branching hyphal end. As concerns the conidial morphology, our fungus is similar to *T. angulatum* as suggested by Roldán et al. (1987), but the latter has pale colonies and conidia with narrower elements.

There is a fungus with strikingly similar conidia described as an unnamed anamorph of the bitunicate loculoascomycete *Perisporiopsis lophirae* (Deighton) Arx (Müller and von Arx 1962, *Perisporiopsidaceae*; Sivanesan 1984, *Parodiaceae*). At present, *Perisporiopsis* is classified among Dothideomycetes incertae sedis, in *Parodiopsidaceae* (Eriksson 2004). The conidiogenesis of the *Perisporiopsis* anamorph involves percurrently proliferating conidiogenous cells and repeated formation of a funnel-like collarette, left behind by each seceding conidium (cf. Moreau and Moreau 1959: Fig. 1i), similar to that seen by Descals and Webster (1982) in *Culicidospora aquatica* R. H. Petersen. Besides this, the authors report sympodial proliferation of the conidiogenous cell (Moreau and Moreau 1959: Fig. 1e-h), also accompanied by a funnel-like collarette appearing after secession. A holoblastic microconidial state with amerosporous small conidia borne on

denticles is also illustrated (Moreau and Moreau 1959: Fig. 1s,t). Macroconidial anamorphs similar to that of *Perisporiopsis lophirae* are reported also for two other members of *Parodiaceae* by Sivanesan (1984). Ecologically, *Perisporiopsis* spp. belong to leaf parasites on forest trees in tropical and subtropical climates in South and Central America and in tropical Africa.

ACKNOWLEDGEMENTS

This contribution is a part of the project GACR no. 206/98/0561. The Administration of Šumava National Park is thanked for the permission to carry out sampling in the streams. The Institute of Botany of the Czech Academy of Sciences is acknowledged for offering accommodation in its field station in Kvilda.

REFERENCES

DESCALS E. (1987): Muestro preliminar de hongos ingoldianos de Cataluña. – Rev. Ibér. Micol. 4: 17–32.

DESCALS E. (1997): Ingoldian fungi from the Catalan Pyrenees: pure culture studies. – Mycotaxon 63: 431–466.

DESCALS E. (1998): Streamborne fungi from Karrantza (Basque Country) and surroundings. – Boll. Soc. Hist. Nat. Balears 41: 191–219.

DESCALS E., PELÁEZ F. and LÓPEZ LLORCA L. V. (1995): Fungal spora of stream foam from Central Spain II. Chorology, spore frequency and unknown forms. – Nova Hedwigia 60: 551–569.

DESCALS E. and WEBSTER J. (1982): Taxonomic studies on aquatic hyphomycetes IV. Pure culture and typification of various species. – Trans. Br. Mycol. Soc. 79: 45–64.

DESCALS E. and WEBSTER J. (1983): Four new staurosporous hyphomycetes from mountain streams. – Trans. Br. Mycol. Soc. 80: 67–75.

ERIKSSON O. E. (web editor) (2004): Outline of Ascomycota – 2004. – http://www.umu.se/ /myconet/curr/current/html.

MARVANOVÁ L. (2001): Streamborne fungal spora in running waters of the Bohemian Forest. – Silva Gabreta 7: 147–164.

MARVANOVÁ L. and BÄRLOCHER F. (1988): Hyphomycetes from Canadian streams. I. Basidiomycetous anamorphs. – Mycotaxon 32: 339–351.

MARVANOVÁ L. and BÄRLOCHER F. (1989): Hyphomycetes from Canadian streams. II. Three new taxa. – Mycotaxon 35: 85–99.

MARVANOVÁ L. and GULIS V. I. (2000): Notes on waterborne spora from Austria. – Österr. Z. Pilzk. 9: 125–140.

MATSUSHIMA T. (1971): Microfungi of the Solomon Islands and Papua-New Guinea. – 78 p. Kobe.

MESSNER K. and STÜVE B. (1986): Aquatische Hyphomyceten – aussergewöhnlicher Formenreichtum in der Ysperklamm. – Wasser und Abwasser 30: 215–223.

MOREAU C. and MOREAU M. (1959): Champignons foliicoles de Guinée. I. Ascomycetes du Lophira alata Banks et leurs parasites. – Rev. Mycol. 24: 324–330.

MÜLLER E. and ARX J. A. VON (1962): Die Gattungen der didymosporen Pyrenomyceten. – In: Beiträge zur Kryptogamenflora der Schweiz, Bd. 11, Heft 2, 922 p. Wabern-Bern.

REGELSBERGER B., MESSNER K. and DESCALS E. (1987): Species diversity of aquatic hyphomycetes in four Austrian streams. – Mycotaxon 30: 439–454.

ROLDÁN A., DESCALS E. and HONRUBIA M. (1987): Hifomicetos acuáticos en las cuencas altas de los ríos Segura y Quadalquivir. – An. Biol. Veget. 3: 3–13.

ROLDÁN A. and PUIG M. A. (1992): Hifomicetos acuáticos en la cuenca del Río Esva (Asturias, norte de España). – Bol. Soc. Micol. Madrid 17: 3–11.

SIVANESAN A. (1984): The bitunicate ascomycetes and their anamorphs. – 701 p. Vaduz.

VOGLMAYR H. (1996): Spores of Ingoldian fungi in two Austrian rivulets. – Österr. Z. Pilzk. 5: 23–49.

CZECH MYCOL. 56 (3–4), 2004

Fungi on Juncus trifidus in the Czech Republic (II) with taxonomical notes to some species

MARKÉTA SUKOVÁ[1] and ANDRZEJ CHLEBICKI[2]

[1]National Museum, Mycological Department,
Václavské nám. 68, CZ-115 79 Praha 1, Czech Republic,
marketa.sukova@nm.cz
[2]Polish Academy of Sciences, W. Szafer Institute of Botany,
Lubicz 46, PL-31 512 Kraków, Poland,
chlebick@ib-pan.krakow.pl

Suková M. and Chlebicki A. (2004): Fungi on Juncus trifidus in the Czech Republic (II) with taxonomical notes to some species – Czech Mycol. 56: 203–221

In this second contribution, other eight species of ascomycetes and anamorphic fungi on *Juncus trifidus* collected in the Czech Republic are described (*Ascochyta junci*, *Lachnum diminutum*, *Phaeosphaeria vagans*, *Phialocephala* sp., *Pseudoseptoria* sp., *Pycnothyrium junci*, *Stagonospora junciseda*, *Unguicularia* sp.). Additional localities of *Arthrinium cuspidatum* and *Niptera eriophori* described in the first contribution are given. A fungus previously published as *Septoria* sp. was identified as *Septoria chanousiana*. Additional material of some fungi (*Ascochyta junci*, *Septoria chanousiana*, *S. minuta*, *Unguicularia millepunctata*) from other substrata and countries was studied with the aim to compare it with material from *Juncus trifidus* from the Czech Republic. Numbers of fungi on *Juncus trifidus* at studied localities are discussed.

Key words: *Ascochyta*, dark septate endophyte (DSE), *Pseudoseptoria*, *Pycnothyrium*, *Septoria*, *Stagonospora*, *Unguicularia*

Suková M. a Chlebicki A. (2004): Houby na sítině Juncus trifidus v České republice (II) s taxonomickými poznámkami k některým druhům – Czech Mycol. 56: 203–221

V tomto druhém příspěvku je popsáno dalších osm druhů askomycetů a anamorfních hub nalezených na sítině *Juncus trifidus* v České republice (*Ascochyta junci*, *Lachnum diminutum*, *Phaeosphaeria vagans*, *Phialocephala* sp., *Pseudoseptoria* sp., *Pycnothyrium junci*, *Stagonospora junciseda*, *Unguicularia* sp.). Jsou doplněny další lokality k druhům *Arthrinium cuspidatum* a *Niptera eriophori*, které byly publikovány s podrobným popisem v prvním příspěvku. Houba uvedená v prvním příspěvku pod jménem *Septoria* sp. byla určena do druhu jako *Septoria chanousiana*. Pro srovnání byl též studován materiál některých druhů z jiných substrátů a zemí (*Ascochyta junci*, *Septoria chanousiana*, *S. minuta*, *Unguicularia millepunctata*). Jsou připojeny poznámky k počtům druhů hub na sítině *Juncus trifidus* na jednotlivých studovaných lokalitách.

INTRODUCTION

This paper is a continuation of the first article (Fungi on *Juncus trifidus* in the Czech Republic I) published in Czech Mycology 56(1–2), where a general introduction was given and fourteen species of ascomycetes and anamorphic

fungi were mentioned (Suková 2004). Other interesting species described here are especially from the Hrubý Jeseník Mts. as well as the Krkonoše Mts. and Šumava Mts. (Czech Republic).

METHODS

Unless stated otherwise, dried material was prepared in water under a stereomicroscope and studied and measured under a light microscope. Photographs in Figs. 1, 2 and 3B-C were taken using Nomarski contrast. The amyloid reaction of the asco-apical apparatus (I+, I-) was examined in Melzer's reagent (MLZ). Descriptions of fungi from *Juncus trifidus* are based on collected material, which is deposited in the herbaria PRM and KRAM.

Tab. 1. Localities and character of studied *Juncus trifidus* populations.

Loc.	Localities	Altitude	Character of *Juncus trifidus* stands
1	Western Bohemia / Germany, Šumava Mts. / Bayerischer Wald Mts., 6.5 km SW of the village of Zelená Lhota, Mt. Velký Ostrý / Gr. Osser and rock ridge running SE from the peak	1280–1290 m	tufts and stands on rocks of various orientation
2	Western Bohemia, Šumava Mts., 6 km NW of the village of Železná Ruda, Jezerní stěna rock wall, on and under SW edge of cirque of Černé jezero lake, 49°10' 12.5" N, 13°10' 21" E	1300–1315 m	stands and isolated tufts on rocks
3	Eastern Bohemia / Poland, Krkonoše Mts. / Karkonosze Mts., SE and E side of peak of Mt. Sněžka / Śnieżka	1560–1590 (-1600) m	large terrestrial stands with scattered stones
4	Eastern Bohemia, Králický Sněžník mountain range, Vlaštovčí skály rocks c. 850 m SW of peak of Mt. Králický Sněžník	1260–1290 m	scattered tufts on rocks
5	Northern Moravia, Hrubý Jeseník Mts., 4.5 km ESE of the village of Ramzová, Mt. Keprník, 50°10' 13" N, 17°06' 59.5" E	1415–1423 m	mostly terrestrial stands, less frequently stands on small rocks
6	Northern Moravia, Hrubý Jeseník Mts., 5.5 km SE of the village of Ramzová, Mt. Vozka, 50°08' 47" N, 17°08' 11" E	1360–1370 m	stands on rocks and among stones
7	Northern Moravia, Hrubý Jeseník Mts., Mt. Červená hora, small E oriented rock between Červená hora and Kamenné okno, 50°08' 44.5" N, 17°08' 09.5" E	c. 1300 m	scattered (not numerous) tufts on the rock
8	Northern Moravia, Hrubý Jeseník Mts., c. 5.3 km W of the village of Karlova Studánka, Petrovy kameny rock	1430 m	two tufts on ENE slope of the rock

For the studying of dark septate endophytes, roots after gathering were preserved in a refrigerator in a plastic bag. In the beginning, roots were washed in water. Only whitish roots were analysed. To clear root cells, roots were placed in 50 % aqueous chloral hydrate for 30 min. at room temperature and then transferred to lactophenol or destilled water.

To establish "similarities" we followed a method based on fungal host specifity (Chlebicki et al. in press).

For localities and character of studied *Juncus trifidus* populations see Tab. 1.

Results and Discussion

Fungi collected on Juncus trifidus

ASCOMYCETES

Lachnum diminutum (Roberge) Rehm, Hedwigia 23: 51, 1884.
Bas.: *Peziza diminuta* Roberge, Ann. Sci. Nat. Bot., ser. 3, 7: 185, 1847.

Description: Dried apothecia shortly stipitate, 180–260 μm in diam., outer surface vermillion-red or brown, discs deeply orange to vermillion-red. Hairs 21–44 × 3.2–4.5 μm (longer ones are located at margin, shorter ones on outer surface of excipulum), cylindrical, hyaline, incrustate, mostly 1–2-septate. Asci 47–53 × 8–8.7 μm, 8-spored, with slightly conical apices, ascospores located mostly in upper part of ascus. Ascospores one-celled, 11.7–12.5 × 1.5–2.5 μm (measured in ascus), hyaline, biguttulate. Paraphyses probably young, narrowly lanceolate, 2.7–3.5 μm wide, slightly exceeding asci.

Habitat: On old stem and bract of *Juncus trifidus*.

Material studied: Krkonoše Mts., Sněžka (loc. 3), 13 July 2002, leg. M. Suková, PRM 901845 (two apothecia only).

Comments: This poor occurrence of *Lachnum diminutum* in the alpine belt is interesting and is situated at the margin of ecological valence of the species. *Lachnum diminutum* is characteristic of *Juncus effusus* and *Juncus filiformis* in montane and lower altitudes (see also Scheuer 1988, Suková et al. 2003). Poor material of *Lachnum diminutum* was also found on *Juncus filiformis* near Mt. Sněžka (loc. 3) in the subalpine belt.

Additional material studied: Czech Republic, Eastern Bohemia, Krkonoše Mts., Úpské rašeliniště bog, c. 1 km ENE of Luční bouda chalet, on *Juncus filiformis*, 23 August 2004, leg. M. Suková, PRM 901860.

Niptera eriophori, reported in the first article (Suková 2004)

Additional note: The species was collected also at the locality Červená hora.

Material studied: Hrubý Jeseník Mts., Červená hora (loc. 7), on dead stems of *Juncus trifidus*, 5 July 2002, leg. M. Suková, PRM 901857.

Phaeosphaeria vagans (Niessl) O. E. Erikss., Ark. Bot. 6: 430, 1967.
Bas.: *Pleospora vagans* Niessl, Verh. Naturf. Ver. Brünn 14: 174, 1876. Fig. 1A.

Description: Ascomata black, immersed, slightly lifting the surface tissues of the plant, 180–240 μm in diam., openings without conspicuous periphyses. Asci cylindrical, shortly stipitate, 77–93.5 × 13.5–16.5 μm. Ascospores (observed in asci) biseriate, muriform, with (4-)5 transversal septa and one longitudinal septum in the central part, pointed to both ends, slightly constricted at the first septum, not constricted or only slightly constricted at other septa, 17–19.6 × 5.7–7 μm (measured in asci), olive brown, hyaline to subhyaline and two-celled when young. Pseudoparaphyses hyaline, septate, 1.8–3 μm wide.

Habitat: On dead stem of *Juncus trifidus*.

Material studied: Hrubý Jeseník Mts., Červená hora (loc. 7), 17 May 2003, leg. M. Suková, PRM 901843.

Comments: This non-specialised fungus is known especially from various *Poaceae*, some *Juncus* species and some species of *Cyperaceae* (Shoemaker and Babcock 1989). During the research devoted to *Juncus trifidus* in the Czech Republic only scanty material was found at only one locality. Probably, the fungus was present on other substrata at the locality and *Juncus trifidus* was colonised accidentally.

Unguicularia sp. Fig. 2A.

Description: Dried apothecia small, sessile, broadly cup-shaped to urn-shaped, whitish with pale beige-brown tint, up to 100 μm in diam., hairs whitish. Excipulum composed of thin-walled, hyaline (near base of apothecium pale brownish) cells. Hairs glassy (glassy matter not changing in 5 % KOH), gradually pointed to rounded apex, 6.5–22 × 2.7–5.7 μm, dividing line between glassy part of hair (5.5–13 × 2.7–5.5 μm) and lumen straight or only slightly concave. Hairs pale brown in MLZ. Asci 8-spored, 11.5–26 × 3.5–5 μm, clavate to nearly cylindrical, upper part of asci conical to rounded, asco-apical apparatus amyloid (blue) in MLZ without pre-treatment in KOH. Ascospores one-celled, 4.7–7.3 × 1–1.5 μm, straight, hyaline.

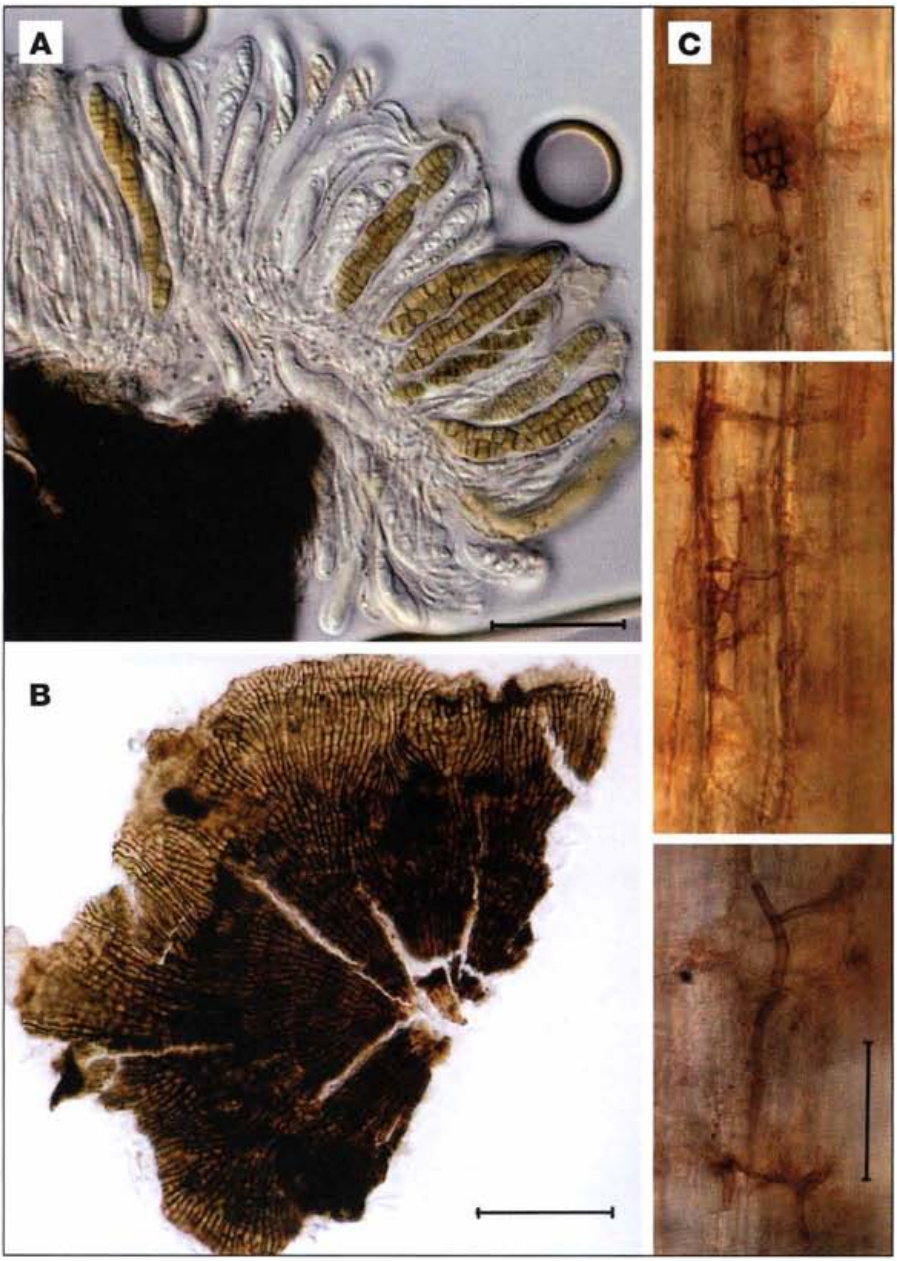

Fig. 1. A: *Phaeosphaeria vagans* (Niessl) O. E. Erikss. (PRM 901843), asci with ascospores and pseudoparaphyses (in water); B: *Pycnothyrium junci* Grove (PRM 901851), upper wall of conidioma (in water); C: *Phialocephala* sp. (dark septate endophyte – DSE), sclerotia and hyphae (in water). Scale bars: A-C: 50 μm.

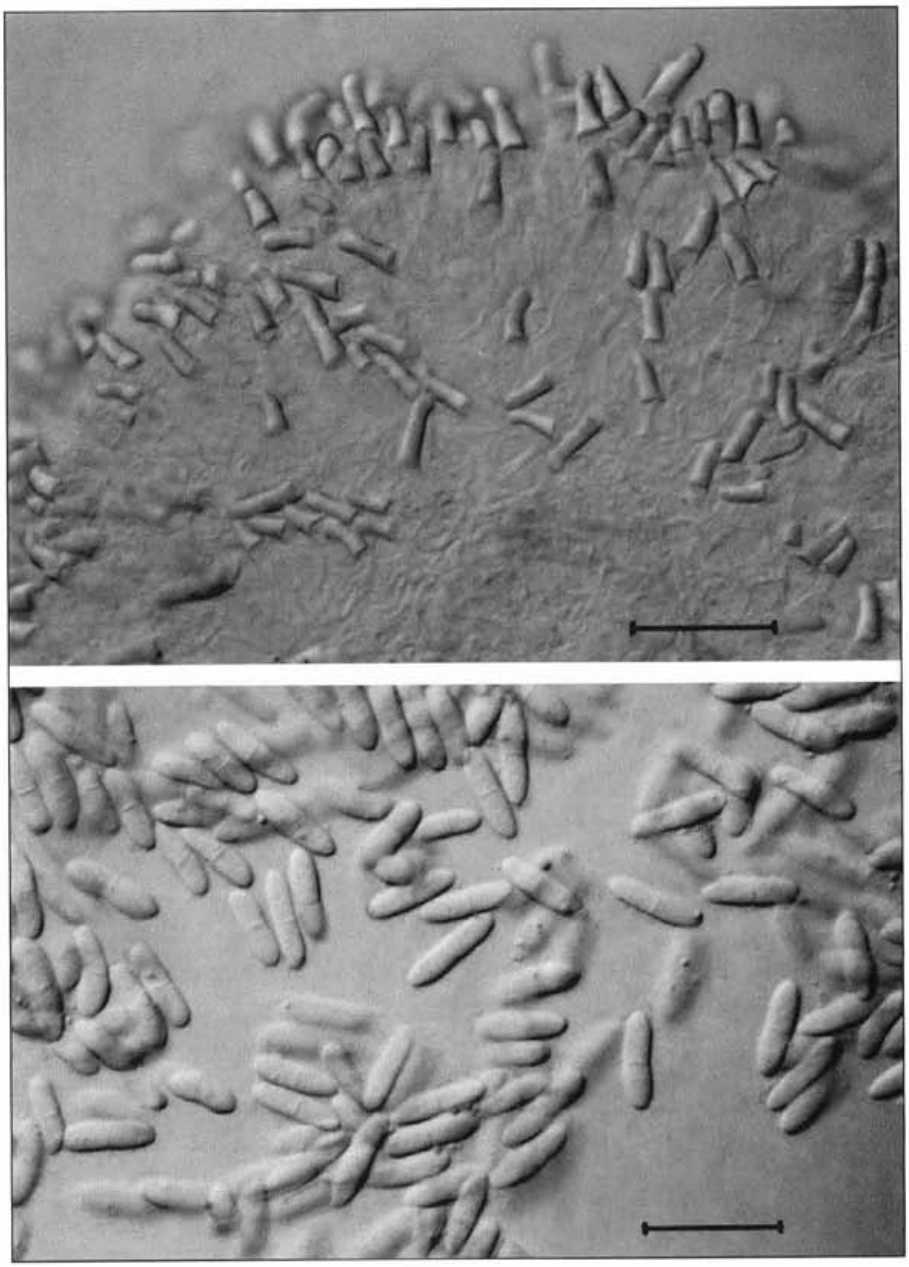

Fig. 2. A: *Unguicularia sp.* (PRM 901844), outer surface of excipulum bearing hairs (in water); B: *Asochyta junci* (Oudem.) Melnik (PRM 901856), conidia (in water). Scale bars: A-B: 20 µm.

Habitat: On old stems of *Juncus trifidus*.

Material studied: Hrubý Jeseník Mts., Červená hora (loc. 7), 17 May 2003, leg. M. Suková, PRM 901844.

Comments: This material is distinctly different from *Unguicularia costata* (Boud.) Dennis known from the genus *Juncus* (see Raschle 1977, Ellis and Ellis 1985). Studying Raschle's monograph (Raschle 1977) and comparative material (*U. millepunctata* on *Heracleum sphondylium*), our material appeared to be most similar to *U. millepunctata* (Lib.) Dennis. However, *U. millepunctata* is known only from dicotyledonous herbs and trees. Moreover, hairs of our *Unguicularia* sp. are smaller, but may be in the range of variability of *U. millepunctata*.

Korf and Kohn (1980) lowered the genus *Unguicularia* Höhn. to the subgenus rank as *Hyalopeziza* Fuckel subgen. *Unguicularia* (Höhn.) Korf et L. M. Kohn.

Comparative material studied: *Unguicularia millepunctata* (Lib.) Dennis, Czech Republic, Northern Moravia, Moravskoslezské Beskydy Mts., left bank of Rožnovská Bečva river 400 m before Jeřábkový potok tributary, alt. 640 m, on *Heracleum sphondylium*, 18 August 1999, leg. M. Suková, PRC.

COELOMYCETES

Ascochyta junci (Oudem.) Melnik, Nov. Sist. Niz. Rast. 12: 204, 1975.
Bas.: *Diplodina junci* Oudem., Ned. Kruidk. Archf., ser. 3, 2: 1109, 1904.
Fig. 2B, 4A.

Description: Conidiomata black, slightly elongated in the direction of plant tissues, 130–240 μm long, 110–180 μm wide, opened by a small, almost rounded pore, 13–17 × 11–14 μm. Wall dark blackish brown, a textura angularis in surface view. Conidiogenous cells hyaline, subglobose. Conidia two-celled, hyaline, straight, 10.5–13 × 2.5–3.7 μm, not constricted at septa or only slightly constricted, often 4-guttulate.

Habitat: On dead stems, petals, rarely bracts or leaves of *Juncus trifidus*.

Material studied: Krkonoše Mts., Sněžka (loc. 3), 5 June and 13 July 2002, leg. M. Suková, PRM 901859 and 901855. – Karkonosze Mts. (Poland), Śnieżka (loc. 3), 21 November 1996, leg. A. Chlebicki, KRAM F. – Hrubý Jeseník Mts., Vozka (loc. 6), 21 March 2004, leg. M. Suková et A. Chlebicki, PRM 901856.

Comments: According to Punithalingam (1988), *Ascochyta junci* was only known from a single (type) collection from peduncles and bracts of *Juncus squarrosus* from the Netherlands. However, it has been reported also from the Czech Republic by Petrak (1920), who published the species (as *Diplodina junci* Oudem.) from the same host plant (*J. squarrosus*).

Ascochyta junci is reported here for the first time from *Juncus trifidus*. Conidia in the studied material were mostly almost symmetrical with rounded ends whereas in the drawing by Punithalingam (1988) conidia were distinctly narrowed towards the apex in the type collection on *Juncus squarrosus*. We examined Punithalingam's slide (IMI 311017, entire conidiomata, see Fig. 3B) and found that the conidia were really mostly more or less narrowed towards both ends (more towards the apical end). But the difference in shape of conidia between our material on *Juncus trifidus* and Punithalingam's drawing and slide did not turn out to be revelant, because the slide was prepared in lactophenol whereas we examined our material in water. When we compared our material from *Juncus trifidus* with a collection from *Juncus squarrosus* (PRM 901854, see Fig. 3A) prepared in water, conidia were of the same shape.

Comparative material studied: *Ascochyta junci* (Oudem.) Melnik, Czech Republic, Western Bohemia, Krušné hory Mts., SE slope of Jeřábí vrch, at signal road running along state border at 500 m from the border, alt. c. 930 m, on *Juncus squarrosus*, 16 May 1999, leg. M. Suková, PRM 901854.

Ascochyta junci was found mature in spring (May to beginning of June) and also in late autumn (November). The type collection from the Netherlands was collected in March (see Punithalingam 1988). On *Juncus trifidus*, the species was observed especially on inflorescences (petals, also capsules) and stems, rarely on leaves and bracts. Punithalingam (1988) discussed the parasitism of this fungus. We saw *Ascochyta junci* mostly on overwintered, well-developed capsules and petals, only once on an underdeveloped capsule.

The record of *Ascochyta caricicola* Melnik reported previously from *Juncus trifidus* from the Tatra Mts. (Poland) by the second author (Chlebicki 2002) is in fact *Ascochyta junci* – the material (deposited in KRAM F) agrees with our description here.

Pseudoseptoria sp. Fig. 4B-C.

Description: Conidiomata immersed, (66-)80–95(-130) μm long, (63-)75–87 μm wide, in upper part with a rounded opening (15–20 μm in diam.). Wall a textura angularis in surface view, composed of dark brown cells, 6.5–13 × × 5.5–10.5 μm. Conidiogenous cells hyaline, broadly ampulliform, 5–8 μm high, 6.5–7.5 μm wide (in water as well as lactophenol), formed on inner surface of the wall. Conidia mostly falcate, acute at upper end, slightly acute also at basal end, hyaline, (16.7-)20–23.5 × (1.5-)1.7–2 μm, often guttulate.

Habitat: On dead stems and bracts of *Juncus trifidus*.

Material studied: Šumava Mts., Jezerní stěna (loc. 2), 14 May 2002, leg. M. Suková, PRM 901846. – Krkonoše Mts., Sněžka (loc. 3, both Czech and Polish

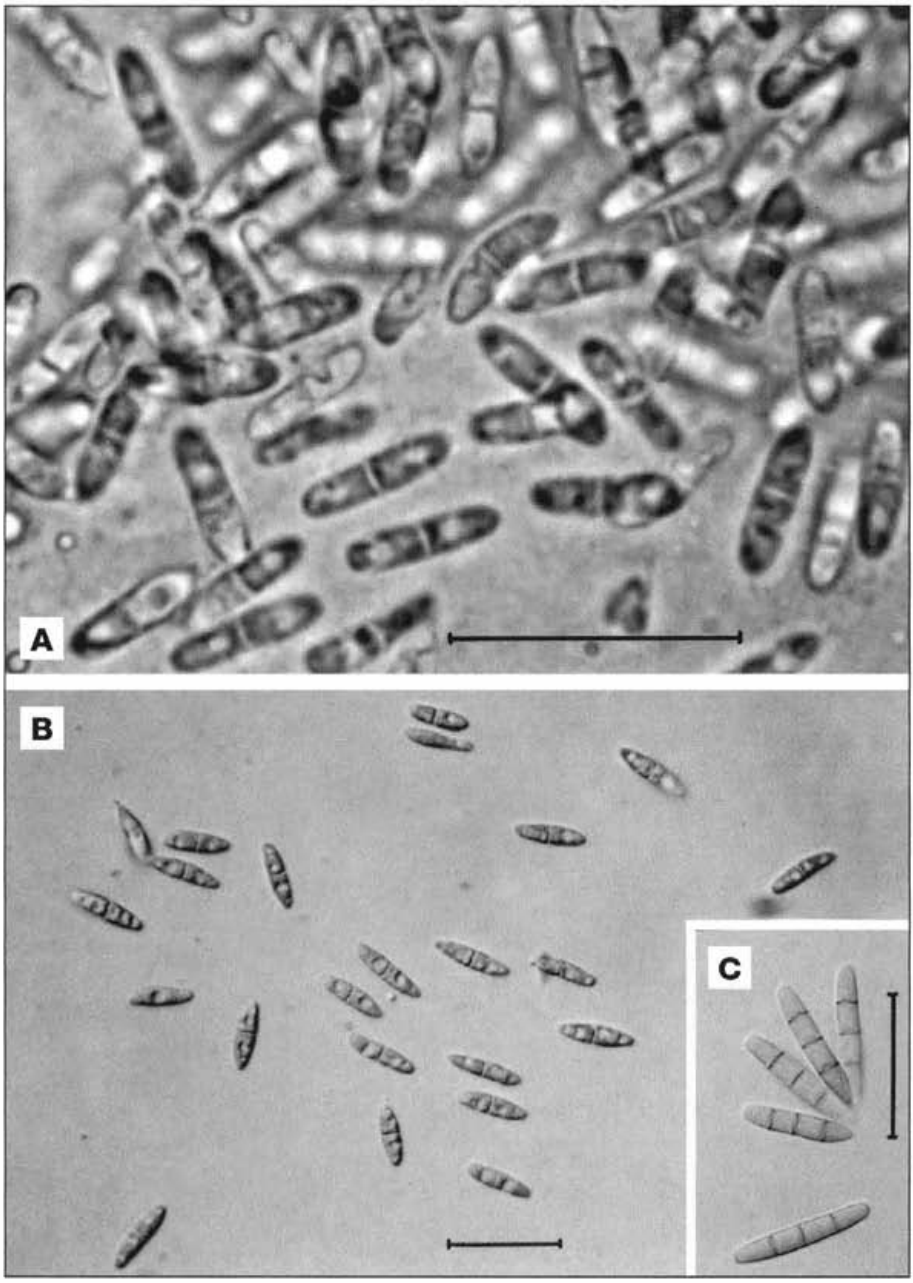

Fig. 3. A: *Ascochyta junci* (Oudem.) Melnik on *Juncus squarrosus* (PRM 901854), conidia (in water); B: *Ascochyta junci* (Oudem.) Melnik on *J. squarrosus* (IMI 311017), conidia, slide ex herb. L prepared by Punithalingam in lactophenol; C: *Stagonospora junciseda* (Sacc.) Sacc. (PRM 901853), conidia (in lactophenol). Scale bars: A-C: 20 µm.

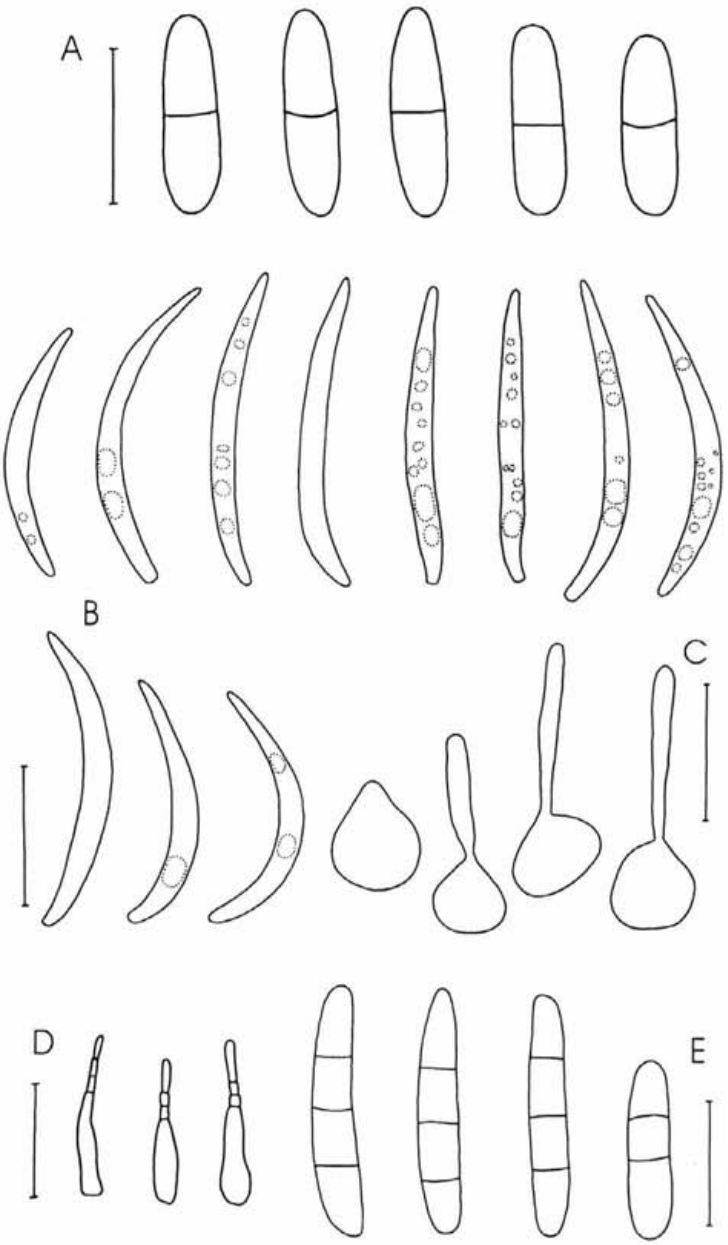

Fig. 4. A. *Ascochyta junci* (Oudem.) Melnik on *Juncus trifidus*, conidia (in water); B-C: *Pseudoseptoria* sp. (in water), B: conidia, C: schema of conidiogenous cells producing conidia; D: *Septoria minuta* J. Schröt. (IMI 188720a) published from *Luzula sylvatica* by Ellis and Ellis (1985), conidiogenous cells (in water); E: *Stagonospora junciseda* (Sacc.) Sacc., conidia (in lactophenol). Scale bars: A-E: 10 μm.

sides), 5 June 2002, leg. M. Suková, PRM 901849. – Hrubý Jeseník Mts.: Vozka (loc. 6), 17 May 2003, leg. M. Suková, PRM 901848; Červená hora (loc. 7), 5 July 2002 and 17 May 2003, leg. M. Suková, PRM 901858 and 901847.

Comments: The size of the conidia was (16.7-)20–23.5 × 1.7–2 μm in most collections. Longer conidia [26–29 × (1.5-)2 μm] were found in material from the Czech side of Mt. Sněžka (loc. 3). Openings of the conidiomata located strictly under stomata of *Juncus trifidus* were observed in the material from Jezerní stěna (loc. 2) and probably this is a property of the whole species.

The material described above belongs to the genus *Pseudoseptoria* (see Sutton 1980). It differs from *Pseudoseptoria donacis* (Pass.) B. Sutton (represented in our study by the collection from Thümen, Herb. Mycol. Oecon., no. 607, PRM 652606) at least in having conidia narrower in shape with less acute ends and darker conidioma wall composed of cells with somewhat thicker wall. The shape of the observed conidiogenous cells was more similar to *Pseudoseptoria*, however neither annellate papillas typical of *Pseudoseptoria* nor scars typical of *Septoria* were seen.

Identification on species level was not possible, because we have not yet found any usable comparative material of *Septoria minuta* J. Schröt. (Jahresber. Schles. Ges. Vaterl. Cult. 65[1887]: 284, 1888) – a species with falcate, one-celled conidia described from *Juncaceae* (*Luzula*). *Septoria minuta* was originally described from *Luzula spicata* and *Elyna bellardi* (syn. of *Elyna myosuroides*, see Dostál 1989) from Greenland (Schröter 1888). The original material was collected on *Luzula spicata* in 1857 by E. Wenck and should be deposited in the herbarium of E. Wenck. Unfortunately, we have not yet been able to find out where this herbarium is located. The WRSL herbarium, where a large part of Schröter's collection is deposited, does not possess any specimen of *Septoria minuta*. We do not combine *Septoria minuta* into *Pseudoseptoria* now, because its conidiogenous cells, which are not described in the original description, must be checked first. We have not been able to study the type collection of *Septoria minuta* and among other collections we have seen only material published by Ellis and Ellis (1985), which may be but need not be a good representative of the species *Septoria minuta*.

Comparative material studied: *Septoria minuta* J. Schröt. published by Ellis and Ellis (1985), England, South Devon, Slapton Ley Nature Reserve, on *Luzula sylvatica*, 6 October 1974, leg. D. L. Hawksworth, IMI 188720a.

The collection IMI 188720a published from *Luzula sylvatica* (Ellis and Ellis 1985) differs from our *Pseudoseptoria* sp. in having pycnidia on dead spots on green leaves. The spots are pale olive-brown, in part with pycnidia, surrounded by a beige-brown area and a paler, distinctly demarcated, beige margin. The conidiogenous cells (Fig. 4D) are narrowly ampulliform, longer than wide, probably with annellate papillas. The conidia are thinner in shape (in comparison with our material from *Juncus* and also with the original description of *Septoria minuta*),

(11-)13–17(-20.5) × 1 μm, and almost straight or slightly falcate or curved, not distinctly regularly falcate.

Comparison of *Pseudoseptoria* sp. with the literature: *Septoria minuta* is known from leaves of *Luzula* spp. from North America (also Greenland), Europe and Asia (Saccardo 1892, Cooke 1955, Teterevnikova-Babajan 1987, Farr et al. 1989). The length of the conidia of our material agrees rather with the description of *Septoria minuta* in Teterevnikova-Babajan (1987), who mentioned conidia 10–31 μm long, and the falcate conidia agree with descriptions in Schröter (1888), Saccardo (1892), and Ellis and Ellis (1985). Teterevnikova-Babajan (1987) mentioned straight conidia. Schröter (1888) mentioned falcate conidia 17–20 × 2–2.5 μm in size for material from *Luzula spicata* in his protologue of *Septoria minuta*. Our *Pseudoseptoria* sp. possesses conidia somewhat narrower and more variable in length.

Pycnothyrium junci Grove, British stem and leaf fungi, vol. 2, p. 197, 1937. Fig. 1B.

Description: Conidiomata brownish black, flat, shield-shaped, rounded, 190–260 μm in diam. Wall of the shield composed of brown, distinctly angular, radiately arranged, 2–2.5(-3.5) μm wide cells. Conidia one-celled, hyaline, straight, (6.5-)7.5–10 × 1.7–2.2 μm, mostly with two big and several smaller guttules.

On dead stems, leaves and bracts of *Juncus trifidus*.

Material studied: Šumava Mts., Velký Ostrý (loc. 1), 1 June 2003, leg. M. Suková, PRM 901852. – Hrubý Jeseník Mts., Vozka (loc. 6), 5 July 2002, leg. M. Suková, PRM 901851.

Comments: The character of conidiomata of our material agrees very well with the description by Grove (1937). Conidia in Grove's description are a little smaller (6–8 × 1–1.5 μm), but we consider it a variability in the range of the species.

Septoria chanousiana Ferraris, Malpighia 16: 466, 1902.

Comments: We compared our material of *Septoria* sp. published in a previous article (Suková 2004) from *Juncus trifidus* (conidia 23–25.5 × 1.8–2.1 μm) with *Septoria chanousiana* from its typical host plant (*Luzula*) and they appear to be conspecific. The material on *Luzula* (WSP 42204) possesses conidia of the same shape measuring (19-)22–29 × 1.7–2.2 μm. Conidiomata of *Septoria chanousiana* studied on green leaves of *Luzula* were located on small beige spots, surrounded by a violet-brown colour, whereas pycnidia on *Juncus trifidus* were situated directly on withering, but still somewhat green leaves. Teterevnikova-Babajan (1987) men-

tioned conidia 19–21 × 2 μm large and Sprague (1962) conidia 20–23 × 1–1.2 μm for *Septoria chanousiana* on *Luzula*.

Comparative material studied: *Septoria chanousiana*, 'Suoqualmia N. For. Wash.', on *Luzula piperi*, 24 July 1955, leg., det. (as *Septoria minuta*) and rev. (as *Septoria chanousiana*) R. Sprague, WSP 42204.

Stagonospora junciseda (Sacc.) Sacc., Syll. Fung. 3: 452, 1884.
Bas.: *Hendersonia aquatica* subsp. *junciseda* Sacc., Michelia 2: 350, 1881.
Figs. 3C, 4E.

Description: Conidiomata pycnidial, immersed, slightly lifting the surface tissues of the plant, ostioles surrounded by black surface areas (up to 70 μm in diam.), elongated in the direction of the stem, 180–230 × 100–180 μm. Conidia subhyaline with pale ochraceous tint, cylindrical, tapering towards their rounded ends (more towards the upper end), 14–20.5 × 3–3.8 μm (in lactophenol), four-celled, not constricted at the septa. Young three-celled and two-celled conidia were also observed.

Habitat: On dead stem of *Juncus trifidus*.

Material studied: Šumava Mts., Jezerní stěna (loc. 2), 14 May 2002, leg. M. Suková, PRM 901853.

Comments: There are not many juncicolous *Stagonospora* species with narrow, 3-septate conidia reported in the literature. We noted only two species of such character: *Stagonospora junciseda* (Sacc.) Sacc. with conidia 21–30 × 3–3.5 μm in size according to Ellis and Ellis (1985) or 25–30 × 3–3.5 μm (Saccardo 1884, Allescher 1901 as *S. aquatica* subsp. *junciseda*, Grove 1935) and *Hendersonia juncina* J. W. Ellis with conidia 14–18 × 3.5–4 μm (Grove 1937). Both the species should have conidia not constricted at the septa. The conidiomata of the first one should be up to 200 μm in diam., of the second one only 100 μm. Of course we do not know whether *Stagonospora junciseda* (Sacc.) Sacc. and *Hendersonia juncina* J. W. Ellis are conspecific or not. Grove (1935, 1937) reported them as two different species. In later literature, *H. juncina* was mentioned neither as a synonym nor as a separate species.

Material from *Juncus trifidus* from the Babia Góra Mts. previously published by the second author (Chlebicki 2002) as *Stagonospora* cf. *caricinella* belongs to the same species (*Stagonospora junciseda*) as the material from the Šumava Mts. described above. Material published from Mt. Śnieżka (Chlebicki 2002) possesses two- or three-celled and sligthly ochraceous conidia 13–19 × 3–4.5 μm large, not constricted at the septa, symmetrical, with obtuse ends. We never observed four-celled conidia in this material. Moreover, conidia from Mt. Śnieżka are somewhat wider than those four-celled ones. It is probably a different taxon.

HYPHOMYCETES

Arthrinium cuspidatum, reported in the first article (Suková 2004).

Additional note: At the locality Červená hora, where the population of *Juncus trifidus* is very small, scanty material of *Arthrinium* was found with conidia having inward curved horns strongly resembling those of *Arthrinium luzulae*. The conidia measured 17–17.5 × 12.5–13.7 μm incl. horns and were 8.3–8.6 μm long (excl. horns) in face view. But we found several old conidia with inward curved horns also in good collections of *A. cuspidatum* cited in the previous article (Suková 2004). Presence of old conidia of such character is normal at *A. cuspidatum*.

Material studied: Hrubý Jeseník Mts., Červená hora (loc. 7), on dead stems of *Juncus trifidus*, 5 July 2002, leg. M. Suková, PRM 901850, not abundant; old colonies, but conidia, hyphae and mother cells of conidiophores seen.

Phialocephala sp., dark, septate endophyte (DSE)

Comments: So far, dark, septate endophytic fungi were noted in 8 species of *Juncaceae* (Jumponen and Trappe 1998). They are ubiquitous fungi frequently noted in the arctic and alpine plants (Schadt et al. 2001). We noted very distinct septate hyphae and microsclerotia (Fig. 1C) in the young roots of the plant. We observed also solitary conidiophores with conidia, identical with the anamorphic fungus of the genus *Phialocephala* Kendr. They were slightly brown, c. 50 μm long, bearing an indistinct head covered with slime.

Material studied: Hrubý Jeseník Mts., Vozka (loc. 6), roots of *Juncus trifidus*, 21 March 2004, leg. A. Chlebicki, KRAM.

Comments to numbers of fungi on Juncus trifidus at studied localities

See also information in Tabs. 1 and 2.

Unless stated otherwise, the number of specialised fungi (restricted to *Juncaceae* and *Cyperaceae*) is discussed.

Comments to the richest localities (Sněžka in the Krkonoše Mts. and Jezerní stěna in the Šumava Mts.) were published in a previous article (Suková 2004). Now, we want to add some notes on the distribution of fungi in the Hrubý Jeseník Mts. (a). We add also comments to numbers of fungi at localities with terrestrial *Juncus trifidus* stands (b), localities with rocks (c) and stands on rocks oriented to cirques (d) within the whole studied area (the Czech Republic incl. localities at the border).

a) Distribution of fungi in the Hrubý Jeseník Mts.

The smallest population of *Juncus trifidus* is on Petrovy kameny rock (loc. 8). By the way, also the endemic plant *Campanula gelida* Kovanda (see Slavík 2000) is known from here. The only two tufts of *Juncus trifidus* hosts three species of fungi which are common in all studied *Juncus trifidus* populations. Only one of the two fungi inhabiting plant tissues under stomata (*Mycosphaerella perexigua* var. *minima* Johanson and *Pseudoseptoria* sp.) is present.

The number of fungi and especially the presence of specialised species is connected with plant population size. The presence of a relatively big number of plurivorous fungi is characteristic of the small *Juncus trifidus* population at Mt. Červená hora (loc. 7). Several tufts of *Juncus trifidus* are located on a small rock oriented to Sněžná kotlina glacial cirque and are covered by snow longer than e.g. the population on Mt. Vozka.

The richest (in fungi) *Juncus trifidus* population of the Eastern Sudetes is undoubtedly on Mt. Vozka (loc. 6). Also another relict plant, *Empetrum hermaphroditum*, occurs at this locality.

Mt. Keprník (loc. 5) is conspicuously poor in *Juncus trifidus* fungi. It is possible that *Juncus trifidus*, present there mostly terrestrially, is gradually suppressed by *Poaceae*. Only scanty material of *Juncus trifidus* is found on a small rock (rather a big stone than a rock).

b) Localities with terrestrial Juncus trifidus stands studied in the Czech Republic.

Except of Mt. Keprník (loc. 5, Hrubý Jeseník Mts.), also Mt. Sněžka (loc. 3, Krkonoše Mts.) with prevailing terrestrial stands of *Juncus trifidus* was examined. Compared with Mt. Keprník, Mt. Sněžka is a rich locality at relatively high altitude, with a bigger *Juncus trifidus* population, which seems to be stable and possesses various microhabitats for fungi (e.g. dead stems lying in moss cushions, on stones, in *Juncus trifidus* tufts, etc.).

c) Localities with big rocks studied in the Czech Republic.

Localities with big rocks are mostly rich in *Juncus trifidus* fungi. These are (arranged from the rich to poor) Jezerní stěna (loc. 2), Vozka (loc. 6), Velký Ostrý (loc. 1) and Králický Sněžník (loc. 4). There is also a big rock at the locality Petrovy kameny (loc. 8), but because of the small *Juncus trifidus* population also the number of fungi is very low.

d) Stands on rocks oriented to cirques studied in the Czech Republic.

The locality Jezerní stěna (loc. 2, Šumava Mts.) is influenced by its orientation to the cirque of Černé jezero lake. This cirque has specific climatic conditions

(higher air humidity and less strong winds) in comparison with studied Czech localities situated on open peaks (Suková 2004). The influence of the above described leature is apparently less strong at the locality Červená hora (loc. 7, Hrubý Jeseník Mts.) oriented to a more open cirque named Sněžná kotlina.

Discussion: It is clear that relict populations of *J. trifidus* can survive on big rocks (c) or at high altitude (terrestrial stands on Mt. Sněžka, loc. 3). Reduction of plant population is correlated with a decrease in the number of fungus species (Chlebicki 2002). The same effect can be observed when plant colonises a new area (Chlebicki 2002). Small *Juncus trifidus* populations (loc. 5, 7 and 8 in the Hrubý Jeseník Mts.) can be explained as an effect of vanishing populations but it is also possible that the plant colonised these areas recently (loc. 5).

Method based on fungal host specifity and discussion

Non-specialised fungi (see Tab. 1) were excluded before applying the method based on fungal host specifity (Chlebicki et al. in press; Chlebicki 2002 as FMM – fungal markers method), which we followed to establish "similarities". We included only species restricted to *Cyperaceae* and *Juncaceae*. Most included species are strictly juncicolous (*Ascochyta junci*, *Hysteronaevia minutissima*, *Lachnum diminutum*, *Pycnothyrium junci*, *Naeviella paradoxa* and *Stagonospora junciseda*). Some of included species (*Arthrinium cuspidatum*, *Brunnipila calycioides*, *Mycosphaerella perexigua* var. *minima* and *Septoria chanousiana*) can infect many species of *Cyperaceae* and *Juncaceae*. However, the picture of fungus distribution in isolated areas of *Juncus trifidus* is very similar to the distribution of *Dryas*-specific fungi on *Dryas octopetala* in the Carpathians (see Chlebicki and Suková 2004).

Similarities in fungi composition from the Šumava Mts., Krkonoše Mts., Mt. Králický Sněžník and the Hrubý Jeseník Mts. are not distinct. However, the most similar appear Krkonoše Mts. and Šumava Mts., which possess suitable habitats for *Juncus trifidus*. It is significant that the similarities between Králický Sněžník and Hrubý Jeseník (close areas) are smaller than between Krkonoše and Hrubý Jeseník (distant areas). This means that the process of vanishing of plant populations from Králický Sněžník is more advanced than from Hrubý Jeseník. The big population in the Krkonoše Mts. is inhabited by fungi not found in other Czech *Juncus trifidus* populations, (*Lachnum diminutum*, *Naeviella paradoxa* and *Septoria chanousiana*). Also the population at Jezerní stěna rock wall in the Šumava Mts. possesses such fungi (*Hysteronaevia minutissima* and *Stagonospora junciseda*).

Tab. 2. Occurrence of fungi on *Juncus trifidus* at the studied localities: Šumava Mts.: Velký Ostrý (loc.1), Jezerní stěna (loc. 2); Krkonoše Mts.: Sněžka (loc. 3); Králický Sněžník mountain range: Králický Sněžník (loc. 4); Hrubý Jeseník Mts.: Keprník (loc. 5), Vozka (loc. 6), Červená hora (loc. 7), Petrovy kameny (loc. 8). The Polish side of Mt. Sněžka and the German side of Mt. Velký Ostrý were also included. The relative size of *Juncus trifidus* populations is indicated. The total number of all species present at each locality on *Juncus trifidus* and the number of specialised (restricted to *Juncaceae* and *Cyperaceae*) ones are given. Species restricted to *Juncaceae* and *Cyperaceae* are marked by the index (S). Data published in this article are in bold. Other data are from a previous article (Suková 2004). Presence of DSE (dark septate endophyte) was investigated only at one locality (and at the locality identified as *Phialocephala* sp.), therefore it was not included into the total number of species.

Phytogeographical unit	Hercynicum		Western Sudetes	Eastern Sudetes				
Mts.	Šumava Mts.		Krkonoše Mts.	Králický Sněžník	Hrubý Jeseník Mts.			
Locality	1	2	3	4	5	6	7	8
Size of population of *Juncus trifidus*	++++	++++	+++++	+++	++++	++++	++	+
Total number of all species	**11**	**11**	**15**	**9**	**6**	**10**	**9**	**3**
Number of specialised species	**4**	**6**	**8**	**3**	**3**	**6**	**3**	**3**
Arthrinium cuspidatum(S)	*	*	*	*	*	*	*	*
Ascochyta juncí(S)			*			*		
Botrytis cinerea	*		*	*	*		*	
Brunnipila calycioides(S)	*	*	*	*	*	*	*	*
Cladosporium herbarum	*	*	*	*		*		
Dinemasporium strigosum	*	*	*	*	*	*		
Epicoccum nigrum	*		*				*	
Hysteronaevia minutissima(S)		*						
Hysteropezizella diminuens	*	*	*	*		*	*	
Lachnum diminutum(S)			*					
Lachnum roseum		*						
Mycosphaerella perexigua var. *minima*(S)	*	*	*	*	*	*		*
Naeviella paradoxa(S)			*					
Niptera eriophori	*	*	*	*	*	*	*	
Periconia atra	*		*	*				
Phaeosphaeria vagans							*	

Tab. 2. – continuation

Phytogeographical unit	Hercynicum		Western Sudetes	Eastern Sudetes				
Mts.	Šumava Mts.		Krkonoše Mts.	Králický Sněžník	Hrubý Jeseník Mts.			
Locality	1	2	3	4	5	6	7	8
***(Phialocephala* sp.)**						(*)		
***Pseudoseptoria* sp.**(S)		*	*			*	*	
Pycnothyrium junci(S)	*					*		
Septoria chanousiana(S) (*Septoria* sp.)			*					
Stagonospora junciseda(S)		*						
***Unguicularia* sp.**							*	

ACKNOWLEDGEMENTS

We wish to thank Dr. Erin B. McCray (BPI) for his help in literature search. We are grateful to curators of herbaria IMI, PRC and WSP for arranging loans. The research was supported by grants of the Ministry of Culture of the Czech Republic (projects no. MK0CEZ99F0201 and RK04P03OMG010).

REFERENCES

ALLESCHER A. (1901): Fungi imperfecti: Hyalin-sporige Sphaerioideen. Lf. 74. – In: Rabenhorst's Krypt.-Fl. Deutschl., Oest. und Schweiz, ed. 2, 1/6: 961–992, Leipzig.

CHLEBICKI A. (2002): Biogeographic relationships between fungi and selected glacial relict plants. – Monographiae Botanicae 90: 1–230.

CHLEBICKI A. and SUKOVÁ M. (2004): Fungi of alpine 'islands' of Dryas octopetala in the Carpathians. – Mycotaxon 90(1): 153–176.

CHLEBICKI A., KNUDSEN H. and OLEJNICZAK P. (in press): Immigration routes of Dryas integrifolia and D. octopetala to Greenland as inferred from their associated fungi. – Nova Hedwigia 80(3–4).

COOKE W. B. (1955): Fungi of Mount Shasta. (1936–1951). – Sydowia 9: 94–215.

DOSTÁL J. (1989): Nová Květena ČSSR. Vol. 1, 2. – 1548 p. Praha.

ELLIS M. B. and ELLIS J. P. (1985): Microfungi on land plants. – 818 p. London.

FARR D. F., GERALD F. B., CHAMURIS G. P. and ROSSMAN A. Y. (1989): Fungi on plants and plant products in the United States. – 1252 p. St. Paul.

GROVE W. B. (1935): British stem and leaf fungi (Coelomycetes). Vol. 1. – 488 p. Cambridge.

GROVE W. B. (1937): British stem and leaf fungi (Coelomycetes). Vol. 2. – 407 p. Cambridge.

JUMPONEN A. and TRAPPE J. M. (1998): Dark septate endophytes: a review of facultative biotrophic root-colonizing fungi. – New Phytol. 140: 295–310.

KORF R. P. and KOHN L. M. (1980): Revisionary studies in the Hyaloscypheae. I. On genera with glassy hairs. – Mycotaxon 10: 503–512.

PETRAK F. (1920): Der mykologische Nachlaß Josef Jahn's, ein Beitrag zur Pilzflora des Egerlandes. – Ann. Mycol. 18: 105–135.

PUNITHALINGAM E. (1988): Ascochyta II. Species on monocotyledons (excluding grasses), cryptogams and gymnosperms. – Mycol. Pap. 159: 1–235.

RASCHLE P. (1977): Taxonomische Untersuchungen an Ascomyceten aus der Familie der Hyaloscyphaceae Nannfeldt. – Sydowia 29: 170–236.

SACCARDO P. A. (1884): Sylloge fungorum. Vol. 3. – 860 p. Patavii.

SACCARDO P. A. (1892): Sylloge fungorum. Vol. 10. – 964 p. Patavii.

SCHADT C. W., MULLEN R. B. and SCHMIDT S. K. (2001): Isolation and phylogenetic identification of a dark-septate fungus associated with the alpine plant Ranunculus adoneus. – New Phytol. 150: 747–755.

SCHEUER C. (1988): Ascomyceten auf Cyperaceen und Juncaceen im Ostalpenraum. – In: Bibliotheca Mycologica 123, p. 1–274, Berlin and Stuttgart.

SCHRÖTER J. (1888): Beiträge zur Kenntnis der nordischen Pilze. – Jahresber. Schles. Ges. Vaterl. Cult. 65[1887]: 266–284.

SHOEMAKER R. and BABCOCK C. E. (1989): Phaeosphaeria. – Can. J. Bot. 67: 1500–1599.

SLAVÍK B. [ed.] (2000): Květena České republiky. 6. [Flora of the Czech Republic.] – 770 p. Praha.

SPRAGUE R. (1962): Some leafspot fungi on western Juncaceae. – II. – Res. Stud. State Coll. Wash. 30: 169–173.

SUKOVÁ M. (2004): Fungi on Juncus trifidus in the Czech Republic. I. – Czech Mycol. 56: 63–84.

SUKOVÁ M., SCHEUER C. and BURYOVÁ B. (2003): New records and ecology of Naeviopsis carneola in Central Europe with notes on other fungi growing on Juncus filiformis. – Czech Mycol. 55: 223–239.

SUTTON B. C. (1980): The Coelomycetes. – 696 p. Kew.

TETEREVNIKOVA-BABAJAN D. N. (1987): Griby roda Septoria v SSSR. – 478 p. Jerevan.

CZECH MYCOL. 56 (3–4), 2004

Biological control of two phytopathogenic fungal species isolated from the rhizoplane of soybean (Glycine max)

MOHAMED HASHEM

Department of Botany, Faculty of Science, Assiut University, Assiut, Egypt
mhashem2000eg@yahoo.com

Hashem M. (2004): Biological control of two phytopathogenic fungal species isolated from the rhizoplane of soybean (Glycine max). – Czech Mycol. 56: 223–238

Two hundred isolates representing 31 fungal species (20 genera) were recovered from soybean roots. Samples were collected from 12 localities at 3 different growth stages of the crop. The most dominant species were *Aspergillus flavus, Fusarium oxysporum, Fusarium solani* (*Nectria haematococca*), *Macrophomina phaseolina* and *Rhizoctonia solani*. Pathogenicity tests have proved the ability of *Macrophomina phaseolina* and *Rhizoctonia solani* to infect soybean roots and produce the symptoms of damping-off and root-rot diseases. The efficacy of three antagonists (*Trichoderma harzianum, Epicoccum nigrum* and *Paecilomyces lilacinus*) as well as two organic compounds (Strom and F-760) was evaluated as to their control of pathogenic fungi. Biocontrol fungi significantly suppressed *Macrophomina phaseolina* and *Rhizoctonia solani* in vitro and in vivo. *Epicoccum nigrum* and *Paecilomyces lilacinus* suppressed the growth of the pathogens by producing an inhibition zone while *Trichoderma harzianum* suppressed them by overgrowing. Strom and F-760 showed lower reduction effect of diseases in comparison with the antagonists.

Keywords: biological control, soybean, *Macrophomina phaseolina, Rhizoctonia solani*

Hashem M. (2004): Biologická kontrola dvou fytopatogenních hub izolovaných z povrchu kořenů sóji (Glycine max). – Czech Mycol. 56: 223–238

Z kořenů sóji bylo získáno 200 izolátů reprezentujících 31 druhů hub z 20 rodů. Vzorky byly získány z 12 lokalit a ze 3 různých růstových stádií. Dominantními druhy byly *Aspergillus flavus, Fusarium oxysporum, Fusarium solani* (*Nectria haematococca*), *Macrophomina phaseolina* a *Rhizoctonia solani*. Testy patogenicity prokázaly schopnost druhů *Macrophomina phaseolina* a *Rhizoctonia solani* infikovat kořeny sóji a vyvolávat příznaky padání klíčních rostlin a kořenové hniloby. Byla hodnocena schopnost tří antagonistických druhů (*Trichoderma harzianum, Epicoccum nigrum* a *Paecilomyces lilacinus*) a dvou organických fungicidů (Strom a F-760) potlačovat patogenní houby. Antagonistické houby významně potlačovaly druhy *Macrophomina phaseolina* a *Rhizoctonia solani* jak in vitro, tak in vivo. *Epicoccum nigrum* a *Paecilomyces lilacinus* potlačovaly růst patogenů vytvořením inhibiční zóny, zatímco *Trichoderma harzianum* přerůstáním. Fungicidy Strom a F-760 vykazovaly menší potlačení chorob ve srovnání s antagonistickými houbami.

INTRODUCTION

Modern agriculture has tended to apply ever-larger amounts of fungicides to attain the yield potential of crops. This leads inevitably to disturbances in the biological balance and has caused severe disease outbreaks, environmental

pollution, and to increasing amounts of toxic chemicals in food chains. Nowadays, there are propelling constraints urging to look for alternative control methods in crop production. This has led to intensified research on biological control of plant diseases (Hazarika and Das 1998, El-Naggar et al. 2001).

Soybean is an important oil crop in Egypt as well as elsewhere in the world. It is attacked by many plant pathogens. *Rhizoctonia solani* and *Macrophomina phaseolina* are involved in many diseases of this crop such as damping-off, root-rot, stem-rot and charcoal rot (Vyas 1994, Ehteshmaul-Haque and Ghaffar 1995, Vallone 1998, Datta et al. 2000).

Recently, biological control of *Rhizoctonia solani* and *Macrophomina phaseolina* has intensively been studied by many researchers throughout the world (Das and Dutta 1999, Zheng and Sinclair 2000). Application of *Trichoderma* spp. as a soil drench or seed treatment to reduce the severity of soybean root diseases has received growing attention in research (Killebrew et al. 1993, Das and Dutta 1999, Izhar et al. 1999, Datta et al. 2000). Efficiency of some other antagonists e.g. *Paecilomyces lilacinus*, *Gliocladium roseum*, *Gliocladium virens*, *Aspergillus* spp. and *Penicillium* spp. in control of both *Rhizoctonia solani* and *Macrophomina phaseolina* is mentioned by many authors (Ehteshmaul-Haque et al. 1992, Siddiqui et al. 2000).

In Egypt, biological control of such organisms was studied by a few researchers (Yehia et al. 1994, Aziz et al. 1997, El-Shawadfy 1997). Thus, the present work aimed to investigate safe, economic and biological control for the management of soybean root diseases caused by *Rhizoctonia solani* and *Macrophomina phaseolina*.

MATERIALS AND METHODS

Collection of samples

Soybean root samples were collected from 12 different localities in Assiut Governorate (Upper Egypt) during April-August 2001. From each field, 3 samples were taken at three different stages [seedling (20–25 days), flowering (50–60 days) and mature (80–90 days)] of the crop, 108 samples in total. Mean disease rating (MDR) of the collected root samples was estimated with a disease index using the following formula:

$MDR = \Sigma\ (ab)/n$, where

$\Sigma\ (ab)$ is the sum of plants,

a is the degree to which the plant is affected,

b is the number of plants which has the same degree,

n is total number of diseased plants.

To detect the different degrees (to which the plant is affected), roots were classified into 6 categories:

1 = 0–<5 %; 2 = 5–<15 %; 3 = 15–<25 %; 4 = 25–<50 %; 5 = 51–<75 % and 6 = 75–100 % discoloration of roots.

Isolation of rhizoplane fungi

Soybean roots were washed in running tap water and were cut into 1-cm segments. The segments were divided into two groups. The first group was washed with sterilised distilled water 3 times, dried and inserted on the surface of potato dextrose agar (PDA) medium amended with streptomycin (60 $\mu g.ml^{-1}$). The second group was surface sterilised by soaking in 3 % solution of sodium hypochlorite (NaOCl) for 2 min., then washed 3 times with sterilised distilled water, and inoculated into another group of plates (9 cm in diameter) containing the same medium. In each Petri dish five segments were placed (10 plates per sample were used in each case) and incubated at 28 ± 2 °C for 5–7 days, then examined for fungal analysis. The fungi were examined and identified using relevant references (Raper and Thom 1949, Raper and Fennell 1965, Rifai 1969, Ellis 1976, Booth 1977, Domsch et al. 1980, Moubasher 1993).

Pathogenicity test

Pathogenicity of *Rhizoctonia solani* and *Macrophomina phaseolina* was determined on soybean plants under greenhouse conditions. Inocula of each isolate were prepared by growing in 500 ml glass bottles containing sterilised barley grain medium at 28 ± 2 °C for 21 days (modified from Soliman et al. 1993). The inoculum of each fungus was mixed thoroughly with clay soil at a rate of 2 % (w/w) and then placed in pots (20 cm in diameter). Ten surface disinfected seeds were sown in each pot. Non-infested soil was mixed with 2 % (w/w) sterilised barley grains and was used as control. Plants were watered when necessary. Three replicates were used in each treatment. Percentages of pre- and post-emergency of damping-off of seedlings were estimated after 2 weeks from planting. Twenty-five days after cultivation, percentage of survived plants was determined and then the seedlings were uprooted to estimate the mean disease rating (MDR) of root-rot in them. To verify the infection of soybean roots with the two pathogens, *Rhizoctonia solani* and *Macrophomina phaseolina* were reisolated from the infected plants.

Preliminary antagonism test

Three antagonistic fungi, viz. *Trichoderma harzianum*, *Epicoccum nigrum* and *Paecilomyces lilacinus*, were isolated from the soybean rhizoplane. The inhibitory effect of these antagonists on the growth rate of *Rhizoctonia solani* and *Macrophomina phaseolina* was studied by the dual culture method in Petri dishes according to the method described by Hazarika and Das (1998). After 5 days of incubation at 28 ± 2 °C on PDA medium, the radial growth of the pathogen's colonies in dual culture was measured and the percentage of inhibition was calculated compared to the control. Also, the inhibition zone was estimated and mycoparasitism detected visually and by light microscope.

Tested compounds

The effect of two organic compounds Strom and Fenor (F-760) on mycelial growth of both pathogens (*Rhizoctonia solani* and *Macrophomina phaseolina*) was studied in Petri dishes. Strom is a derivative of blood protein of fibrinogen, albumin and globulin with sodium cellulose glycolic acid (Schkalikov et al. 1994). Fenor (F-760) is a quaternary ammonium salt (4-aminobenzoate-2-hydroxypropyl, triethylammonia), (Schkalikov et al. 1994). The recommended dose of each compound (2.5 % for Strom and 1.4 % for F-760) was thoroughly mixed in sterilised PDA medium separately, and poured into Petri dishes (three replicates for each treatment). Mycelial disks of 4-day old cultures of the pathogens (5 mm in diameter) were placed in the middle of the plates. Plates containing PDA were only inoculated with the same tested fungi and served as control. The diameters of the colonies were measured after 1, 2, 3 and 4 days.

Pot experiments

The inoculum of antagonists and pathogens was prepared as mentioned above (under Pathogenicity test). Inocula of both antagonist and pathogen were mixed with soil (2 % w/w of each). The control treatment was mixed with 4 % (w/w) of sterilised barley seeds. In the case of Strom and F-760, the inoculum of the pathogens only was added and the seeds of soybean were dressed in suspensions of these compounds containing the recommended dose of each compound separately, before planting. Percentages of pre- and post-emergence damping-off of seedlings, survived plants, mean disease rating (MDR) of root-rot disease as well as fresh and dry weights of plants (30 days old) were estimated. The experiments were arranged in complete randomised design and the data were analysed using LSD at 5 %.

Tab. 1. Mean disease rating (MDR) of collected plants from different localities.

Locality	Plant growth stages		
	Seedling	Flowering	Mature
1	1.0	2.0	3.1
2	1.7	2.7	3.3
3	1.7	2.0	2.6
4	2.3	3.3	3.5
5	2.1	2.7	3.2
6	2.2	3.0	4.2
7	1.7	3.2	4.1
8	2.3	3.0	4.5
9	2.1	2.5	4.1
10	1.7	3.2	5.0
11	2.2	2.6	4.2
12	1.6	2.3	3.3

RESULTS

The mean disease rating (MDR) of root-rot of collected samples from different localities was estimated and is represented in Table 1. Generally, it is clear that the discoloration of the roots increased with age of the plant. The MDR fluctuated between 1.0 and 5.0. Locality 10 exhibited the highest rate (5.0), while locality 3 gained the lowest (2.6) rate at crop maturity stage.

Thirty-one fungal species belonging to 20 genera were isolated from soybean root surfaces (Table 2). In general, the most dominant genera that occurred in high frequencies throughout the three different plant stages were *Aspergillus* (63.7 %), *Fusarium* (60.7 %), *Macrophomina* (36.3 %), *Rhizopus* (15.3 %) and *Rhizoctonia* (10.5 %). In seedling stage the most dominant species were *Aspergillus flavus* (35.2 %), *Rhizopus stolonifer* (8.9 %), *F. solani* (5.8 %), *Macrophomina phaseolina* (5.4 %), *A. niger* (4.3 %) and *Fusarium moniliforme* (3.1 5 %). During the flowering stage the order of dominant species was changed and the most frequent were *Aspergillus flavus* (12.2 %), *Fusarium oxysporum* (11.8 %), *Fusarium solani* (8.0 %), *Mucor racemosus* (6.9 %), *Rhizopus stolonifer* (5.2 %), *Rhizoctoria solani* (4.0 %) and *Fusarium moniliforme* (3.5 %). At the maturity of the crop, *Macrophomina phaseolina* (26.7 %), *Fusarium oxysporum* (21.0 %), *Alternaria alternata* (20.4), *Mucor racemosus* (13.1 %) and *Fusarium solani* (5.4 %) represented the most dominant species. Other fungal species were observed in low percentage (0.1–2.3 %) during the three periods of isolation (Table 2).

Tab. 2. Percentages of fungi isolated from non-sterilised soybean roots (600 segments; 50 segments per sample).

Species	Plant growth stages			Total
	Seedling	Flowering	Mature	
Acremonium strictum W. Gams	0.0	0.8	0.9	1.7
Alternaria alternata (Fr.) Keissl.	0.1	3.2	20.4	23.7
Aspergillus	41.4	17.2	5.1	63.7
A. flavipes (Bainier et Sartory) Thom et Church	0.4	0.3	0.0	0.7
Aspergillus flavus Link	35.2	12.2	2.3	49.7
A. fumigatus Fresen.	0.3	0.2	0.0	0.5
A. niger Tiegh.	4.3	2.3	1.6	8.2
A. ochraceus G. Wilh.	0.6	0.7	0.2	1.5
A. terreus Thom	0.7	1.5	1.0	3.2
Chaetomium globosum Kunze	0.1	0.1	0.0	0.2
Cladosporium cladosporioides (Fresen.) G. A. de Vries	0.0	0.2	1.9	2.1
Cunninghamella elegans Lendn.	0.1	0.1	0.1	0.3
Curvularia lunata (Wakker) Boedijn	0.2	0.5	0.1	0.8
Drechslera	1.4	0.9	0.3	2.6
Drechslera halodes (Drechsler) Subram. et B. L. Jain	0.5	0.1	0.2	0.8
Drechslera spicifera (Bainier) Arx	0.9	0.8	0.1	1.8
Epicoccum nigrum Link	0.2	0.2	0.5	0.9
Fusarium	10.4	23.3	27.0	60.7
Fusarium moniliforme J. Sheld.	3.1	3.5	0.6	7.2
Fusarium oxysporum Schltdl.	1.5	11.8	21.0	34.3
Fusarium solani (Mart.) Sacc.	5.8	8.0	5.4	19.2
Clonostachys rosea (Link: Fr.) Schroers et al. f. *rosea*	0.0	0.5	0.2	0.7
Macrophomina phaseolina (Tassi) Goid.	5.4	4.2	26.7	36.3
Mucor racemosus Bull.	2.2	6.9	13.1	22.2
Myrothecium verrucaria (Alb. et Schwein.) Ditmar	0.0	0.1	0.1	0.2
Paecilomyces lilacinus (Thom) Samson	0.1	0.0	0.0	0.1
Penicillium	0.8	0.4	0.4	1.6
P. chrysogenum Thom	0.2	0.1	0.1	0.4
P. corylophilum Dierckx	0.2	0.1	0.1	0.4
Penicillium funiculosum Thom	0.4	0.2	0.2	0.8
Rhizoctonia solani J. G. Kühn	1.4	4.0	5.1	10.5
Rhizopus stolonifer (Ehrenb.) Lind	8.9	5.2	1.2	15.3
Stachybotrys chartarum (Ehrenb.) S. Hughes	0.1	0.0	0.1	0.2
Trichoderma harzianum Rifai	0.4	0.4	1.6	2.4
Ulocladium chartarum (Preuss) E. G. Simmons	0.1	0.2	0.2	0.5

Tab. 3. Percentages of fungi isolated from surface-sterilised soybean roots (600 segments; 50 segments per sample)

Species	Plant growth stages			Total
	Seedling	Flowering	Mature	
Alternaria alternata	5.0	8.5	15.8	29.3
Aspergillus	8.4	5.2	4.6	18.2
Aspergillus flavus	4.5	3.2	3.5	11.2
A. fumigatus	0.2	0.2	0.1	0.5
A. niger	2.1	1.5	0.5	4.1
A. ochraceus	0.5	0.1	0.2	0.8
A. terreus	1.1	2.0	0.3	3.4
Cladosporium cladosporioides	0.2	0.1	0.0	0.3
Curvularia lunata	0.8	0.5	0.4	1.7
Drechslera	3.4	7.0	5.9	16.3
Drechslera halodes	2.1	3.5	3.0	8.6
Drechslera spicifera	0.5	3.0	2.5	6.0
Epicoccum nigrum	0.1	0.2	0.2	0.5
Fusarium	11.0	22.5	49.5	83.0
Fusarium moniliforme	5.0	7.0	10.2	22.2
Fusarium oxysporum	2.5	10.5	30.5	43.5
Fusarium solani	3.5	5.0	8.5	17.0
Clonostachys rosea	0.0	0.1	0.1	0.2
Macrophomina phaseolina	8.2	15.6	40.3	64.1
Myrothecium verrucaria	0.0	0.1	0.0	0.1
Penicillium	0.5	0.5	0.6	1.6
Penicillium chrysogenum	0.3	0.4	0.5	1.2
Penicillium funiculosum	0.2	0.1	0.1	0.4
Rhizoctonia solani	5.0	8.3	8.9	22.2
Trichoderma harzianum	0.2	0.2	0.2	0.6

The data in Table 3 demonstrate that 21 fungal species were isolated from the surface sterilised roots. The most dominant species isolated in high frequency from the three stages of growth were *Macrophomina phaseolina* (64.1 %), *Fusarium oxysporum* (43.5 %), *Alternaria alternata* (29.3 %), *Fusarium moniliforme* (22.2 %), *Penicillium funiculosum* (22.2 %) *Fusarium solani* (17.0 %), *Aspergillus flavus* (11.2 %), *Drechslera halodes* (8.6 %) and *Drechslera spicifera* (6.0 %).

In seedling stage, the most dominant species were *Macrophomina phaseolina* (8.2 %), *Rhizoctonia solani* (5.0 %), *Alternaria alternata* (5.0 %), *Fusarium*

Tab. 4. Pathogenicity test of *Rhizoctonia solani* and *Macrophomina phaseolina*.

Treatments	% of damping-off		Surviving plants (%)	MDR of root-rot
	Pre-emergence	Post-emergence		
Control	6.67	3.33	90.00	1.67
Rhizoctonia solani	56.62	20.00	26.67	4.33
Macrophomina phaseolina	53.33	20.00	26.67	4.67
LSD at 5 %	11.54	6.66	9.42	1.15

Tab. 5. Inhibitory effect of antagonists on *R. solani* and *Macrophomina phaseolina* in vitro.

Treatments	Inhibition of growth (% of control)	Inhibition zone (in mm)	Mycoparasitism (overgrowth)
Rhizoctonia solani			
Epicoccum nigrum	12.28	5	–
Paecilomyces lilacinus	25.06	3.5	–
Trichoderma harzianum	43.08	0.0	+
Macrophomina phaseolina			
Epicoccum nigrum	25.76	11	–
Paecilomyces lilacinus	24.38	7.5	–
Trichoderma harzianum	50.30	0.0	+

moniliforme (5.0 %) and *Aspergillus flavus* (4.5 %). At flowering and mature stages, *Macrophomina phaseolina* occupied the first place among the isolated fungi and was detected in 15.6 % and 40.3 % of the total examined root segments, respectively. *Fusarium oxysporum*, *Fusarium moniliforme*, *Rhizoctonia solani*, *Alternaria alternata*, and *Drechslera halodes* were the most dominant species following *Macrophomina phaseolina*. The percentage of these fungi collectively, was 42.8 % at the flowering stage and 76.9 % in the mature stage of plants. The rest of the fungal species were rarely isolated (Table 3).

The results in Table 4 proved the ability of both *Rhizoctonia solani* and *Macrophomina phaseolina* to infect seedlings of soybean and cause pre- and post-emergence damping-off as well as root-rot disease. They reduced the percentage of survived plants to 26.33 % and 26.67 % and increased the MDR to 4.33 and 4.67, respectively.

The test of Strom and F-760 in the of control of *Rhizoctonia solani* and *Macrophomina phaseolina* was carried out in Petri dishes and the obtained results are represented in Figs. 1, 2 and 3. It is clear that F-760 is more effective than

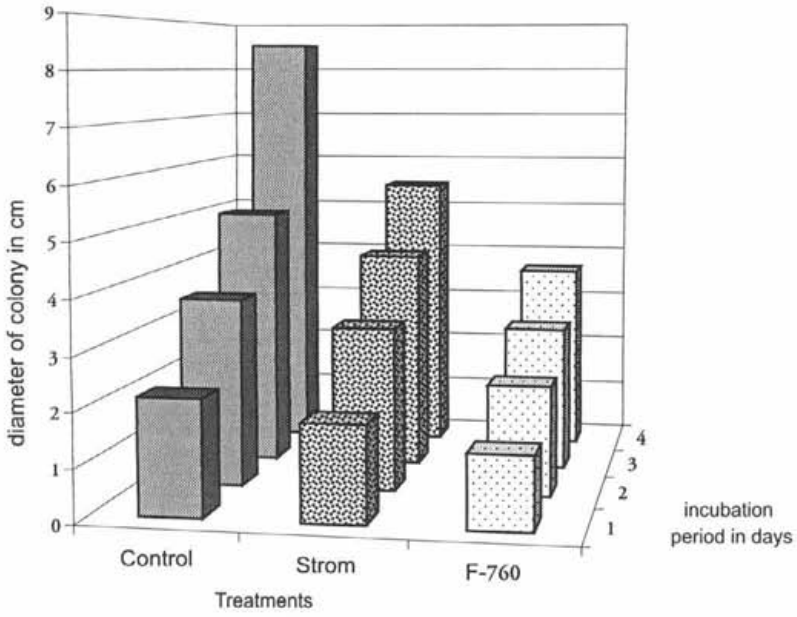

Fig. 1. Effect of Strom and F-760 on the mycelial growth of *Rhizoctonia solani*.

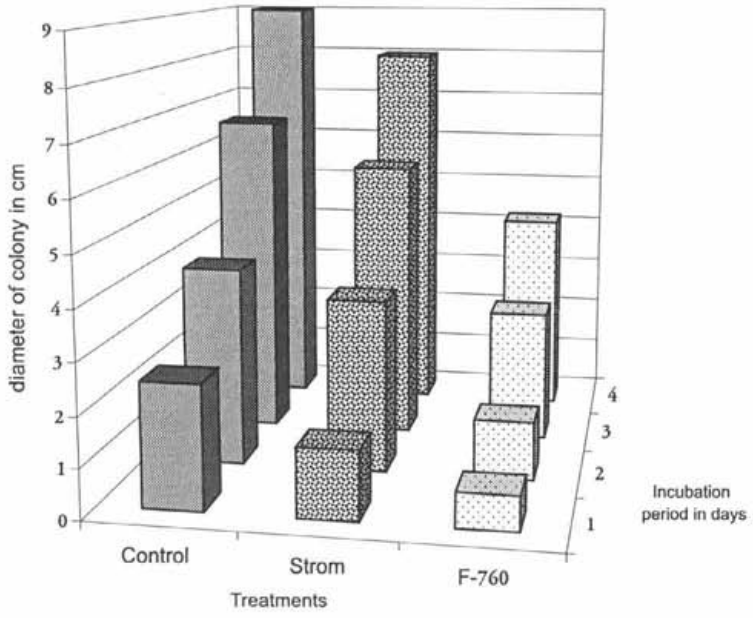

Fig. 2. Effect of Strom and F-760 on the mycelial growth of *Macrophomina phaseolina*.

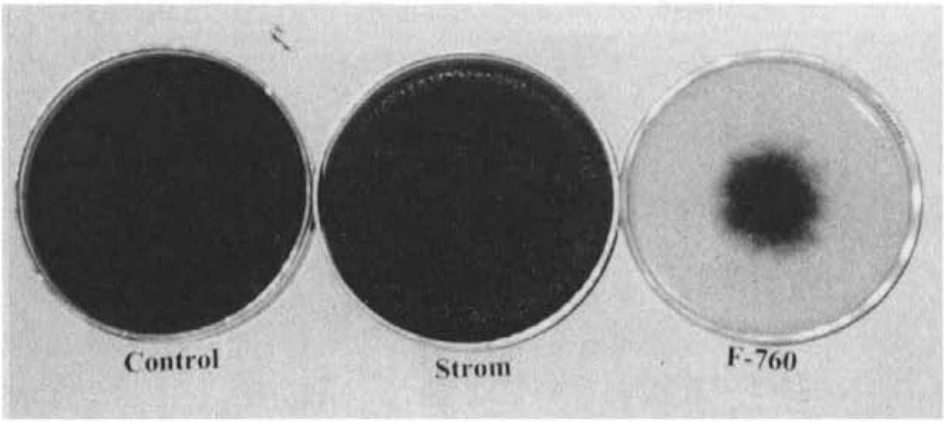

Fig. 3. Inhibition of mycelial growth of *Macrophomina phaseolina by* Strom and F-760.

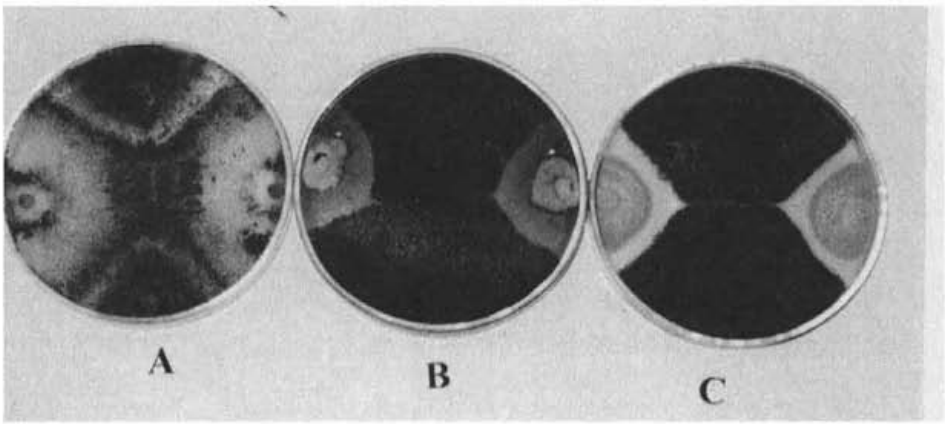

Fig. 4. Antagonist's inhibition of the growth of *Macrophomina phaseolina* by overgrowth of *Trichoderma harzianum* (A) and production of inhibition zone by *Epicoccum nigrum* (B) and *Paecilomyces lilacinus* (C).

Strom in the inhibition of the mycelial growth of the two pathogens. F-760 and Strom showed a pronounced inhibitory effect of the mycelial growth of *Rhizoctonia solani* (56.9 % and 35.3 % of the control, respectively) at the end of the incubation period (Fig. 1). *Macrophomina phaseolina* was affected by the two tested compounds all through the incubation period (Fig. 2 and 3). At the end of the experiment, this inhibition was 53.3 % by F-760 and 11.4 % in the case of Strom in comparison with the control.

The antagonistic effect of *Epicoccum nigrum*, *Paecilomyces lilacinus* and *Trichoderma harzianum* against *Rhizoctonia solani* and *Macrophomina phaseolina*

Tab. 6. Effect of antagonists and compounds on *Rhizoctonia solani* under greenhouse conditions.

Treatments	Damping off (%)		Surviving plants (%)	MDR of root-rot		Weight of seedlings	
	Pre-emergence	Post-emergence		As seedling	At maturity	Fresh	Dry
Control	10.00	3.33	86.67	1.67	2.33	2.83	0.62
Rhizoctonia solani	56.67	16.67	26.67	4.33	4.67	2.52	0.45
Rhizoctonia solani + *Epicoccum nigrum*	26.67	0.00	73.33	2.33	2.67	3.07	0.73
Rhizoctonia solani + *Trichoderma harzianum*	30.00	6.67	63.33	2.67	2.67	2.97	0.70
Rhizoctonia solani + *Paecilomyces lilacinus*	30.00	6.67	63.33	2.67	3.00	2.95	0.65
Rhizoctonia solani + Strom	30.00	16.67	53.33	3.33	3.33	2.80	0.60
Rhizoctonia solani + F-760	26.67	13.33	56.67	3.33	3.33	2.81	0.56
LSD at 5 %	9.36	9.36	10.11	1.01	0.94	0.15	0.08

was studied in the laboratory as a preliminary test. Table 5 and Fig. 4 show that *Trichoderma harzianum* exerted the highest inhibitory effect on the mycelial growth of the pathogens (it reduced the growth of *Rhizoctonia solani* and *Macrophomina phaseolina* by 43.8 % and 50.3 % of the control, respectively). The inhibition of the pathogens by *Trichoderma harzianum* was related to its ability to overgrow them (mycoparasitism), whereas *Epicoccum nigrum* and *Paecilomyces lilacinus* reduced the growth of *Rhizoctonia solani* and *Macrophomina phaseolina* by production of an inhibition zone. The width of the inhibition zone produced by *Epicoccum nigrum* was 5 and 11 mm against *Rhizoctonia solani* and *Macrophomina phaseolina,* respectively. *Paecilomyces lilacinus* exerted 3.5 and 7.5 mm wide inhibition zones against the same pathogens in the same order.

In pot experiments, the effect of the antagonists and the organic compounds on *Rhizoctonia solani* and *Macrophomina phaseolina* was studied under greenhouse conditions. Application of antagonists as soil treatment and organic compounds as seed treatment significantly reduced the pre- and post-emergence damping-off and root-rot diseases caused by *Rhizoctonia solani*. The best result was achieved by *Epicoccum nigrum* when mixed with the pathogen. It was involved in the reduction of pre-emergence of seedlings in 26.67 % of the cases and completely eliminated the post-emergence damping-off disease (Table 6).

Tab. 7. Effect of antagonists and compounds on *Macrophomina phaseolina* under greenhouse conditions.

Treatments	Damping off (%)		Surviving plants (%)	MDR of root-rot		Weight of 30 days old plant	
	Pre-emergence	Post-emergence		As seedling	At maturity	Fresh	Dry
Control	10.00	3.33	86.67	1.67	2.33	2.83	0.62
Macrophomina phaseolina	53.33	16.67	30.00	4.33	2.33	2.47	0.55
Macrophomina phaseolina + *Epicoccum nigrum*	26.67	3.33	70.00	2.33	2.33	3.08	0.84
Macrophomina phaseolina + *Trichoderma harzianum*	23.33	6.67	70.00	2.67	2.64	2.85	0.71
Macrophomina phaseolina + *Paecilomyces lilacinus*	30.00	10.00	60.00	2.67	2.67	3.10	0.81
Macrophomina phaseolina + Strom	33.33	13.33	53.33	3.67	3.67	2.96	0.72
Macrophomina phaseolina + F-760	36.67	16.67	47.67	3.67	3.67	2.92	0.67
LSD at 5 %	8.55	9.36	24.77	1.01	1.01	0.24	0.08

All other treatments (*Trichoderma harzianum, Paecilomyces lilacinus*, Strom and F-760) also significantly reduced the percentage of pre- and post-emergence damping-off compared with *Rhizoctonia solani*. The number of surviving plants was significantly increased by the application of all antagonists and organic compounds. The MDR of root-rot of soybean was reduced significantly as a result of application of antagonists or organic compounds. It ranged from 2.33 in the case of *Epicoccum nigrum* and 3.33 in case of Strom. Fresh and dry weights of seedlings increased by the application of the antagonists and organic compounds (Table 6).

The results in Table 7 show that *Macrophomina phaseolina* is probably the main causal agent of pre- and post-emergence damping-off and root-rot diseases of soybean. It was responsible for the death of 53.33 % of seedlings before germination and 16.67 % after germination. On the other hand, mixing of antagonists with these pathogens resulted in a significant reduction of both diseases. Also, these treatments improved the percentage of surviving plants as well as fresh and dry weights of seedlings. *Epicoccum nigrum* and *Trichoderma harzianum* exhibited the best effect on plants. They increased the percentage of surviving plants (70 %) and reduced the MDR to 2.33. Application of Strom and F-760 as seed treatment

also improved the health of plants and reduced the rate of disease to some extent compared with the antagonistic fungi.

DISCUSSION

In this study, thirty-one fungal species were recovered from the rhizoplane of soybean. The most dominant fungi which were isolated in high frequencies during the three periods of isolation (seedling, flowering and mature stages) were *Aspergillus flavus, Macrophomina phaseolina, Fusarium oxysporum*, *Alternaria alternata*, *Mucor racemosus, Fusarium solani, Rhizopus stolonifer, Rhizoctonia solani, A. niger* and *Fusarium moniliforme*. Most of these species, especially *Alternaria alternata*, *Fusarium moniliforme*, *Fusarium solani, Macrophomina phaseolina* and *Rhizoctonia solani* were reported as soybean root pathogen (Rupe 1991, Killebrew et al. 1993, Moubasher 1993, Aziz et al. 1997, Datta et al. 2000).

At seedling stage, *Aspergillus flavus* was the most dominant species, isolated in high frequency (35.2 % of total segments). It was recorded as a soybean root inhabiting fungus by many researchers (Tsay 1990, Dubey and Dwivedi 1988, Deb and Dutta 1991, Killebrew et al. 1993, Vyas 1994). Tsay (1990) reported that *Aspergillus flavus* reduced the emergence and caused blight and stunting symptoms on developed soybean seedlings. On the contrary, Dubey and Dwivedi (1988) and Deb and Dutta (1991) used *Aspergillus flavus* as an antagonistic organism against soybean root pathogens. Other fungi were isolated in relatively low frequencies and reported in many cases as soil or root saprophytes (Moubasher 1993, Tseng 1995).

From the surface sterilised roots, 21 species were isolated, of which *Macrophomina phaseolina, Rhizoctonia solani*, *Alternaria alternata, Fusarium moniliforme, Aspergillus flavus* and *Fusarium oxysporum* were considered the main dominant species. Isolation of these species from the soybean rhizoplane and rhizosphere was reported by many others researchers (Dubey and Dwivedi 1988, Killebrew et al. 1993, Vyas 1994).

The pathogenicity test with *Rhizoctonia solani* and *Macrophomina phaseolina* proved their ability to cause pre- and post-emergence damping-off and root-rot diseases of soybean seedlings. These results were confirmed by findings of many researchers (Vyas 1994, Ehteshamul-Haque and Ghaffar 1995, Aziz et al. 1997, El-Shawadfy 1997, Hazarika and Das 1998, Vallone 1998, Datta et al. 2000).

The preliminary test of the effect of organic compounds (Strom and F-760) on the control of *Rhizoctonia solani* and *Macrophomina phaseolina* revealed that the efficacy of F-760 in reduction of the mycelial growth of the pathogens is greater than that of Strom. These compounds were used successfully in the control of

root-rot disease of wheat by Russian scientists (Schkalikov 1995, 1996; Schkalikov and Schekhovtcova 1994; Schkalikov et al. 1994).

In dual culture, *Trichoderma harzianum*, *Paecilomyces lilacinus* and *Epicoccum nigrum* significantly reduced the mycelial growth of *Rhizoctonia solani* and *Macrophomina phaseolina*. The ability of different species of *Trichoderma* to inhibit the growth and parasitise the mycelia of *Rhizoctonia solani* and *Macrophomina phaseolina* was demonstrated by many investigators (Yehia et al. 1994, Vyas 1994, Ehteshamul-Haque and Ghaffar 1995, Das and Dutta 1999, Datta et al. 2000). This character of *Trichoderma* spp. is correlated to their ability to coil around hyphae of the pathogens and degrade them by producing degrading enzymes, especially 1,3-glucanase, chitinase and cellulase, which play an important role in lysis of the cell wall of pathogenic fungi (Hayes et al. 1993, Pisi et al. 2001)

Application of *Paecilomyces lilacinus* to control both *Rhizoctonia solani* and *Macrophomina phaseolina* was evaluated either singly or in combination with other fungi. They were used as seed dressing or soil treatment (Ehteshamul-Haque et al. 1992, Siddiqui et al. 2000).

In this study *Epicoccum nigrum* seemed to be a promising organism to control *Macrophomina phaseolina* and *Rhizoctonia solani*, while it has received little attention in the literature (Pascual et al. 1999, Huang et al. 2000).

In pot experiments, application of antagonistic fungi as soil treatments and organic compounds as seed dressing successfully controlled the target pathogens. Antagonists as well as organic compounds significantly reduced the disease index of plants and increased the percentage of emerged and surviving plants. Also, fresh and dry weights of seedlings improved as a result of application of these biocontrol agents. These results were in agreement with published data (Ehteshamul-Haque et al. 1992, Schkalikov 1995, 1996, Schkalikov and Schekhovtcova 1994, Schkalikov et al. 1994, Siddiqui et al. 2000). Ehteshamul-Haque and Ghaffar (1995) observed more than 50 % reduction in *Macrophomina phaseolina* and *Rhizoctonia solani* infection of 30-day-old soybean seedlings as a result of application of *Trichoderma harzianum*, *Trichoderma viride, Trichoderma hamatum*, *Trichoderma koningii, Trichoderma pseudokoningii* and *Bacillus japonicum* as seed treatments.

ACKNOWLEDGEMENTS

The author is grateful to Prof. Dr. V. A. Schkalikov, Head of the Plant Pathology Department, Moscow Agricultural Academy, Russia for providing the organic compounds Strom and F-760. He also thanks Prof. Dr. M. B. Mazen and Prof. Dr. A. M. Moharram, Botany Department, Faculty of Science, Assiut University, Assiut, Egypt for great help in checking the identification of the fungal genera and species recorded in this work.

REFERENCES

AZIZ N. H., EL-FOULY M. Z., EL-ESSAWY A. A. and KHALAF M. A. (1997): Influence of bean seedling root exudates on rhizosphere colonization by Trichoderma lignorum for the control of Rhizoctonia solani. – Botany Bulletin Academy Sinica 38: 33–39.

BOOTH C. (1977): Fusarium, laboratory guide to identification of the major species. – 237 p. Kew.

DAS B. C. and DUTTA P. (1999): Biological management of stem rot of soybean caused by Rhizoctonia solani Kuhn. – Journal of the Agricultural Science Society of North-East India 12(2): 217–220.

DATTA P., DAS B. C. and HAZARIKA D. K. (2000): Integrated management of soybean stem rot. – Journal of Biological Control 14(1): 67–69.

DEB P. R. and DUTTA B. K. (1991): Studies on biological control of foot rot disease of soybean caused by Sclerotium rolfsii Sacc. – Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz 98(5): 539–546.

DOMSCH K. H., GAMS W. and ANDERSON T. H. (1980): Compendium of soil fungi, Vol. 1. – 859 p. London.

DUBEY R. C. and DWIVEDI R. S. (1988): Antagonism between Macrophomina phaseolina and some rhizosphere microfungi of soybean. – International Journal of Tropical Plant Diseases 6(1): 89–84.

EHTESHAMUL-HAQUE S. and GHAFFAR A. (1995): Effect of Bradyrhizobium japonicum and fungicides in the control of root-rot disease of soybean. – Pakistan Journal of Botany 27(1): 227–232.

EHTESHAMUL-HAQUE S., HASHMI R. Y. and GHAFFAR A. (1992): Biological control of root-rot disease of lentil. – LENS Newsletter 19(2): 43–45.

ELLIS M. B. (1976): More dematiaceous hyphomycetes. – 507 p. Kew.

EL-NAGGAR M. M. F., AHMAD F. A. M., EL-FAKHARANY I. I. and BAYOUMI O. C. (2001): Effect of some pesticide residues extracted from tomato fruits and potato tubers on albino rats. – In: Proceeding of the first conference on safe alternative of pesticides for pest management, Assiut University, Faculty of Agriculture, 28–29th Oct., p. 131–144.

EL-SHAWADFY M. M. (1997): Biological management of soil-borne pathogens and root-knot nematode complexes on soybean. – In: Proceedings of the first international workshop of Afro-Asian nematologists, Menoufiya University, Egypt, 8–13 June.

HAYES C. K., PETERBAUER C., TRONSMO A., KLEMSDAL S. and HARMAN G. E. (1993): Antifungal chitinolytic enzymes from Trichoderma harzianum and Gliocladium virens purification, characterization, biological activity and molecular cloning. – In: Muzzarelli R. A. A. (ed), Chitin Enzymology, p. 383–392, Ancona, Italy.

HAZARIKA D. K. and DAS K. K. (1998): Biological management of root-rot of French bean (Phaseolus vulgaris L.) caused by Rhizoctonia solani. – Plant Diseases Research 13(2): 101–105.

HUANG H. C., BREMER E., HYNES R. K. and ERICKSON R. S. (2000): Foliar application of fungal biocontrol agents for the control of white mold of dry bean caused by Sclerotinia sclerotiorum. – Biological Control 18(3): 270–276.

IZHAR I., SIDDIQUI I. A., EHTESHAMUL-HAQUE S. and GHAFFAR A. (1999): Multiplication of plant growth-promoting rhizobacteria for use in the control of root-rot disease of crop plants. – Pakistan Journal of Botany 31(2): 397–405.

KILLEBREW J. F., ROY K. W. and ABNEY T. S. (1993): Fusarial and other fungi on soybean seedlings and roots of older plants and interrelationships among fungi, symptoms and soil characteristics. – Canadian Journal of Plant Pathology 15(3): 139–146.

MOUBASHER A. A. (1993): Soil fungi in Qatar and other Arab countries. – 566 p. Qatar.

PASCUAL S., MELGAREJO P. and MAGAN N. (1999): Production of the fungal biocontrol agent Epicoccum nigrum by solid substrate fermentation: effect of water activity on accumulation of compatible solutes. – Mycopathologia 146(2): 83–89.

PISI A., ROBERTI R., ZAKRISSON E., FILIPPINI G., MANTOVANI W. and CESARI A. (2001): SEM investigation about hyphal relationships between some antagonistic fungi against Fusarium spp. foot rot pathogen of wheat. – Phytopath. Mediterr. 40: 37–44.

RAPER K. B. and FENNELL D. J. (1965): The genus Aspergillus. – 686 p. Baltimore.

RAPER K. B. and THOM C. (1949): A manual of Penicillium. – 875 p. Baltimore.

RIFAI E. (1969): A revision of the genus Trichoderma. – Mycologia 116: 1–56.

RUPE J. C., GBUR E. E. and MARX D. M. (1991): Cultivar responses to sudden death syndrome of soybean. – Plant Dis. 75: 47–50.

SCHKALIKOV V. A. (1995): Ecology of protection of grain crops against diseases. – Moscow Agricultural Academy's Bulletin 2: 142–147 (in Russian).

SCHKALIKOV V. A. (1996): A complex method of protection of grain crops from root-rots. – D. Sc. thesis, Moscow Agricultural Academy (in Russian).

SCHKALIKOV V. A. and SCHEKHOVTCOVA O. N. (1994): Biological control of wheat from root-rots. – Protection of Plants 11: 20 (in Russian).

SCHKALIKOV V. A., SCHEKHOVTCOVA O. N. and IBRAHIM H. H. (1994): Proteins and Strom – inducers of immunity of grain crops to root-rots. – Protection of Plants 6:12 (in Russian).

SIDDIQUI I. A., QURESHI S. A., SULTANA V., EHTESHAMUL-HAQUE S. and GHAFFAR A. (2000): Biological control of root-rot and root knot disease complex of tomato. – Plant and Soil 227(1–2): 163–169.

SOLIMAN N. H., MANSOUR M. S., IBRAHIM I. A. M. and ABADA K. A. (1993): Biological and chemical control of broad-bean.– Journal of Applied Science 8(7): 347–351.

TSAY J. G. (1990): Aspergillus seedling blight of soybean and factors affecting its development. – Plant Protection Bulletin 32: 83–194.

TSENG T. C., TU J. C. and TZEAN S. S. (1995): Mycoflora and mycotoxins in dry bean (Phaseolus vulgaris) produced in Taiwan in Ontario, Canada. – Bot. Bull. Acad. Sin. 36: 229–234.

VALLONE S. (1998): Disease management in no-tillage soybean system.– JIRCAS Working Report 13: 35–42.

VYAS S. C. (1994): Integrated biological and chemical control of dry root-rot on soybean. – Indian Journal of Mycology and Plant Pathology 24(2): 132–134.

YEHIA A. H., ABD-EL-KADER D. A., SALEM D. E. and SAYED-AHMED A. A. (1994): Biological soil treatment with Trichoderma harzianum to control brown stem rot of soybean in Egypt. – Egyptian Journal of Phytopathology 22(2): 143–157.

ZHENG X. Y. and SINCLAIR J. B. (2000): The effects of traits of Bacillus megaterium on seed and root colonization and their correlation with the suppression of Rhizoctonia root-rot of soybean. – Biological Control 45(2): 223–243.

CZECH MYCOL. 56 (3–4), 2004

First record of a Pseudobaeospora species from the Czech Republic

SLAVOMÍR ADAMČÍK[1] and SOŇA RIPKOVÁ[2]

[1]Institute of Botany, Dúbravská 14, SK-845 23 Bratislava, Slovakia;
[2]Comenius University, Faculty of Natural Sciences, Department of Botany,
Révová 39, SK-811 02 Bratislava, Slovakia;
ripkova@fns.uniba.sk

Adamčík S. and Ripková S.: First record of a Pseudobaeospora species from the Czech Republic – Czech Mycol. 56: 239–246

During the fourth meeting of young mycologists in the Protected Landscape Area of Třeboňsko (16–19 October 2003) we found a taxon of the genus *Pseudobaeospora* characterised by the absence of clamp-connections. Comparing our specimen with the two other European species without clamp-connections, *P. oligophylla* (Singer) Singer and *P. pillodii* (Quél.) Wasser, we have come to the conclusion that our specimen does not fit either species. More specimens are needed for a definite delimitation of this presumably new taxon.

Key words: fungi, *Tricholomataceae, Pseudobaeospora*

Adamčík S. a Ripková S.: Prvý nález taxónu z rodu Pseudobaeospora z Českej republiky. – Czech Mycol. 56: 239–246

Na 4. stretnutí mladých mykológov v CHKO Třeboňsko (16.–19. október 2003) sme našli taxón z rodu *Pseudobaeospora* Singer, vyznačujúci sa absenciou praciek. Porovnaním nášho zberu s dvoma ďalšími druhmi, ktoré nemajú pracky, *P. oligophylla* (Singer) Singer a *P. pillodii* (Quél.) Wasser, sme dospeli k záveru, že náš zber nemôžeme stotožniť ani s jedným z nich. Na ohraničenie predpokladaného nového taxónu je však treba viac zberov.

INTRODUCTION

The genus *Pseudobaeospora* Singer, a little known member of the family *Tricholomataceae*, is characterised by small to very small, collybioid, mostly violet basidiocarps (a few species have basidiocarps with whitish, greyish or pale brown tints), and by the presence of thick-walled and dextrinoid basidia and spores.

In October 2003 we found a member of *Pseudobaeospora* in the Nature Reserve of Staré jezero (Třeboňská pánev Basin, Southern Bohemia). Our specimen consists of only one basidiocarp (Fig. 1). It represents the first find of the genus *Pseudobaeospora* in the Czech Republic.

Material and methods

The macrocharacters were observed in fresh material. Colours of basidiocarps were compared with Kornerup and Wanscher (1978) and expressed by symbols in parentheses. The microcharacters were mainly observed in dried material using a light microscope with oil immersion lens. Fragments of lamellae, stipe and pileipellis were examined in 5 % KOH, Melzer's reagent, and a solution of Congo Red in ammonia (1 ml of 25 % ammonia dissolved in a filtrated solution of 1.5 g Congo Red and 50 ml distilled water). Values of microcharacters were estimated as 5 and 95 percentiles of 30 measurements. Spore size refers to thick-walled dextrinoid spores only. The abbreviations of herbaria are cited in accordance with the Index Herbariorum (Holmgren et al. 1990).

Description

Pseudobaeospora sp.

Pileus 4.5 mm wide, hemisphaerical, umbonate, with 1–1.5 mm long marginal striation, when wet dark violet-brown (10F4), when dry greyish brown with violet tint (paler than 10D3), surface smooth, dry and matt. Stipe 20 × 0.6 mm, cylindrical, violet-brown (10E4–10F5), smooth, with whitish rhizoids at base. Lamellae sparse, L = 11, l = 0–1, ± 1 mm wide, adnexed, violet-brown (concolorous with stipe), with even, concolorous edge. Context more or less concolorous with surface, without specific smell, turning brownish-yellowish in 5 % KOH.

Basidia 2-spored, 16.5–25 × 3.5–5.5 μm, narrowly clavate; a few thick-walled and dextrinoid. Spores 4–4.9 × 3.3–4 μm (av. 4.3 × 3.6 μm), Q = 1.08–1.29 (av. Q = 1.21), ellipsoid, hyaline, smooth, thick-walled, dextrinoid. Cheilocystidia 21–33 × 2.5–6 μm, versiform: moliniform, clavate, cylindrical or fusiform, often with lateral nodules or finger-like projections. Caulocystidia 16–31 × 3–4 μm, cylindrical, narrowly clavate. Pileipellis yellowish-brownish in KOH, made up of a narrow suprapellis of slender hyphae with terminal cells 10.5–40 × 3–8.5 μm, cylindrical, occasionally also narrowly lageniform or narrowly clavate, over a seemingly pseudoparenchymatic subpellis of 9–24 μm thick hyphae. Clamp-connections absent from all parts of the basidiocarp.

Specimen examined: Czech Republic, Třeboňská pánev Basin, Protected Landscape Area of Třeboňsko, Nature Reserve Staré jezero, alt. 440 m, 48°58'12" N, 14°53'31" W, in litter among *Molinia* sp. under *Alnus glutinosa*, 17 Oct. 2003, leg. S. Adamčík and S. Ripková (SAV).

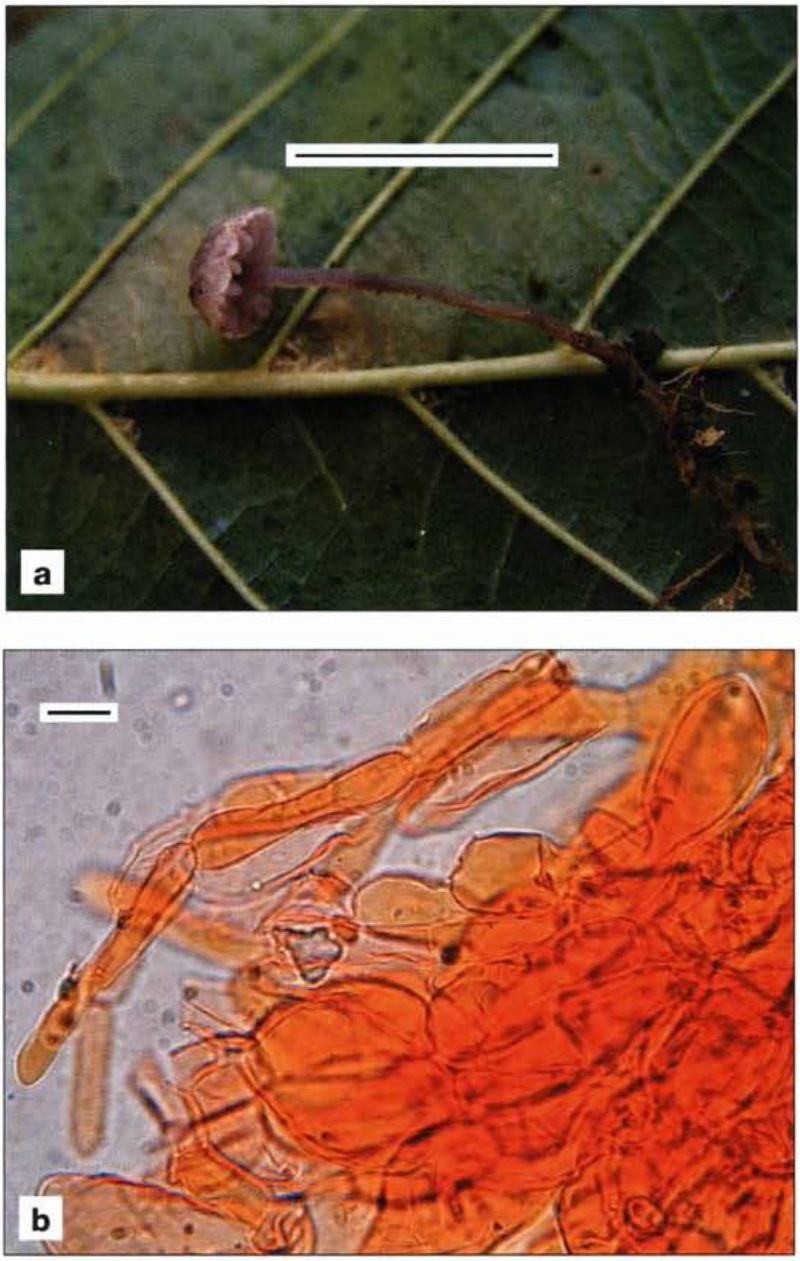

Fig. 1. *Pseudobaeospora* spec. – a: basidiocarp (scale bar = 10 mm, photo J. Holec), b: pileipellis (scale bar = 10 µm).

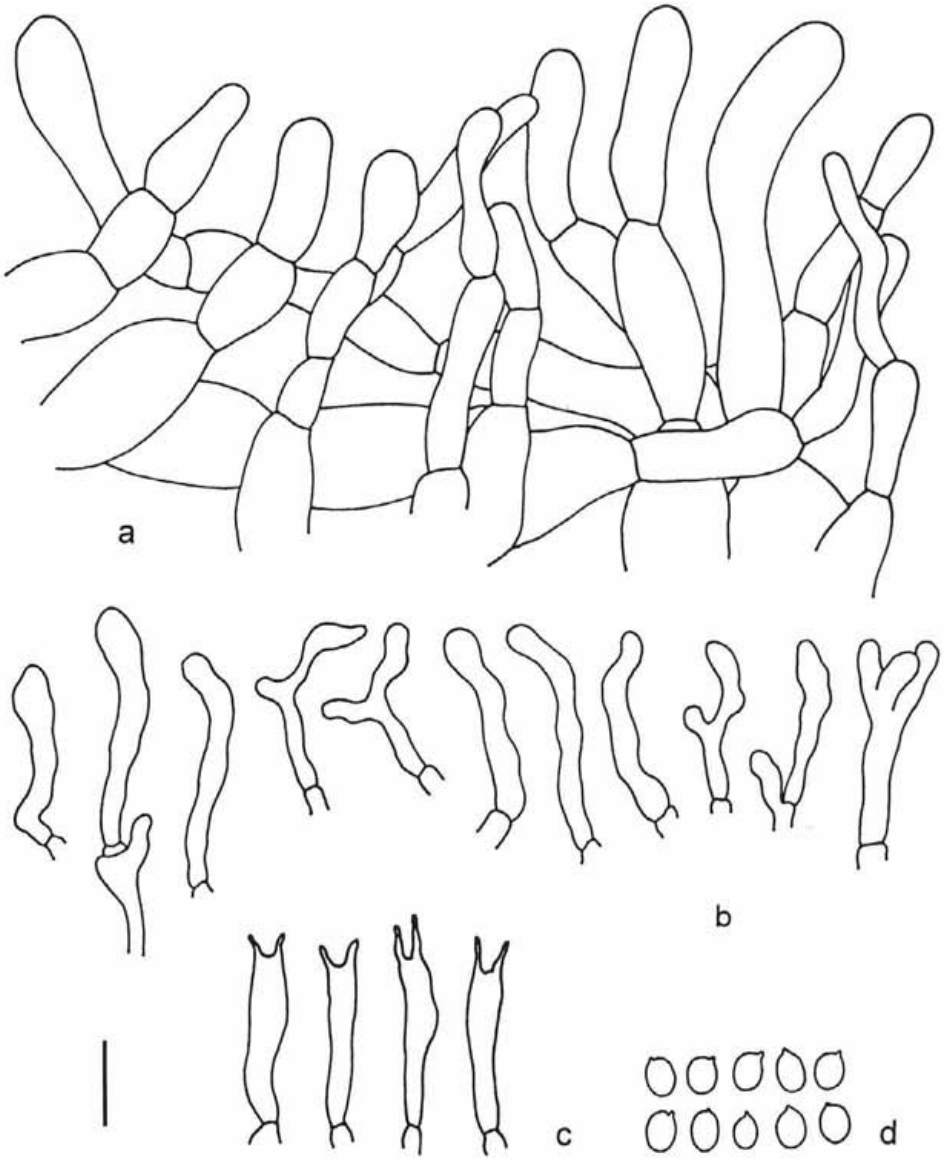

Fig. 2. *Pseudobaeospora* spec. – a: pileipellis, b: cheilocystidia, c: basidia, d: spores (scale bar = 10 μm).

Discussion

We have observed the following main characters of our *Pseudobaeospora* specimen: 2-spored basidia, absence of clamp-connections, presence of slender but distinct cheilocystidia, and a suprapellis of slender hyphae with distinct, cylindrical, occasionally also narrowly lageniform or narrowly clavate, ± erect terminal cells. Only two of the fifteen hitherto known species of the genus *Pseudobaeospora* in Europe (Bas 2002, Bas 2003; Adamčík and Ripková 2004) do not have clamp-connections, viz. *P. oligophylla* (Singer) Singer and *P. pillodii* (Quél.) Wasser (Bas 2002).

We have compared our specimen with Singer's (Singer 1938) and Bas's (Bas 2003) descriptions of *P. oligophylla* and Wasser's (Wasser 1980) and Bas's (Bas 2003) descriptions of *P. pillodii* (Tab. 1). The original description of *P. pillodii* by Quélet (1890), which is very brief and does not allow a modern interpretation, has not been included in our comparison.

Our specimen differs from *P. oligophylla* and *P. pillodii* by the striate margin of the pileus and very sparse lamellae (L = 11). Two-spored basidia have been observed only in *P. pillodii* and in our specimen. Bas (2003) noted that although specimens of *P. pillodii* have been found with 2-spored basidia only, nothing is gained by formally describing a 2-spored variety or forma, as specimens occur with 2- and 4-spored basidia sometimes even on one lamella.

The spores of our specimen are distinctly larger than those of *P. oligophylla*, but slightly overlap the extreme values of the spore size of *P. pillodii*.

Our specimen also differs in the presence of cheilocystidia. Only Singer (1938) noted very slender filiform cheilocystidia in *P. oligophylla*, but distinctly thinner ones than those of our specimen. The caulocystidia – not mentioned by Singer (1938) and Wasser (1980) – of our specimen do not differ from the caulocystidia observed by Bas (2003) in both species.

All specimens of both clampless species of *Pseudobaeospora* were found in mountain forests and subalpine forests (at 1200–1900 m alt.): *P. oligophylla* in association with *Larix sibirica*, *Pinus sibirica* and *Picea* sp., and *P. pillodii* in association with *Alnus viridis*, *A. incana*, *Abies*, *Larix*, *Pinus cembra* and *Rhododendron*. In contrast, we have found our specimen in basin in a hilly country (at 440 m alt.) in association with *Alnus glutinosa*.

Bas (2002, 2003) considers the structure of the pileipellis, the colour of the basidiocarp, chemical reaction of the pileipellis to KOH, and the presence or absence of clamp-connections as the main distinguishing characters in the genus. All three clampless taxa have basidiocarps with a rather similar coloration. The reaction to KOH has been observed only in our specimen and *P. pillodii* and is insignificant there. Consequently, the only character responsible for classifying our specimen is the pileipellis structure.

Tab. 1. Comparison of the specimen from the Czech Republic with selected published descriptions of clampless species of *Pseudobaeospora*.

	Adamčík and Ripková	**Singer (1938)**	**Bas (2003)**	**Wasser (1980)**	**Bas (2003)**
	our specimen	***P. oligophylla***	***P. oligophylla***	***P. pillodii***	***P. pillodii***
Pileus	margin striate	margin non-striate	margin non-striate	–	margin non-striate
Lamellae	L = 11, l = 0–1	–	L = ± 19, l = 3	–	L = 12–19(-30), l = 0–3
Basidia	2-spored	4-spored	4-spored	4-spored	4- and/or 2-spored
Spores	4–4.9 x 3.3–4 μm	3.2–3.4 x x 2.5–2.8 μm	3.4–3.9(-4.4) x x 2.8–3.5(-3.7) μm	3.2–4.5 x x 2.6–3.2 μm	(3.2-)3.7–4.5(-4.9) x x (2.6-)2.9–3.6 μm
Cheilocystidia	21–33 x 2.5–6 μm, moliniform, clavate, cylindrical, fusiform, often with lateral nodules or finger-like projections	1.5–2 μm wide filiform	absent	absent	absent
Pileipellis	made up of suprapellis of slender hyphae with terminal cells 10.5–40 x x 3–8.5 μm, cylindrical, occasionally also narrowly lageniform or narrowly clavate, over a seemingly pseudoparenchymatic subpellis of 9–24 μm thick hyphae	made up of hyphae with terminal cells 20–26 x x 17–25 μm large, rarely erect, clavate, cylindrical, rarely globose, but mostly repent, filiform or catenuliform, 3–17 μm wide	made up of suprapellis of loosely arranged, 3.5–8.5 μm wide, radial hyphae, with abundant, repent to ascending, rarely erect pileocystidia 26–43 x 4.0–7.5 μm, cylindrical to sublageniform and subutriform, rather frequently subcapitate (apex 3.5–8.0 μm wide), over a subpellis of 9–18 μm wide, short-celled hyphae	–	made up of a distinct to rather indistinct suprapellis of 1.6–7.0(-10) μm wide radial hyphae, gradually passing into a subpellis of rather short– and broad-celled hyphae 15–40(-44) x x 8–28(-35) μm, rarely with a very few repent to slightly ascending, cystidioid terminal cells
Ecology	on litter among *Molinia* sp. under *Alnus glutinosa*, at 440 m alt.	among mosses under *Larix sibirica* and *Pinus sibirica*, at 1900 m alt.	on litter under *Picea*, at 1240 m alt.	under *Larix*, *Alnus viridis*, *Rhododendron*	on needle carpets under *Picea*, *Pinus cembra*, *Abies*, and *Larix*, on fallen branch of *Alnus viridis* in shrubbery, under *Alnus incana*, in felted turf of poor grassland, at up to 1700 m alt.

Our specimen is similar to Bas's (Bas 2003) description of *P. oligophylla* because of a suprapellis containing numerous repent to erect hyphal terminations (pileocystidia according to Bas). *P. pillodii* has, according to Bas (2003), also a suprapellis, but such hyphal terminations are scarce. Therefore our specimen cannot be identified as *P. pillodii*. Our specimen has the following characters which are different or slightly overlap those of *P. oligophylla*: (1) striate margin, (2) sparse lamellae (L = 11), (3) 2-spored basidia, (4) larger spores, (5) presence of cheilocystidia and (6) habitat at lower altitude.

Conclusions

Our specimen consists of a single basidiocarp only. However, it is the first representative of the genus *Pseudobaeospora* in the Czech Republic and, moreover, it has a hitherto unknown combination of characters. Comparing our specimen with the two other clampless species, *P. oligophylla* and *P. pillodii*, we have not been able to identify it with either. Therefore we assume that it is a hitherto undescribed taxon, however, more finds are necessary for a formal description.

Acknowledgements

We are very grateful to Jan Holec (National Museum, Department of Mycology, Praha) for help with literature and for a photo of the *Pseudobaeospora* specimen. We thank Miriam Nadubinská (Institute of Botany of the Slovak Academy of Sciences, Department of Plant Physiology, Bratislava) for technical assistance with photography. We are very grateful to Pavel Lizoň and the anonymous reviewers for their advisory notes on the manuscript. The Slovak Grant Agencies VEGA (grant no. 2/4031/04) and APVT (grant no. 51–023902) supported this study.

References

Adamčík S. and Ripková S. (2004): Pseudobaeospora basii, a new species described from Slovakia. – Sydowia 56(1): 1–7.

Bas C. (2002): A reconnaissance of the genus Pseudobaeospora in Europe I. – Persoonia 18: 115–122.

Bas C. (2003): A reconnaissance of the genus Pseudobaeospora in Europe II. – Persoonia 18: 163–199.

Kornerup A. and Wanscher J. H. (1978): Methuen handbook of colour, 3^{rd} edition. – 248 p. London.

Quélet L. (1890): Quelques espèces critiques ou nouvelles de la Flore Mycologique de France. – C. R. Ass. franç. Av. Sci. 18: 508–514.

SINGER R. (1938): Notes sur quelques Basidiomycètes. – Rev. Mycol 3: 187–199.
WASSER S. P. (1980): Flora Fungorum RSS Ucrainicae. Basidiomycetes, Agaricaceae. – 328 p. Kiev.

CZECH MYCOL. 56 (3–4), 2004

New species of marasmioid genera (Basidiomycetes, Tricholomataceae) from tropical Africa – V. Marasmius violaceoides, a new species based on M. violaceus Henn. in the sense of Singer

VLADIMÍR ANTONÍN

Moravian Museum, Department of Botany, Zelný trh 6, CZ-659 37 Brno, Czech Republic
vantonin@mzm.cz

Antonín V. (2004): New species of marasmioid genera (Basidiomycetes, Tricholomataceae) from tropical Africa – V. Marasmius violaceoides, a new species based on M. violaceus Henn. in the sense of Singer. – Czech Mycol. 56: 247–252

A new species, *Marasmius violaceoides* (Basidiomycetes, *Tricholomataceae*), is described for a taxon known in the modern literature as *Marasmius violaceus* Henn. sensu Singer. Revision of the type specimen of *Marasmius violaceus* showed that this taxon belongs to the genus *Gymnopus*.

Key words: Basidiomycetes, type revision, *Marasmius*, *M. violaceoides*, *Gymnopus*, Africa, new species.

Antonín V. (2004): Nové druhy marasmioidních rodů (Basidiomycetes, Tricholomataceae) tropické Afriky – V. Marasmius violaceoides, nový druh popsaný pro M. violaceus Henn. ve smyslu Singera. – Czech Mycol. 56: 247–252

Marasmius violaceus ve smyslu R. Singera (Singer 1964, 1965) je popsán jako nový druh, *Marasmius violaceoides*. Typová revize druhu *Marasmius violaceus* Henn. totiž ukázala, že tento druh patří do rodu *Gymnopus* (Pers.) Roussel.

INTRODUCTION

This paper represents the fifth and last part of a series of descriptions of new taxa of marasmioid genera from tropical Africa (Antonín 2003a, b; 2004a, b).

Marasmius violaceus Henn. was introduced in the modern literature by Singer (1964, 1965). However, he has never seen fresh carpophores and a type specimen. He studied only herbarium material preserved in the herbarium in Meise (BR, see list below) and probably identified herbarium specimens collected by M. Goossens-Fontana with *M. violaceus* only according to (macroscopic) similarity of both collections. A revision of a type specimen (syntype) of *M. violaceus* from the herbarium in Stockholm (S) showed that it undoubtedly represents a *Gymnopus* species, and clearly differs from *M. violaceus* s. Singer. Therefore,

it is necessary to describe a new species for the fungus called *M. violaceus* by Singer (1964, 1965).

Microscopic features are described from material mounted in Melzer's reagent, Congo Red and about 5 % KOH. For basidiospores the following factors are used: E (quotient of length and width in any one spore) and Q (mean of E-values). Authors of fungal names are cited according to Kirk and Ansell (1992), the herbarium abbreviations according to Holmgren and Keuken (1974). The colour descriptions follow Kornerup and Wanscher (1983).

TYPE REVISION OF MARASMIUS VIOLACEUS

Marasmius violaceus Henn., Bot. Jahrb. Syst. 23: 549. 1897.

Type specimen revised. Cameroon, Yaounde, in a moist virgin forest on dead leaves, 1 Oct. 1894 leg. G. Zenker 435 (syntype, S F-16255). This specimen consists of several broken carpophores loosely covered by a mould.

Original description by Hennings (1897). Pileo tenui-membranaceo, convexo-campanulato, vertice interdum applanato, radiato-striato, levi, glabro 4–10 cm diametro, margine tenui, pulchro-violaceo; stipite tereti, firmo, farcto, aequali, levi glabroque, violaceo 3–5 cm longo, 3 mm crasso, lamellis adnatis, decurrentibus, sublanceolatis, subconfertis basi interdum anastomosantibus, violaceo-subflavescentibus; sporis subglobosis, levibus 3–5 μ.

Results of the type revision. Basidiospores 6.0–8.0(-10) × 4.5–5.2(-6.5) μm, ellipsoid, thin-walled, non-dextrinoid, hyaline. Basidia 25 × 12 μm (only one found), 4-spored, clavate. Basidioles up to 30(-35) × 12 μm, clavate, (sub)cylindrical, subfusoid. Cheilocystidia 11–17 × 6.0–9.0 μm, clavate, thin-walled, smooth. Pleurocystidia absent. Trama hyphae ± cylindrical, thin-walled, non-dextrinoid, hyaline, up to 15 μm wide. Pileipellis a cutis composed of cylindrical, radially arranged, ± thin-walled, smooth or minutely incrusted, up to 6.0 μm wide hyphae; terminal cells ± adpressed, cylindrical or clavate. Stipitipellis a cutis consisting of cylindrical, parallel, slightly thick-walled, non-dextrinoid, up to 5.0 μm wide hyphae with pale ochraceous walls in KOH. Caulocystidia absent. Clamp-connections present in all tissues.

Conclusions. The microscopic characters mentioned above, especially the structure of the pileipellis and non-dextrinoid hyphae, as well as macroscopic features, agree very well with those of the genus *Gymnopus* (Pers.) Roussel. However, I refrain to make a new combination without detailed studies of this genus in tropical Africa.

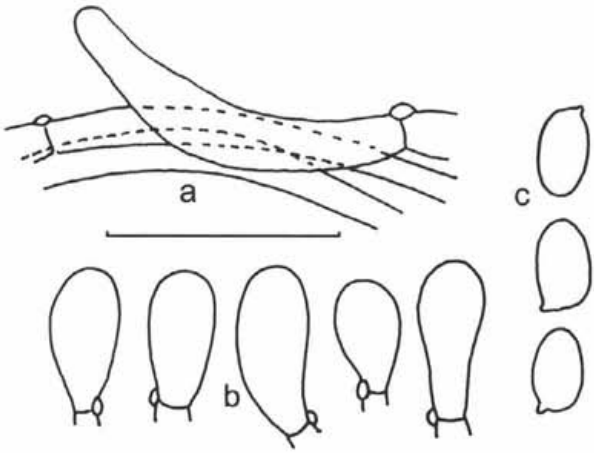

Fig. 1. *Marasmius violaceus* (syntype) – a: pileipellis hyphae, b: cheilocystidia, c: basidiospores. Scale bar = 20 μm.

DESCRIPTION OF A NEW SPECIES

Marasmius violaceoides Antonín sp. nov.

Pileo 21–40 mm lato, campanulato, dein subapplanato, cum centro obtuso vel applanato, sulcato, violaceo, violaceo-brunneo, pallide violaceo striato. Lamellis confertis vel subdistantibus, L = 16–20, l = 1–2, albidis vel pallide griseo-aurantiacis, acie concolore. Stipite 110–125 × 2,5–3,5 mm, non-insititio, glabro, apicem violaceo, ad basim usque obscure brunneo. Sporis 15.5–22.3 × × 3.3–5.0 μm, clavatis, clavato-cylindraceis vel lacrimoideis, hyalinis, inamyloideis. Basidiis tetrasporis. Cheilocystidiis 14–24 × (4.2-)6,2–9,2 μm, clavatis, tenuitunicatis. Pleurocystidiis absentibus. Pileipellis hymeniformis, e cellulis clavatis vel vesiculosis, 18–40 × 11,5–15(-19) μm, laevibus. Pileocystidiis et caulocystidiis absentibus. Hyphis dextrinoideis, fibulatis. Ad folia putrida.

Holotypus: Democratic Republic of Congo, Provincia Equateur, Binga, IV. 1947 leg. M. Goossens-Fontana 680, holotypus in herbario BR 11250–74 (ut *M. violaceus*) asservatur.

Misapplication. *Marasmius violaceus* Henn. s. Singer 1964, 1965.

Pileus 21–40 mm broad, up to 30 mm high, campanulate, then rather applanate, often subumbonate, strongly sulcate except for centre (which is often rugose), striae paler violaceous coloured (pileus striped), sometimes entirely finely veined, glabrous, violaceous, violet brown or brown with slightly violaceous

tinge (11D-F5). Lamellae close to subdistant, L = 16–20, l = 1–2, rounded-adnate to adnate, rather narrow, white, whitish or pale greyish orange (± 5B3), with concolorous, entire, curved edge. Stipe 110–125 × 2.5–3.5 mm, slightly attenuated towards apex, hollow, smooth, glabrous, distinctly violaceous above, more distinctly brown towards base; basal mycelium tomentose, dirty white or dirty pale ochraceous. Context thin and whitish in pileus, concolorous with surface and fibrillose, subcartilaginous in stipe; smell and taste fungoid [according to Singer (1964, 1965a) and a photograph].

Basidiospores 15.5–22.3 × 3.3–5.0 μm, E = 3.7–4.9, Q = 4.3, clavate, cylindrical-clavate to lacrimoid, hyaline, thin-walled. Basidia (28-)35.5–49 × × 7.0–10.0 μm, 4-spored, clavate. Basidioles 19–46(-51) × 5.5–11.5 μm, clavate, cylindrical or fusoid. Cheilocystidia 14–24 × (4.2-)6.2–9.2 μm, clavate, thin-walled, hyaline. Pleurocystidia absent. Hyphae ± cylindrical, branched, thin-walled, up to 11.5 μm wide. Pileipellis a hymeniderm composed of 18–40 × 11.5–15(-19) μm, clavate to (sub)vesiculose, thin- to slightly thick-walled, smooth cells, sometimes covered with a thin gelatinous layer. Stipitipellis a cutis consisting of parallel, cylindrical, slightly thick-walled, up to 6.0 μm wide hyphae, with pale yellowish brownish walls in KOH. Caulocystidia absent. Clamp-connections present in all tissues.

Chemical reactions: all hyphae dextrinoid, other structures and basidiospores non-dextrinoid.

Ecology. Single, on decaying leaves in a marshy forest, on dry soil (terre ferme) and in a rain forest with *Gilbertiodendron dewevrei*.

Distribution. So far known from Cameroon, the Democratic Republic of Congo, Zambia and probably Nigeria.

Revised specimens.

CAMEROON: South West Province, Korup National Park, trail to Rengo Rock, 8 Apr. 1997 leg. P. J. Roberts K934 (K(M) 91512 and BRNM 691108). – DEMOCRATIC REPUBLIC OF CONGO: Equateur Province, Binga, Apr. 1947 leg. M. Goossens-Fontana 680 (holotype, BR 11250–74, as *M. violaceus*). – Tshopo Province, close to Batiabongena (5 km NNE), 16 Apr. 1984 leg. B. Buyck 1444 (BR 11753–16) and 1445 (BR 11752–15). – NIGERIA: ? Cross River State, Cross River, Ikom River, 1 May 1990 leg. R. A. Nicholson 418 (K(M) 16722, as *M. haematocephalus*). – ZAMBIA: Chowo Forest, 10 Dec. 1981 leg. J. Rammeloo 7806 (BR K 4397). – Ibid., leg. J. Rammeloo 7757 (BR K 4351). – Ibid., 7 Dec. 1981 leg. J. Rammeloo 7713 (BR 1999–68).

Remarks. *Marasmius violaceoides* is characterised by having a distinctly campanulate, distinctly sulcate, violaceous, striate pileus, a very long, violaceous tinged stipe, rather large basidiospores, very long basidia, clavate cheilocystidia, pileipellis cells sometimes covered with a thin gelatinous layer, and by the absence of caulocystidia. It belongs to sect. *Globulares* Kühner.

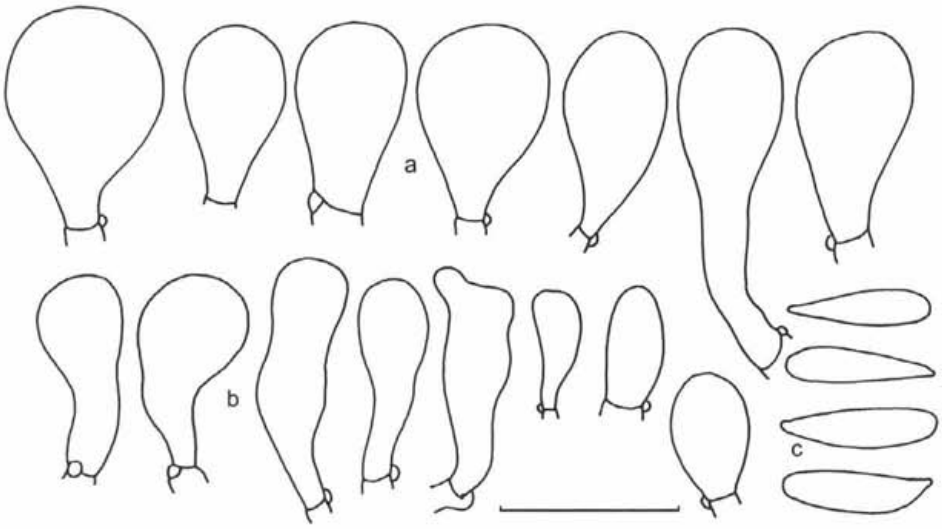

Fig. 2. *Marasmius violaceoides* (Buyck 1444 and 1445, Rammeloo 7757) – a: pileipellis cells, b: cheilocystidia, c: basidiospores. Scale bar = 20 μm.

This species was also described by Singer (1964, 1965) and its colour picture by M. Goossens–Fontana was published by Singer (1965: Pl. 44, fig. 5), all under the name of *M. violaceus*.

Compared to other violaceous species without developed pleurocystidia, *M. musisporus* Desjardin et E. Horak has a smaller (8–25 mm), in sulci yellow coloured pileus, a smaller stipe (50–70 × 1–1.5 mm) and very large basidiospores (30–40 × 4.5–5 μm); it was described from Papua New Guinea (Desjardin and Horak 1997). *Marasmius purpureostriatus* Hongo, found in Japan and Papua New Guinea, has a larger (15–50 mm), purple and white to cream striped pileus, a stipe without any violaceous tinges and larger basidiospores [19–28(-32) × 4–6 μm] (Desjardin and Horak 1997, isotype ZT!). *Marasmius poromycenoides* Singer (Singer 1976), from South America, has a smaller (11–16 mm), reticulate pileus, strongly anastomosed lamellae, a smaller stipe (35–50 × 1–1.5 mm) and small basidiospores (5.7–6.2 × 3.5–3.8 μm).

ACKNOWLEDGEMENTS

The author is very obliged to the curators of the herbaria BR, K and S for the loan of type and other herbarium specimens. My thanks are due also to Zdeněk Pouzar (Prague, Czech Republic) for valuable nomenclatural and taxonomic notes.

The study of this group was supported by the Grant Agency of the Czech Republic (no. 206/01/0093).

REFERENCES

ANTONÍN V. (2003a): New species of Marasmius (Basidiomycetes, Tricholomataceae) from tropical Africa – I. Sect. Epiphylli, Fusicystides, Globulares, Hygrometrici and Neosessiles. – Mycotaxon 85: 109–130.

ANTONÍN V. (2003b): New species of marasmioid genera (Basidiomycetes, Tricholomataceae) from tropical Africa – II. Gloiocephala, Marasmius, Setulipes and two new combinations. – Mycotaxon 88: 53–78.

ANTONÍN V. (2004a): New species of marasmioid genera (Basidiomycetes, Tricholomataceae) from tropical Africa – III. Marasmius sect. Sicci. – Mycotaxon 89(2): 399–422.

ANTONÍN V. (2004b): New species of marasmioid genera (Basidiomycetes, Tricholomataceae) from tropical Africa – IV. Four new taxa of the genus Marasmius and one new combination. – Mycotaxon 89(2): 423–431.

DESJARDIN D. E. and HORAK E. (1997): Marasmius and Gloiocephala in the South Pacific region: Papua New Guinea, New Caledonia, and New Zealand taxa. Part 1: Papua New Guinea and New Caledonia taxa, Part 2: New Zealand taxa. – In: Petrini O., Petrini L. E. and Horak E. (eds.), Taxonomic monographs of Agaricales II., Bibl. Mycol. 168: 1–152.

HENNINGS P. (1897): Fungi camerunenses. II. – Bot. Jahrb. Syst. 23: 537–558.

HOLMGREN P. K. and KEUKEN W. (1974): Index herbariorum. Ed. 6. – 384 p. Utrecht.

KORNERUP A. and WANSCHER J. H. (1983): Methuen handbook of colour. Ed. 3. – 252 p. London.

SINGER R. (1964): Marasmius congolais recueillis par Mme Goossens-Fontana et d'autres collecteurs belges. – Bull. Jard. Bot. Brux. 34: 317–388.

SINGER R. (1965): Marasmius. – Fl. Iconog. Champ. Congo 14: 253–278.

SINGER R. (1976): Marasmieae (Basidiomycetes-Tricholomataceae). – Fl. Neotropica Monogr. 17: 1–347.

CZECH MYCOL. 56 (3–4), 2004

Tomentella spinosispora Čížek sp. nov. (Thelephoraceae), a new species from the Czech Republic

KAREL ČÍŽEK

Polabiny II. 251, Pardubice, 530 09, Czech Republic

Čížek K. (2004): Tomentella spinosispora Čížek sp. nov. (Thelephoraceae), a new species from the Czech Republic. – Czech Mycol. 56: 253–258

Tomentella spinosispora Čížek spec. nov., a new species of the genus *Tomentella* sect. *Alytosporium* (Link) Kõljalg (*Thelephoraceae*) is described. It has been collected in the nature reserve Klapice near Radotín in Prague. It is characterised by spores which are globose in front view, some broadly ovoid in lateral view, and by the ornamentation consisting of thin, straight, up to almost 3 μm long spines. Hyphae and basidia are thick-walled, brown coloured. In the basal layer of the subiculum thick-walled, incrustated hyphae with frequent clamp-connections are dominant (clamps are lacking in the subhymenium and medial layers of the subiculum).

Key words: *Tomentella spinosispora* spec. nov., basidiomycetes, *Thelephoraceae*, *Tomentella* sect. *Alytosporium*

Čížek K. (2004): Tomentella spinosispora Čížek sp. nov. (Thelephoraceae), nový druh popsaný z České republiky. – Czech Mycol. 56: 253–258

Je popsán nový druh rodu *Tomentella* sect. *Alytosporium* (Link) Kõljalg (*Thelephoraceae*), a sice *Tomentella spinosispora* Čížek; byl nalezen v přírodní rezervaci Klapice u Radotína v Praze. Je charakterizován výtrusy z frontálního pohledu kulatými, bočně někdy široce oválnými, s tenkými, téměř 3 μm dlouhými ostny. Hyfy a bazidie jsou tlustostěnné, hnědě zbarvené. Ve spodní vrstvě subikula dominují tlustostěnné inkrustované hyfy s častými přezkami, zatímco přezky chybí v subhymeniu a v mediální vrstvě subikula.

In the nature reserve Klapice near Radotín in Prague (a part of the Protected Landscape Area Bohemian Karst), a species of *Tomentella* has been collected which is not identical to any *Tomentella* species known to date. The locality is a thermophilous oak (*Quercus petraea*) forest mixed with hornbeam (*Carpinus betulus*) on the top of a calcareous rock. Such localities are rich sources of various species of *Tomentella* and are rather well known in this respect. Nevertheless, there exists only one collection of this significant species.

Tomentella spinosispora Čížek sp. nov.

Diagnosis latina: Carposomata resupinata, late effusa, usque 0,5 mm crassa, sat arcte adhaerentia, solum sicut fragmenta parva separabilia, tenuiter tomentosa

cum hymenio glabro, obscure badioferrugineo ambitu sterile. Subiculum arachnoideo fibrillosum hymenio concolore. Systema hypharum monomiticum, hyphae basales subiculi crasse tunicatae 2–3,5 μm seu 4–5 μm latae, brunneae, saepe incrustatae, cum septis saepe fibulatis, hyphae parte media subiculi 2–3 μm latae, crasse tunicatae, brunneae, septatae, fibulis absentibus. Subhymenium praecipue e hyphis 3,5–5 μm, septis simplicibus, crasse tunicatis, in KOH brunneis cum cellulis brevibus. Basidia 45–60 × 7–10 μm, utriformia, nonnumquam late clavata, in dimidio inferiore crasse tunicata, pariete brunneolo postea pallidiore, basim cum septo simplice, in apice cum sterigmatibus hamatis quatuoribus. Sporae 7–9 μm, in facie frontali globosae, in circumscriptione regulares, in facie laterali subglobosae, usque late ovoideae, in solutione KOH brunneolae, spinis rectis angustis 2,5–3 μm longis regulariter obductae. Hyphae, basidia et sporae in solutione Melzeri partim dextrinoideae et in CB partim cyanophilae. Coloratio coeruleo-viridis hypharum et basidiorum in solutione KOH deest.

Holotypus: Bohemia centralis, area tuta "Klapice" prope Radotín (urbs Praha), 340 m s. m.; *Quercus petraea*, truncus iacens, 30. IX. 2002, leg. Z. Pouzar, PRM 900456, in herbario Musaei Nationalis Pragae asservatur.

DESCRIPTION

Carpophores resupinate, up to 0.5 mm thick, firmly adherent to the substratum, separable only in small fragments, compactly mucedinoid or felt-like, hymenium glabrous, dark brownish ferrugineous. Subiculum arachnoid fibrillose, of the same colour as the hymenium. Sterile margin narrow, brownish grey with short rhizoids and hyphal cords.

Hyphal system monomitic; hyphae 2–4.5(-5) μm wide, cylindric, mostly irregular in transversal section, thick-walled, with simple septa, without clamps, but in the layer close to the substratum often with clamps, often long-celled, sparsely ramified, some glabrous, but often distinctly incrusted, brown in KOH. Richly represented are also cylindric, straight, thick-walled, 2–3 μm broad hyphae with simple septa, which have long as well as short cells, pale to brown coloured in KOH.

Hyphal cords of subiculum rhizoids and margin of carpophore locally free, but mostly densely tangled, 15–60 μm wide, composed of one or more strands. Walls brown to yellowish in KOH.

Subhymenium dominated by 3.5–5 μm wide hyphae with simple septa, with short cells, thick-walled with walls brown in KOH.

Basidia 45–60 × 7–10 μm, utriform, in central part constricted, some clavate, in lower half thick-walled; at base with a simple septum, with four hooked sterigmata. Wall of younger basidia brown in KOH, at maturity comparatively paler.

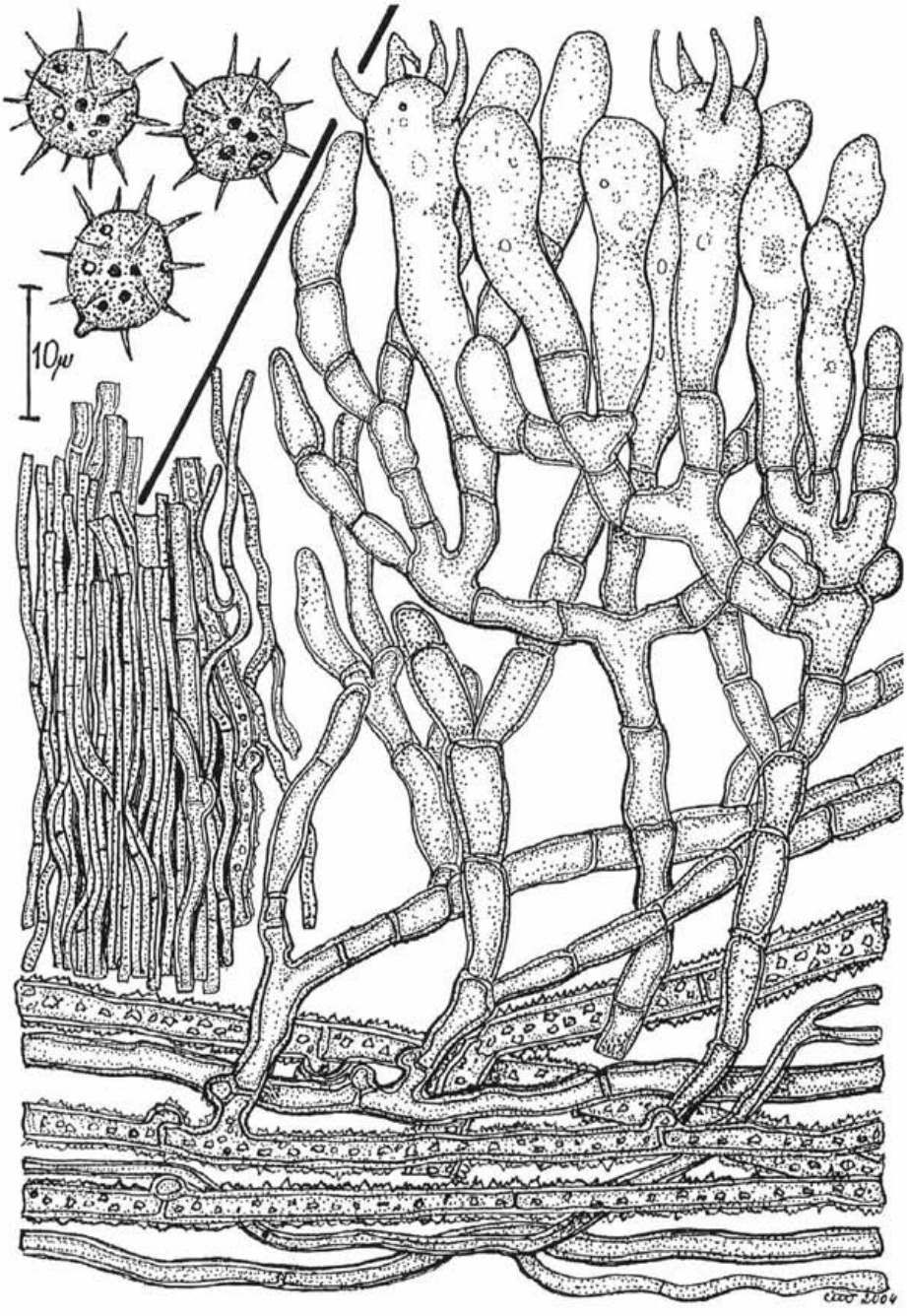

Fig. 1. *Tomentella spinosispora*, holotype (PRM 900456). Anatomy of carpophore with basal hyphae and hyphal cord (left), basidia and spores. Del. K. Čížek.

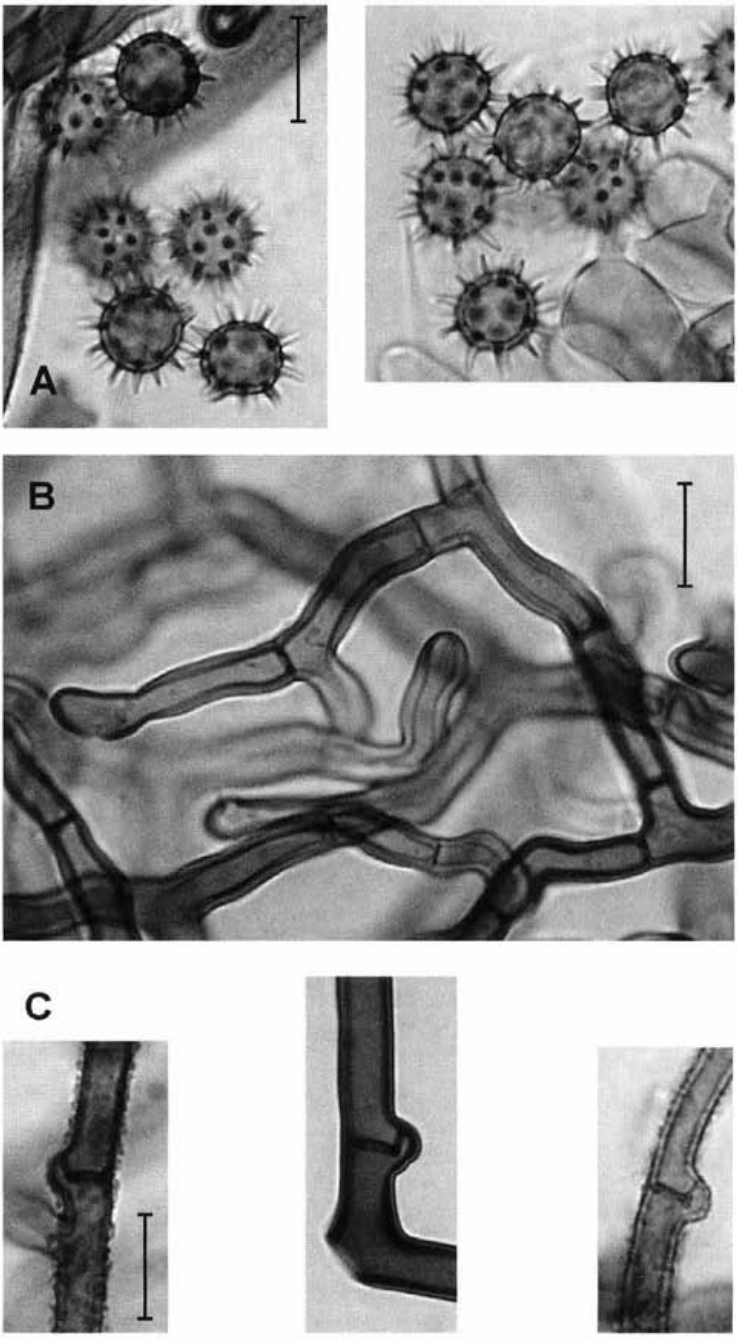

Fig. 2. A: spores, B: hyphae without clamps, C: basal hyphae with clamps. Microphotographs by Jan Holec. Scale bar = 10 μm.

Spores 7–9 μm, in front view globose, regular in circumference, in lateral view subglobose to broadly elliptic; wall brownish in KOH; covered with narrow, straight, regularly arranged, 2.5–3 μm long spines.

Hyphae, basidia and spores with walls partially dextrinoid in Melzer's reagent (especially in younger state), cyanophilous in cotton blue. Bluish-green coloration of hyphae and basidia in KOH solution not observed.

Discussion

When Svrček (1958, 1960) separated the genus *Tomentellastrum* Svrček from *Tomentella* Pat., he pointed out that there exists a rather wide variability and a deficiency of reliable distinguishing characters at the species level in this group. Larsen (1981), author of a monograph of the genus *Tomentellastrum*, emphasised the regularity vs. irregularity of the spore outline and also the general spore form, i.e. whether the spores are elongated along one axis or not (together with the character of spore ornamentation as proposed by him earlier, Larsen 1974).

The most recent approach, represented by Kõljalg (1996), returns species of *Tomentellastrum* back to the genus *Tomentella* Pat. as the section *Alytosporium* (Link) Kõljalg, and resulted in the acceptance of three broadly defined species. In this concept, the spore shape in front view is preferred as the main distinguishing character. In the section *Alytosporium* this is either lobate, triangular, globose or elliptic. Another character is the shape of spores in lateral view together with spore size and length of their spines, the presence or absence of clamps and the colour reaction in a 3 % KOH solution.

I apply Kõljalg's criteria here when delimiting the new species *Tomentella spinosispora*. Spores of this species are 7–9 μm in diam., entirely globose in front view, subglobose to broadly oval in lateral view, long spinose. This spore character of is so far unknown (yet unpublished) in this section. As a further specific distinguishing feature the presence of clamps on basal, incrusted hyphae, the rather thick walls of the basidia and the byssoid character of the hymenial surface could be considered. The closest species *Tomentella badia* (Link) Stalpers has, when compared with our species, spores lobed or triangular or only some irregularly globose in front view. Basidia in a 3 % KOH solution are green, basal hyphae incrusted and almost without clamps. *Tomentella cinereoumbrina* (Bres.) Stalpers, a rare species in our country, has spores, when compared with *T. spinosispora*, obtusely triangular and aculeate in front as well as lateral view with only short spines. Clamps are only scattered in the subhymenium and on bases of the basidia. In morphology of hyphae our new species approaches somewhat the complex of *Tomentella fuscocinerea* (Pers.: Fr.) Donk. In this species, however, spores are obtusely triangular in front view and broadly ellipsoid in lateral view.

Tomentella spinosispora has been compared not only with the rather broadly defined species (Kõljalg 1996) and subspecies of subgen. *Alytosporium* (incl. the genus *Tomentellastrum*), but also with formerly recognised species like *Tomentella fimbriata* M. P. Christ. and *Tomentella macrospora* Höhn. et Litsch., which were collected in the Czech Republic and are documented in herbaria. None of these species has been found to be identical with *Tomentella spinosispora*.

ACKNOWLEDGEMENTS

I would like to thank Zdeněk Pouzar (Prague) for his assistance with the preparation of the text of this article and Jan Holec (Prague) for the microphotographs.

REFERENCES

KÕLJALG U. (1996): Tomentella (Basidiomycota) and related genera in Temperate Eurasia. – In: Synopsis fungorum, vol. 9, p. 1–213, Oslo.

LARSEN M. J. (1974): A contribution to the taxonomy of the genus Tomentella. – Mycologia Memoirs 4: 1–145.

LARSEN M. J. (1981): The genus Tomentellastrum (Aphyllophorales, Thelephoraceae s. str.). – Nova Hedwigia 35: 1–16.

SVRČEK M. (1958): Příspěvek k taxonomii resupinátních rodů čeledi Thelephoraceae s. s. (Contribution to the taxonomy of the resupinate thelephoraceous fungi). – Čes. Mykol. 12: 66–77 (in Czech with Latin descriptions).

SVRČEK M. (1960): Tomentelloideae Cechoslovakiae. Genera resupinata familiae Thelephoraceae s. str. – Sydowia, Ann. Mycol., ser. 2, 14: 170–245.

CZECH MYCOL. 56 (3–4), 2004

Macromycetes of permanent plots in cultural forests in the Moravskoslezské Beskydy Mts. and Vsetínské vrchy hills (Czech Republic)

MARTINA VAŠUTOVÁ

Department of Biology, Faculty of Pedagogy, Palacký University
Žižkovo nám. 5, 771 40 Olomouc
vasutova@pdfnw.upol.cz

Vašutová M. (2004): Macromycetes of permanent plots in cultural forests in the Moravskoslezské Beskydy Mts. and Vsetínské vrchy hills (Czech Republic) – Czech Mycol. 56: 259–289

The mycoflora of cultural (artificial and managed subnatural) forests (i.e. beech, spruce and mixed forests) was studied in 18 permanent plots in the Moravskoslezské Beskydy Mts. and the adjacent part of the Vsetínské vrchy hills (Czech Republic) during the years 1998–2000. Altogether, 314 species of macromycetes were recorded. The highest number of species was recorded in plots in a young spruce forest on a former meadow (72 species) and a waterlogged spruce forest (67 species). Mycorrhizal fungi were the dominant group in older spruce forests (44.2 %), waterlogged spruce forests (43.3 %) and alder forest (45.6 %). A high percentage of terrestrial saprophytes was found in the young forest on a former meadow (43 %). Generally, common species prevailed. The main factor which influenced the species composition of all trophic groups was the composition of the tree layer. These results are compared with results from similar plots in the Czech Republic and neighbouring countries.

Key words: Czech Republic, macromycetes, cultural beech and spruce forests, mycocoenology, permanent plots, ecology

Vašutová M. (2004): Makromycety trvalých ploch kulturních lesů Moravskoslezských Beskyd a Vsetínských vrchů – Czech Mycol. 56: 259–289

V letech 1998–2000 byla studována mykoflóra kulturních lesů (bukové, smrkové a smíšené porosty) na 18 trvalých plochách v jižní části Moravskoslezských Beskyd a přilehlé oblasti Vsetínských vrchů. Celkem bylo zaznamenáno 314 druhů makromycetů. Druhově nejbohatší se jevily plochy v mladém smrkovém lese na bývalé louce (72 druhů) a v podmáčené smrčině (67 druhů). Mykorhizní druhy převládaly ve starších smrkových lesích (44.2 %), podmáčených smrkových lesích (43.3 %) a olšině (45.6 %), naopak vysoké procento terestrických saprofytů bylo zjištěno v mladém smrkovém lese na bývalé louce (43 %). V druhovém složení převažovaly běžné, ekologicky nepříliš specifické druhy. Hlavním faktorem ovlivňujícím druhové složení všech ekologických skupin bylo složení stromového patra. Výsledky jsou srovnávány s výsledky studia obdobných trvalých ploch v ČR a sousedních zemí.

INTRODUCTION

Cultural (artificial and managed subnatural) forests prevail in the landscape of the Czech Republic. It is assumed that the mycoflora of these forests is reduced in

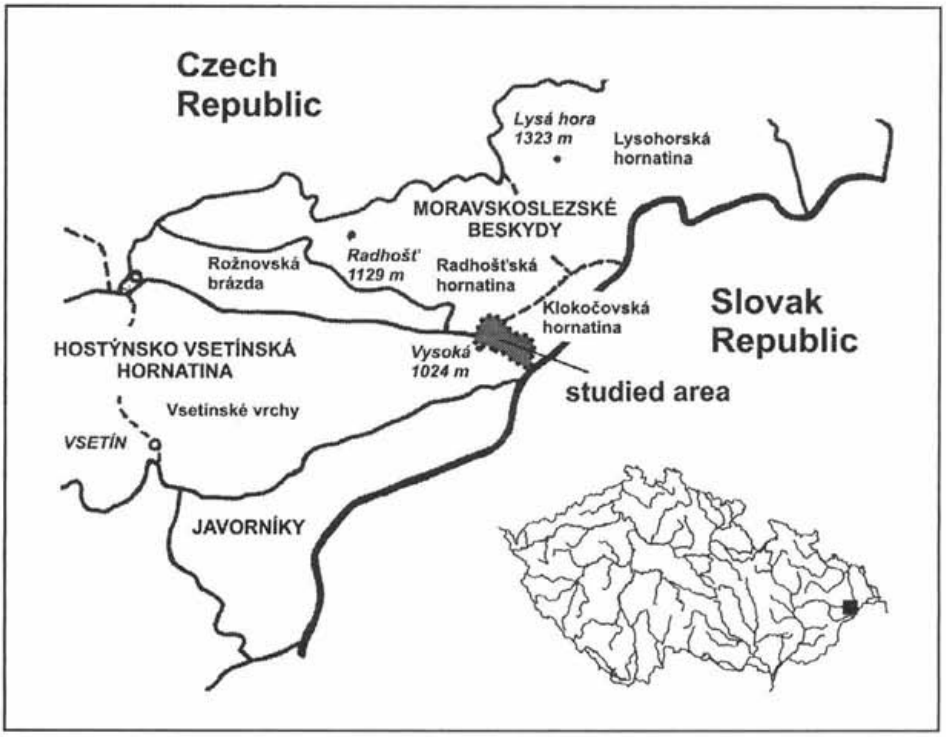

Fig. 1. Delimitation of the study area.

comparison with the mycoflora of natural forests. No details are known about this problem, because cultural types of forests have been studied only marginally (Pilát 1969; Holec 1992 – 1 plot; Hlůza 1988; Šmarda 1972, 1973) in the Czech Republic. In Central Europe cultural forests were studied mainly by Meisel-Jahn and Pirk (1955), Höffler (1955), Ricek (1981), and a review was given by Kost (1992).

This paper is based on my master's (MSc.) thesis. I studied permanent forest plots that were situated in two geomorphological subunits of the Západní Beskydy Mts. (in the southern part of the Moravskoslezské Beskydy Mts. and in the northern part of the Hostýnsko-vsetínská hornatina Mts.) about 690–930 m a.s.l. (Fig. 1). According to the phytogeographical division of the Czech Republic (Skalický 1989), they are situated in the Carpathian Oreophyticum (99a. Radhošťské Beskydy). The average annual temperature is 11.5 °C (station Bílá) to 12.3 °C (station Horní Bečva), the average annual precipitation 1144 mm (station Bílá) and 1101 mm (station Horní Bečva). The geological structure is dominated by Carpathian flysch; dominant soils are brown and acid soils. According to the map of potential vegetation (Neuhäuslová et al. 1998), the natural vegetation of the area

was beech woodland of the *Dentario enneaphylli-Fagetum* association. The major part of the area was deforested during the last 400 years due to intensive grazing (Wallachian colonisation). Gradual afforestation by spruce monocultures was started in the 19th century. Nowadays, these spruce monocultures are dominant, whereas managed beech and mixed stands are confined to limited areas. The original beech-fir forests form a small percentage of the forests in the area and are protected by law in a few small reserves (Salajka, Razula). The mycoflora of these fragments of near-natural beech-fir forests is partly known (e.g. through mycofloristic research by Kuthan 1990). The managed subnatural and artificial forests have not yet been studied in this area.

The aim of this study was to contribute to the knowledge of macromycetes of cultural forests in the Moravskoslezské Beskydy Mts. and the Vsetínské vrchy hills and to evaluate and compare species richness, percentage of trophic groups and species composition on permanent plots with data from similar cultural or natural forest communities. Records of some rare and interesting species are published elsewhere (Vašutová 2004).

METHODS

Permanent plots were established in 1998 and 1999 in different types of forests in the Moravskoslezské Beskydy Mts. and the adjacent part of the Vsetínské vrchy hills in order to cover most of the cultural (artificial, managed subnatural) forest types in the studied region (Table 1). The terms artificial forests and managed subnatural forests are used as follows. Artificial forests are made up by tree species allochthonous to the studied area (*Picea abies, Larix decidua*). Managed subnatural forests are made up by autochthonous tree species, but their age structure is homogeneous.

Three plots (60 × 60 m; I, II and III) in beech, mixed and spruce stands were visited at two-week intervals (from the second half of August to the first half of October at about one-week intervals) over a period of three years (60 visits). These visits contributed to a detailed study of fructification (Vašutová 2001). Later on, 15 additional plots of smaller area (50 × 50 m), which is comparable to plots of other Czech authors (Fellner 1985; Holec 1992, 1997; Lepšová 1988; Fellner and Soukup 1991), were established (plots 1–15). These plots were visited at approximately four-week intervals over a period of two years (10 visits: 1999: 18–7, 21–8, 5–9, 2–10; 2000: 1–6, 14–7, 23–8, 10–9, 20–9, 12–10). Only species that were found in plots I-III during ten visits (see above) were used for comparison between plots I-III and plots 1–15. These reduced plots are called Ir-IIIr.

Occurrence of macromycetes, i.e. fungi with sporocarps larger than c. 1 mm, was studied in the permanent plots. The following taxonomical groups (according to Kirk et al. 2001) were included: Agaricales, Russulales (p.p.), Boletales (p.p.), Polyporales (excl. small corticioid fungi), Cantharellales, Hymenochaetales, Thelephorales, Phallales, Dacrymycetales (p.p.), Tremellales (p.p.), Auriculariales (p.p.), Pezizales, Xylariales (p.p.), Sordariales (p.p.), Hypocreales (p.p.), Helotiales (p.p.), Diaporthales (p.p.), Rhytismatales (p.p.). The concept of macromycetes is different in studies by various authors (see Arnolds 1992). In order to be able to compare the results, Agaricales s.l. (Agaricales; Russulales – *Russulaceae*; Boletales – *Boletaceae, Suillaceae, Paxillaceae, Hygrophoropsidaceae*) were separated from the other macromycetes.

Each plot was characterised by the total number of species, percentage of trophic groups and species composition. Macromycetes were classified into three main trophic groups: mycorrhizal, saprophytic and parasitic. Saprophytic fungi were divided into lignicolous species and terrestrial species (saprophytic species growing on moss, fungi sporocarps, cones etc. are placed in this

group). Parasitic fungi represented only an inconsiderable part of all fungi and in some cases they have an ambiguous trophic behaviour. Therefore they were classified under saprophytic terrestrial fungi in the analysis. Each species of macromycetes was attributed to a trophic group based of the criteria by Kreisel (1987).

Correlations between quantitative parameters and environmental data (number of visits, degree of naturalness of the forest, tree composition, age of stand, shrub, bush and tree cover, slope inclination, orientation of plot, presence of high groundwater level, heterogeneity of plot surroundings, disturbance in plot, number of plants and substrate types – for explanation see Table 1) were tested using the Spearman rank correlation coefficient. Correlations between number of visits and quantitative parameters were analysed with complete data from plots I-III; in the other cases reduced data from plots I-III were used. The Mann-Whitney test was used to statistically evaluate the differences between percentages of single trophic groups in spruce and beech forests. These analyses were carried out using the STATISTICA 6 package. The presence of species in plots (each trophic group separately) and environmental data were analysed by multivariate statistical methods using the programme CANOCO (ter Braak and Šmilauer 1998). Because of the amount of environmental data and their high reciprocal correlation, only the environmental data that most correlated with the main canonical axis were used for the final analysis (detrended correspondence analysis (DCA) with additional correlation of environmental data, covariable data: plot area).

The nomenclature of macromycetes follows Hansen and Knudsen (2000) and Kreisel (1987). Unidentified sporocarps which appeared to be separate species were labelled by numbers. Herbarium specimens are deposited in the author's private herbarium or at the Department of Botany, Moravian Museum, Brno (BRNM). The nomenclature of phytocoenological units follows Moravec et al. (1995).

LOCALISATION OF PERMANENT PLOTS

I – Vsetínské vrchy hills, Horní Bečva, spruce forest on N slope of Mt. Vysoká (1024 m), about 0.9 km WNW of the top, c. 810 m a. s. l.; 49°24'44"N, 18°21'18"E; **II** – Vsetínské vrchy hills, Horní Bečva, mixed forest on N slope of Mt. Vysoká (1024 m), about 1.2 km WNW of the top, c. 760 m a. s. l.; 49°24'48"N, 18°21'13"E; **III** – Moravskoslezské Beskydy Mts., Bílá, beech forest on W slope of Malý Čistý hill (865 m), about 0.6 km W of the top, c. 790 m a. s. l.; 49°24'23"N, 18°24'32"E; **1** – Moravskoslezské Beskydy Mts., Bílá, beech forest on E slope of Mt. Vysoká (1024 m), about 1.2 km NE of the top, c. 790 m a. s. l.; 49°24'34"N, 18°22'23"E; **2** – Moravskoslezské Beskydy Mts., Bílá, beech forest, about 0.8 km WSW of the top of Okrouhlice hill (743 m), c. 740 m a. s. l.; 49°24'20"N, 18°23'35"E; **3** – Vsetínské vrchy hills, Horní Bečva, Bečvice, beech forest on N slope of Mt. Vysoká (1024 m), by spring of the Rožnovská Bečva river, about 0.4 km NE of the top, c. 930 m a. s. l.; 49°24'16"N, 18°21'51"E; **4** – Moravskoslezské Beskydy Mts., Bílá, beech forest on the top of Čistý hill (749 m), about 0.7 km SE of the top of Malý Čistý hill (865 m), c. 750 m a. s. l.; 49°24'41"N, 18°24'35"E; **5** – Vsetínské vrchy hills, Horní Bečva, Bečvice, mixed forest on N slope of Mt. Vysoká (1024 m) about 1.4 km WNW of the top, c. 700 m a. s. l.; 49°24'53"N, 18°21'09"E; **6** – Vsetínské vrchy hills, Horní Bečva, Bečvice, mixed forest with larch about 1.6 km N of the top of Mt. Vysoká (1024 m), c. 700 m a. s. l.; 49°25'05"N, 18°21'33"E; **7** – Moravskoslezské Beskydy Mts., Horní Bečva, Bečvice, alder forest surrounded by spruce forest on E slope of Mt. Kladnatá, about 0.4 km SW of the top (918 m), c. 860 m a. s. l.; 49°26'02"N, 18°21'19"E; **8** – Vsetínské vrchy hills, Horní Bečva, Bečvice, spruce forest about 1 km ENE of the top of Mt. Vysoká (1024 m), c. 760 m a. s. l.; 49°24'44"N, 18°21'52"E; **9** – Moravskoslezské Beskydy Mts., Horní Bečva, Bečvice, waterlogged spruce forest in the spring area of the Sergač brook on N slope of Mt. Grapa (892 m) about 0.3 km WNW of the top, c. 860 m a. s. l.; 49°25'59"N, 18°21'25"E; **10** – Vsetínské vrchy hills, Horní Bečva, Bečvice, spruce forest on N slope of Mt. Vysoká (1024 m), about 0.7 km WNW of the top, c. 890 m a. s. l.;

Tab. 1. Vegetation and habitat characteristics of the permanent plots.

Number of plot	Vegetation	Forest naturalness	Tree composition (%)	Age	Tree /Bush/ Herb cover	Inclination	H. g. level	Char. of plot surroundings	Disturbance	Number of plant species	Number of substrate types
I	Secondary spruce stand	1.5	P (100)	85	80/20/85	12.5	–	2	3	24	12
II	Degradation stage of the *Dentario enneaphylli-Fagetum*	2	F (30), P (30), A (30), (S), (Ac)	59	80/0/15	8	–	2	3	21	33
III	*Dentario enneaphylli-Fagetum Salvietosum glutinosae*	3	F (100)	76	80/0/25	16	–	1	3	59	19
1	*Dentario enneaphylli-Fagetum*	2	F (90), P (10)	76	80/0/20	22	–	1	2	17	25
2	*Dentario enneaphylli-Fagetum*	2	F (100)	76	80/0/10	16	–	1	2	24	18
3	*Dentario enneaphylli-Fagetum Impatientetosum*	3	F (100), (P)	34	70/5/25	28.5	–	2	1	59	21
4	*Dentario enneaphylli-Fagetum Salvietosum glutinosae*	3	F (100)	55	80/0/45	9	–	2	1	32	18
5	Degradation stage of the *Dentario enneaphylli-Fagetum*	2	F (55), P (40), A (5), (Ac), (B)	56	80/0/8	6	–	2	2	16	25
6	Secondary mixed stand with larch	1	P (40), L (30), F (20), (Ac)	51	75/2/15	9	–	1	3	25	23
7	*Arunco silvestris-Alnetum glutinosae Crepidetosum paludosae*	3	P (50), Ai (25), Ag (25)	46	90/5/90	8	+	3	1	53	18
8	Secondary spruce stand	1.5	P (95) L (5), (A)	103	75/5/60	13	–	2	3	16	12
9	Secondary spruce stand resembling the *Mastigobryo-Piceetum*	3	P (100), (A)	83	60/0/75	6.5	+	1	2	29	18
10	Secondary spruce stand	1	P (100)	87	80/5/70	16	–	1	3	16	14
11	Secondary spruce stand	1	P (100), (A)	97	75/0/40	19	–	1	2	11	13

Tab. 1. – continuation.

Number of plot	Vegetation	Forest naturalness	Tree composition (%)	Age	Tree /Bush/ Herb cover	Inclination	H. g. level	Char. of plot surroundings	Disturbance	Number of plant species	Number of substrate types
12	Degradation stage of the *Luzulo-Fagetum descham-psietosum flexuo-sae*	1	P (100)	97	70/0/75	24	–	1	2	11	14
13	Young secondary spruce stand originated from natural seeding and later planting on the meadow of the *Arrhenatherion*	1	P (100), (F, S, B, Ac)	13	80/30/90	13	–	3	3	41	18
14	Secondary spruce stand	1	P (100), (A)	36	75/0/15	16	–	1	2	19	19
15	Secondary spruce stand resembling the *Equiseto-Piceetum deschampsietosum caespitosae*	2	P (100)	99	80/0/90	5	+	1	3	50	16

Legend: Degree of forest naturalness: 1 – artificial forest, 1.5 – artificial forest with subnatural elements, 2 – artificial/managed subnatural forest, 3 – managed subnatural forest; tree composition: P – *Picea abies*, F – *Fagus sylvatica*, A – *Abies alba*, B – *Betula pendula*, S – *Sorbus aucuparia*, Ag – *Alnus glutinosa*, Ai – *Alnus incana*, Ac – *Acer pseudoplatanus*, tree species in parentheses mean that the occurrence was lower than 5 %; H. g. level = high groundwater level. Character of plot surroundings: 1 – homogeneous, i.e. plot is surrounded by a similar type of forest, 2 – partly heterogeneous, 3 – heterogeneous, i.e. plot is surrounded by a different type of forest. Disturbance, i.e. timber cutting on plot or nearby or presence of forest road or forest edge near plot: 1 – no disturbance, 2 – some disturbance, 3 – high disturbance.

49°24'35"N, 18°21'24"E; **11** – Moravskoslezské Beskydy Mts., Horní Bečva, Bečvice, spruce forest on S slope of Mt. Grapa (892 m), about 0.9 km SE of the top, c. 810 m a. s. l.; 49°25'33"N, 18°21'03"E; **12** – Moravskoslezské Beskydy Mts., Horní Bečva, Bečvice, spruce forest on S slope of Mt. Kladnatá (918 m), about 0.6 km NW of the top, c. 800 m a. s. l.; 49°25'54"N, 18°20'58"E; **13** – Vsetínské vrchy hills, Horní Bečva, Bečvice, young spruce forest on N slope of Mt. Vysoká (1024 m), about 1.5 km NNW of the top, c. 700 m a. s. l.; 49°24'57"N, 18°21'12"E; **14** – Moravskoslezské Beskydy Mts., Bílá, spruce forest about 2.3 km S of the top of Lučovec hill (908 m), c. 690 m a. s. l.; 49°24'57"N, 18°23'29"E; **15** – Moravskoslezské Beskydy Mts., Bílá, spruce forest with small peat bogs about 1.3 km NE of the top of Mt. Vysoká (1024 m), c. 720 m a. s. l.; 49°24'52"N, 18°22'06" E.

Tab. 2. Number of species within each ecological group in the permanent plots. I-III: main permanent plots (60 visits); Ir-IIIr: reduced main permanent plots (10 visits); 1–15: additional plots (10 visits); Tot. no. Ag.: total number of Agaricales s. l.; Tot. no. macr.: total number of all macromycetes.

	I	Ir	II	IIr	III	IIIr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agaricales s. l.																					
Mycorrhizal	31	22	30	16	18	9	8	8	13	15	3	8	21	14	26	10	15	9	16	16	25
Sapr. lign.	19	11	21	10	21	11	6	8	10	9	5	4	7	4	13	9	5	0	7	8	7
Sapr. terr.	12	6	21	8	18	11	3	3	11	12	5	9	10	4	6	3	3	0	31	7	10
Sapr. others	7	4	4	1	4	1	0	0	3	0	0	2	1	1	6	0	1	1	5	1	4
Tot. no. Ag.	69	43	76	35	61	31	17	19	37	36	13	23	39	23	51	22	24	10	59	32	46
Other groups of macromycetes																					
Mycorrhizal	2	0	2	1	1	0	0	0	0	1	0	1	0	0	1	0	2	1	1	0	1
Sapr. lign.	15	4	45	29	46	32	26	17	18	20	11	11	5	5	13	6	9	6	10	11	8
Sapr. terr.	1	1	1	1	1	0	0	0	4	0	0	1	2	0	1	1	0	2	0	1	0
Sapr. others	2	0	4	0	3	2	0	0	1	0	0	1	0	0	1	0	0	0	2	0	0
Parasitic	1	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1
Tot. no. macr.	90	49	129	66	112	65	43	36	61	57	24	37	46	29	67	29	35	19	72	44	56

RESULTS

Number of species and percentage of trophic groups in the permanent plots

The number of species collected in each plot is shown in Table 2 and Fig. 2, the correlation coefficients with environmental data in Table 3. A high number of species was found in plots I, II and III (90, 129, 112 species of all macromycetes; 69, 76, 61 species of Agaricales s.l.). These plots were visited 6 times more frequently than the others. The number of species of macromycetes, of Agaricales s.l. and all trophic groups of macromycetes is positively correlated with visit frequency, whereas no correlation was found between visit frequency and percentage of single trophic groups.

When only species found in plots I-III during ten visits (Ir, IIr, IIIr) were used to compare with plots 1–15, the number of species in the permanent plots fell about 42–49 % (49, 66, 65 species of macromycetes). The number of species of

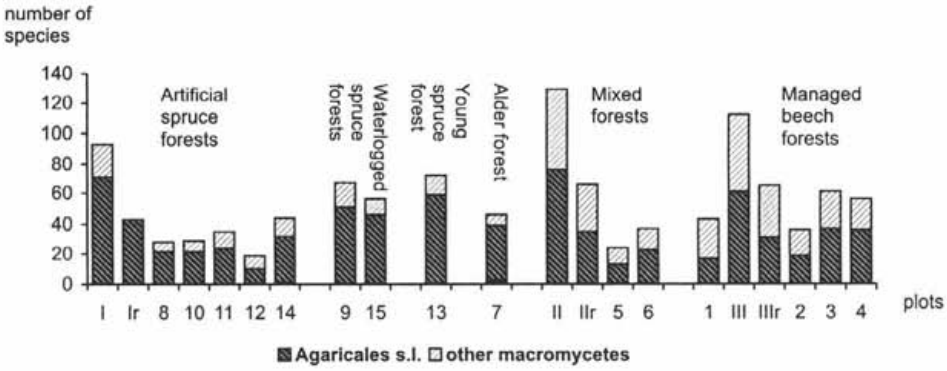

Fig. 2. Number of macromycete species in the permanent plots. Ir, IIr, IIIr – number of macromycete species recorded in plots I, II and III while visiting additional plots 1–15.

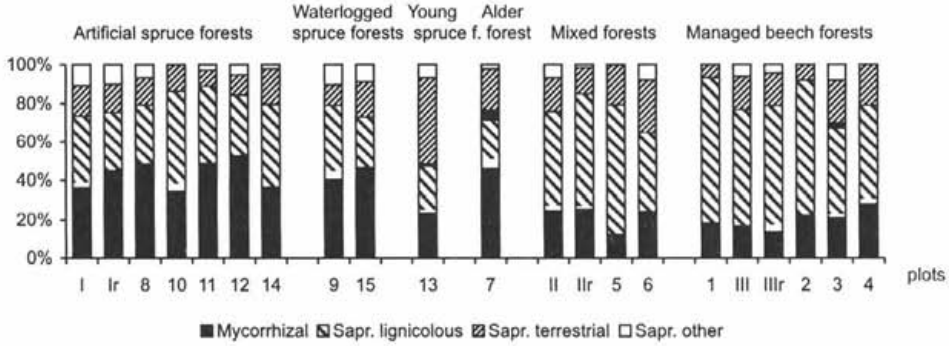

Fig. 3. Percentage of trophic groups in the permanent plots. Ir, IIr and IIIr – percentage of trophic groups recorded in plots I, II and III while visiting additional plots 1–15.

macromycetes was positively correlated with number of plant species and degree of naturalness of the forest; the number of species of Agaricales s.l. with herb cover, high groundwater level and number of plant species. The species richest plots were in the young spruce forest on a former meadow site (plot no. 13: 72 species) and in the waterlogged spruce forests (plots no. 9: 67 species; no. 15: 56 species). A high number of other macromycetes was found in the beech and mixed forest plots I, II and 4. The poorest in species were plots in the old spruce forest on steep slopes (plot no. 12: 19 species) and in the mixed forest (plot no. 5: 24 species).

The percentage of trophic groups in permanent plots is shown in Fig. 3; the correlation coefficients with environmental data are given in Table 3. The

Tab. 3. Correlation between quantitative parameters and environmental data.

	macr	ag	m%	n-m	l%	n-l	s%	n-s
Shrub cover					–0.49		0.58	
Herb cover		0.59	0.59	0.66	–0.83		0.50	
Presence of spruce			0.68		–0.67	–0.61		
Presence of beech			–0.78		0.76	0.72		
Age			0.57					
High groundwater level		0.53		0.62	–0.47			
Heterogeneity of surrounding							0.48	
Degree of naturalness of the forest	0.48					0.54		
Number of plant species	0.75	0.75					0.72	0.84
Number of substrate types			–0.77		0.58	0.68		
Number of visits	0.65	0.64		0.56		0.67		0.56

Legend: macr – number of macromycetes; ag – number of Agaricales s.l.; m% – percentage of mycorrhizal fungi; n-m – number of mycorrhizal fungi; l% – percentage of lignicolous fungi; n-l – number of lignicolous fungi; s% – percentage of saprophytic terrestrial fungi; n-s – number of saprophytic terrestrial fungi. Only factors that significantly correlated with quantitative parameters (r_s, n=18, $p < 0{,}05$) are shown.

percentage of mycorrhizal fungi was positively correlated with presence of spruce, herb layer cover and age of trees and inversely with presence of beech and number of substrate types. The percentage of lignicolous fungi was positively correlated with presence of beech and number of substrate types and inversely with presence of spruce, herb and shrub cover and high groundwater level. The percentage of saprophytic terrestrial fungi was positively correlated with herb and shrub cover, degree of naturalness of the forest and heterogeneity of the plot surroundings.

There are statistical differences between percentages of mycorrhizal and lignicolous fungi in spruce and beech forest plots ($p < 0.05$). Mycorrhizal species were the most important group in permanent plots in older artificial spruce (44 %), waterlogged spruce (43 %) and alder forests (46 %). On average, in plots in beech and mixed forests, mycorrhizal species made up 21 % of macromycetes. A high percentage of terrestrial saprophytes (43 %) was observed in the young spruce forest. Lignicolous species were the dominant group of macromycetes in all beech and some mixed plots.

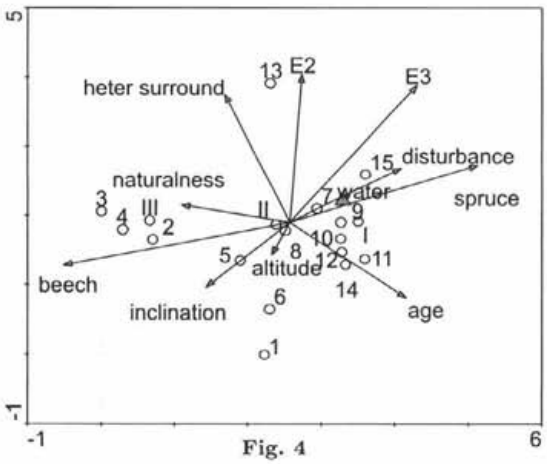

Fig. 4

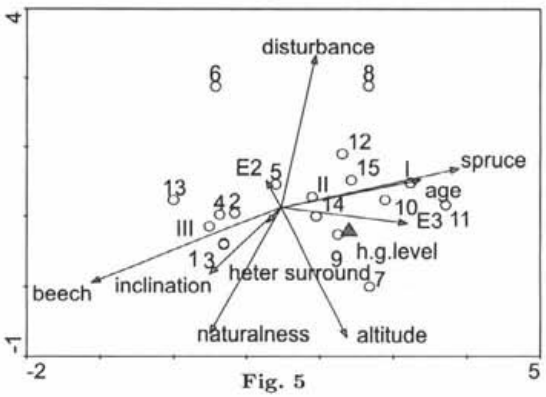

Fig. 5

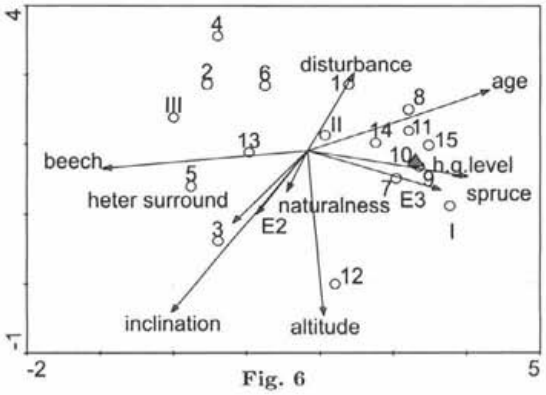

Fig. 6

Fig. 4–6. Biplot of DCA ordination of species composition (mycorrhizal, lignicolous and saprophytic terrestrial species) in 18 permanent plots. Vectors indicate additional correlation of the DCA axis with environmental data. For an explanation of the environmental data see Table 1 (heter surround = heterogeneity of surrounding; water, h. g. level = high groundwater level).

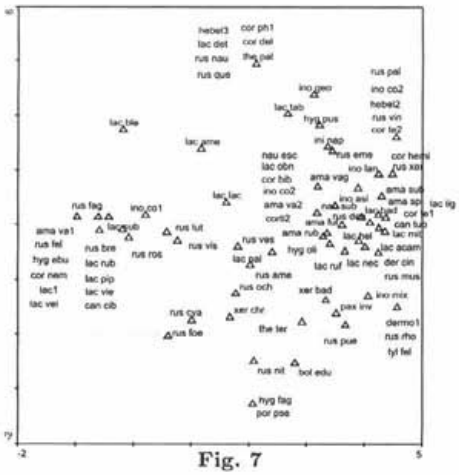

Fig. 7

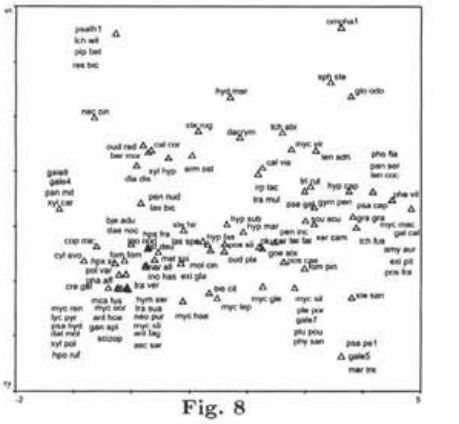

Fig. 8

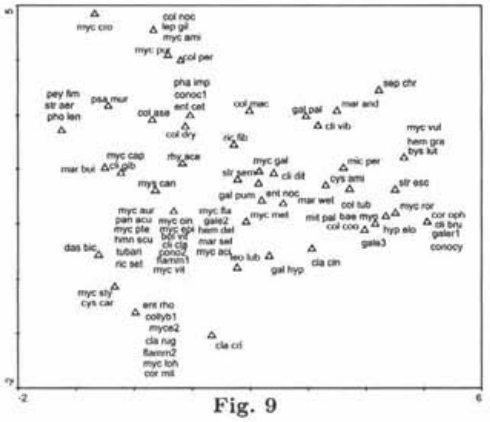

Fig. 9

Fig. 7–9. DCA ordination diagrams showing the position of mycorrhizal, lignicolous and saprophytic terrestrial species. Species codes are 5–6 letter abbreviations.

Species composition in permanent plots

Altogether 314 species of macromycetes (Agaricales s.l.: 211) were recorded in the permanent plots. Only 16 species of macromycetes (Agaricales s.l.: 13) were present in more than 10 plots, 129 species of macromycetes (Agaricales s.l.: 90) were found in one plot only (Table 4).

Species composition of the different trophic groups in the permanent plots was compared by means of DCA, additionally correlated with environmental data. Plot area was used as covariable data (Figs. 4, 5 and 6). After filtering out the influence of plot area, the first two main canonical axes explained 24.8 % of the data variability of mycorrhizal species composition, 21.5 % of the data variability of lignicolous species composition, and 23.4 % of the data variability of saprophytic terrestrial species composition. In all cases, the first canonical axis expressed the tree composition gradient, from beech to spruce. It is the most important in mycorrhizal fungi composition, whereas in the case of saprophytic fungi, the first canonical axis also expresses the age gradient and presence of water. The second canonical axis is determined by the gradient of herb cover, shrub cover and heterogeneity of plot surroundings in the ordination of mycorrhizal fungi, by the gradient of disturbance and forest naturalness in the ordination of lignicolous fungi, and very slightly by altitude in the ordination of saprophytic terrestrial fungi (Figs. 3–5). Details of the relationship between macromycete composition and environmental factors were not discovered because of the high reciprocal correlation of environmental factors and the lack of data on soil characteristics.

In the case of mycorrhizal fungi (Figs. 4 and 7), DCA separated two distinct groups of species strongly linked to beech or spruce trees. The first group in the left part of the ordination diagram was formed by species associated with beech (e.g. *Amanita* sect. *Vaginatae* 1, *Lactarius subdulcis, L. ruginosus, Russula faginea, Hygrophorus eburneus*), that occur in at least two of the plots III, 2, 3 and 4. The second group in the right part was dominated by species associated with spruce (e.g. *Amanita rubescens, Lactarius necator, Lactarius rufus, Lactarius helvus*), that occur in the majority of plots I, 9, 10, 12, 11 and 14. The main dissimilarities are found in the species composition of young forest plot 13 and the other plots. It is caused by the presence of species associated with spruce young forests, e.g. *Lactarius deterrimus, Russula queletii* and *R. nauseosa*, and by the absence of *Russula ochroleuca*. The mycorrhizal species composition in beech plot 1 and spruce plot 8 resembled more the mycorrhizal species composition in mixed forest plots than that in the other beech or spruce forest plots.

In the case of lignicolous fungi (Figs. 5 and 8), DCA distinguished a compact cluster of species associated with beech (e.g. *Marasmius alliaceus, Fomes fomentarius, Inonotus nodulosus*) occurring in all beech plots (III, 1, 2, 3 and 4). A similar lignicolous species composition was found in young forest plot 13. It is

Tab. 4. Occurrence of macromycetes in permanent plots in cultural forests. +, number of plots in bold: species was noted on plot; +, number of plots: species was noted in plot, but not included in ordination.

	I	II	III	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mycorrhizal species – Agaricales s. l.																		
Russula ochroleuca	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	+	+
Xerocomus chrysenteron s.l.	+	+	+	+	+	+	+	.	+	.	+	+	+	.	+	.	+	.
Hygrophorus olivaceoalbus	+	+	.	+	.	.	.	.	.	+	.	+	+	+	+	+	+	+
Laccaria laccata agg.	+	+	+	.	.	+	+	.	+	+	.	+	.	+	.	+	.	+
Amanita rubescens	+	+	.	.	.	.	.	+		+	+	+	.	+	+	.	+	+
Amanita vaginata s.l.	+	+	+	.	.	.	.	.	+	+	+	+	+	.	.	+	.	+
Xerocomus badius	+	+	.	+	.	.	.	.	.	+	+	+	+	.	+	.	+	+
Laccaria amethystea	.	+	+	.	+	+	+	.	.	+	.	+	.	.	.	+	.	+
Russula emetica	.	+	.	.	.	.	.	.	.	+	+	+	.	+	+	+	.	+
Inocybe napipes	.	+	.	.	.	.	.	.	.	+	+	+	+	.	.	+	+	+
Lactarius turpis	+	.	.	.	.	.	.	.	.	+	.	+	+	+	+	.	+	.
Lactarius rufus	+	+	.	.	.	.	.	.	.	+	.	+	.	+	+	.	+	.
Russula cyanoxantha	+	+	+	+	+	.	+	.	.	.	+	.	.	.	.	.	.	.
Amanita fulva	+	+	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	+
Lactarius blennius	.	+	+	.	+	+	+	.	.	.	.	.	.	.	.	+	.	.
Russula viscida	.	+	+	.	+	.	+	+	.	.	+	.	.	.	.	.	.	.
Amanita spissa	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+
Hygrophorus pustulatus	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+
Lactarius subdulcis	.	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Russula puellaris	+	+	.	.	.	.	.	.	+	.	.	.	.	+	.	.	+	.
Russula vesca	+	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+	.
Boletus edulis	+	+	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Lactarius camphoratus	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	+
Lactarius helvus	.	.	.	.	.	.	.	.	.	+	.	+	+	+	.	.	.	.
Lactarius lignyotus	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+
Paxillus involutus	+	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	+	.
Inocybe assimilata	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Amanita cf. *submembranacea*	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+
Amanita sect. *Vaginatae* 1	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Inocybe lanuginosa	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+
Lactarius mitissimus	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Lactarius tabidus	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.
Russula brevipes	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.

Tab. 4. – continuation.

	I	II	III	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Russula densifolia	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+
Russula fellea	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Russula vinosa	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+

Species present in only 1–2 plots: *Cortinarius hemitrichus:* **9**, **15**; *Dermocybe cinnamomea:* **I**, **14**; *Hygrophorus eburneus:* III, **3**; *Inocybe geophylla:* **13**, **15**; *Lactarius* sp. 1: III, **3**; *Lactarius ruginosus:* III, **4**; *Russula amethystina* I, **II**; *Russula faginea* **III**, **4**; *Russula foetens* **III**, **6**; *Russula lutea* **II**, **III**; *Russula mustelina* **I**, **14**; *Russula nigricans* I, II; *Russula rosea* II, **3**; *Russula xerampelina* **I**, **15**; *Inocybe* sect. *Cortinatae* 1: **3**, **7**; *Inocybe* sect. *Cortinatae* 2: I, **7**; *Amanita* sect. *Vaginatae* 2: **7**; *Cortinarius* sp. 1: I; *Cortinarius* sp. 2: **7**; *Cortinarius bibulus* **7**; *Cortinarius delibutus* **13**; *Cortinarius* cf. *nemorensis:* **3**; *Cortinarius* subgen. *Phlegmacium* 1: **13**; *Cortinarius* subgen. *Telamonia* 1: **9**; *Cortinarius* subgen. *Telamonia* 2: **15**; *Dermocybe* sp. 1: **11**; *Hebeloma* sp. 1: I; *Hebeloma* sp. 2: **15**; *Hebeloma* sp. 3: **13**; *Hygrophorus* cf. *fagi:* **1**; *Inocybe mixtilis*: **14**; *Inocybe* sect. *Cortinatae 3*: **15**; *Lactarius badiosanguineus*: **9**; *Lactarius deterrimus*: **13**; *Lactarius obscuratus*: **7**; *Lactarius pallidus*: **8**; *Lactarius piperatus*: **4**; *Lactarius vellereus*: **3**; *Lactarius vietus*: **4**; *Alnicola melinoides*: **7**; *Naucoria submelinoides*: **7**; *Porphyrellus pseudoscaber*: **1**; *Russula* cf. *fragilis*: I; *Russula integra*: II; *Russula nauseosa*: **13**; *Russula nitida*: **6**; *Russula paludosa*: **15**; *Russula queletii*: **13**; *Russula rhodopoda*: **11**; *Tylopilus felleus*: **11**

	I	II	III	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mycorrhizal species – other groups of macromycetes																		
Thelephora terrestris	+	+	+	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.
Cantharellus tubaeformis	+	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+

Species present in only 1–2 plots: *Cantharellus cibarius*: **4**; *Thelephora palmata*: **13**

	I	II	III	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Saprophytic terrestrial species – *Agaricales* s.l.																		
Mycena galopus	+	+	+	.	.	+	+	+	+	+	+	+	+	+	.	+	+	+
Clitocybe vibecina	+	+	.	+	.	.	.	.	+	+	+	+	.	.	.	.	+	+
Cystoderma amiantinum	+	+	.	+	.	+	.	.	.	+	+	+	.	.	.	.	+	+
Marasmius androsaceus	+	+	.	.	.	.	+	.	.	+	.	+	+	+	.	.	+	+

Tab. 4. – continuation.

	I	II	III	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Collybia butyracea var. *asema*	.	+	+	.	+	+	+	+	+	.	.	.	.	.	.	+	.	.
Micromphale perforans	+	.	.	.	.	.	.	.	.	+	+	+	.	+	.	+	+	+
Collybia peronata	.	+	+	+	+	.	+	.	+	.	.	.	.	.	.	+	.	.
Mycena sanguinolenta	.	+	+	.	+	+	.	+	+	.	.	.	.	.	.	+	.	.
Collybia dryophila	.	.	+	.	.	+	+	.	+	.	.	+	.	.	.	.	.	.
Mycena rorida	+	+	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	+
Clitocybe ditopa	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Marasmius bulliardii	.	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.
Mycena pura	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	+	.	.
Psathyrella murcida	.	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Cystoderma carcharias	.	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.
Entoloma conferendum	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.
Galerina pumila	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Marasmius wettsteinii	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+
Mycena capillaris	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.

Species present in only 1–2 plots: *Clitocybe gibba*: **III, 13**; *Collybia confluens*: **4, 13**; *Entoloma cetratum*: II, **6**; *Entoloma rhodopolium*: III, **3**; *Lepista gilva*: **4, 13**; *Mycena amicta*: **4, 13**; *Mycena cinerella*: II, **13**; *Mycena crocata*: **III, 4**; *Mycena epipterygia*: II, **13**; *Mycena metata*: **7, 13**; *Mycena stylobates*: **3, 5**; *Mycena zephirus*: II, III; *Pholiota lenta*: II, **III**; *Stropharia aeruginosa*: II, **III**; *Phaeocollybia arduennensis*: I; *Agrocybe praecox*: III; *Bolbitius vitellinus*: **13**; *Clitocybe* cf. *brumalis*: I; *Clitocybe clavipes*: **13**; *Collybia* sp. 1: **3**; *Collybia maculata*: **II**; *Conocybe* sp. 1: **6**; *Conocybe* sp. 2: **13**; *Flammulaster* sp. 1: **13**; *Galerina* sp. 1: **I**; *Galerina* sp. 2: **13**; *Galerina* sp. 3: **7**; *Hemimycena delectabilis*: **13**; *Hemimycena gracilis*: **15**; *Marasmius setosus*: **13**; *Mycena* sp. 1: I; *Mycena* sp. 2: **3**; *Mycena acicula*: **13**; *Mycena aurantiomarginata*: **13**; *Mycena* cf. *flavoalba*: **13**; *Mycena* cf. *vitilis*: **13**; *Mycena fagetorum*: II; *Mycena vulgaris*: **15**; *Naucoria* sp.: III; *Panaeolus acuminatus*: **13**; *Phaeomarasmius erinaceus*: II; *Psathyrella* sp. 1: III; *Tubaria* sp.: **13**

	I	II	III	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Saprophytic terrestrial species – other groups of macromycetes																		
Clavulina cinerea	+	+	.	.	.	+	.	.	.	+	.	+	+	.	+	.	+	.
Clavulina cristata	.	.	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.

Species present in only 1–2 plots: *Leotia lubrica*: **3, 7**; *Phallus impudicus*: **6**; *Clavulina rugosa*: **3**

Tab. 4. – continuation.

	I	II	III	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Saprophytic lignicolous species – *Agaricales* s. l.																		
Armillaria obscura	+	+	+	.	.	+	+	+	+	.	.	+	.	.	.	+	+	+
Hypholoma capnoides	+	+	+	.	.	.	.	.	.	+	+	+	+	+	.	.	+	+
Mycena galericulata	+	+	+	+	+	+	.	.	.	+	.	+	+	.	.	.	+	.
Mycena viridimarginata	+	+	+	.	.	.	+	+	.	.	+	+	+	.	.	.	+	+
Pluteus cervinus	+	+	+	+	+	+	+	.	.	.	.	+	+	+	.	.	.	.
Megacollybia platyphylla	+	.	+	+	+	+	+	+	.	.	.	+	.	.	.	.	+	.
Hypholoma marginatum	+	+	+	.	+	+	.	.	.	.	.	+	+	.	.	+	.	.
Tricholomopsis rutilans	+	+	.	.	.	.	.	.	+	+	.	+	+	.	.	.	.	+
Hypholoma fasciculare	.	+	+	.	+	.	+	.	.	.	.	+	.	.	.	.	+	.
Marasmius alliaceus	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	+	.
Oudemansiella radicata	.	+	+	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.
Xeromphalia campanella	+	+	+	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.
Gymnopilus penetrans	+	+	.	.	.	.	.	+	.	.	.	.	+	.	.	.	+	.
Mycena haematopus	.	.	+	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.
Mycena leptocephala	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+	.	+
Coprinus micaceus	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.
Hypholoma sublateritium	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+
Mycena oortiana	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mycena silvae-nigrae	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Panellus mitis	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Pleurocybella porrigens	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.

Species present in only 1–2 plots: *Hydropus marginellus*: **III**, **8**; *Kuehneromyces mutabilis*: II, III; *Lentinellus cochleatus* **I**, III; *Mycena maculata*: II, **11**; *Mycena picta*: II, III; *Mycena rubromarginata*: I, II; *Pluteus* cf. *pouzarianus*: II, **9**; *Pholiota subochracea*: I; *Crepidotus applanatus*: I, *Galerina calyptrata*: **11**; *Galerina* sp. 4: **13**; *Galerina* sp. 5: **7**; *Galerina* sp. 6: II; *Galerina* sp. 7: **9**; *Galerina* sp. 8: **13**; *Lentinus adhaerens*: **15**; *Mycena* sp. 24: **3**; *Mycena stipata*: **1**; *Mycena renati*: **III**; *Omphalina* sp. 1: **8**; *Panellus serotinus*: **I**; *Pholiota flammans*: **I**; *Psathyrella* sp. 1: **6**; *Psathyrella* cf. *caput-medusae:* **10**; *Psathyrella hydrophila*: **III**; *Psathyrella* sect. *Pennatae* 1: **7**

Tab. 4. – continuation.

	I	II	III	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Saprophytic lignicolous species – other groups of macromycetes																		
Calocera viscosa	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	+	+
Dacrymyces sp. div.	.	+	+	+	+	.	+	+	+	.	+	.	+	+	+	+	+	+
Fomitopsis pinicola	+	+	.	+	.	+	.	.	.	+	.	+	+	+	+	.	+	+
Calocera cornea	.	+	+	+	+	+	+	.	+	.	.	.	.	.	+	+	.	.
Diatrype disciformis	.	+	+	+	+	+	+	+	+	.	.	.	.	.	.	+	.	.
Postia caesia	+	+	.	+	.	.	.	+	.	+	.	+	.	.	+	.	+	+
Stereum hirsutum	.	+	+	+	+	.	+	+	.	.	.	+	.	.	.	+	.	+
Stereum rugosum	.	+	+	+	+	.	+	+	+	.	+	+	.	.	.	.	.	.
Xylaria hypoxylon	+	+	+	.	+	+	+	+	+	.	.	.	.	.	.	.	+	.
Hypoxylon fragiforme	.	+	+	+	+	+	+	.	.	.	.	.	.	.	.	+	+	.
Bertia moriformis	.	+	+	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.
Bisporella citrina	.	+	+	+	+	.	+	.	.	+	.	+	.	.	.	.	.	.
Exidia plana	.	+	+	+	.	+	+	+	.	.	.	+	.	.	.	.	.	.
Melogramma spiniferum	.	.	+	+	+	+	+	+	.	.	.	.	.	.	.	.	+	.
Bjerkandera adusta	.	+	+	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.
Daedaleopsis confragosa	.	+	+	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.
Inonotus hastifer	.	+	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Inonotus nodulosus	.	+	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.
Mollisia cinerea	+	+	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.
Phanerochaete affinis	+	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Pseudohydnum gelatinosum	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+
Fomes fomentarius	.	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Nectria cinnabarina	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.
Postia stiptica	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Schizopora sp.	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Sphaerobolus stellatus	+	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+
Stereum sanguinolentum	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	.	+	.
Trichaptum fuscoviolaceum	.	+	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.
Ustulina deusta	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Antrodiella hoehnelii	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ascocoryne sarcoides	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gloeophyllum odoratum	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.
Hymenoscyphus serotinus	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Lasiosphaeria spermoides	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Tab. 4. – continuation.

	I	II	III	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Physisporinus sanguinolentus	+	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Scutellinia scutellata	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+
Trametes versicolor	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.

Species present in only 1–2 plots: *Antrodiella faginea*: II, **3**; *Cylindrobasidium evolvens*: **III**, **13**; *Datronia mollis*: II, **III**; *Exidia pithya*: II, **13**; *Ganoderma applanatum*: **III**, **3**; *Hypoxylon serpens*: **III**, **3**; *Merulius tremellosus*: III, **7**; *Mycoacia fuscoatra*: III, **1**; *Neobulgaria pura*: III; *Peniophora incarnata*: II, **9**; *Phellinus viticola*: **I**, **11**; *Polyporus varius*: III, **4**; *Trametes suaveolens*: **1**, **4**; *Trechispora farinacea*: **II**, **9**; *Trichaptum abietinum*: **II**, **12**; *Xylaria polymorpha*: II, **III**; *Aleurodiscus amorphus*: II; *Amylostereum areolatum*: I; *Antrodia heteromorpha*: II; *Ascotremella faginea*: III; *Creopus gelatinosus*: **III**; *Gloeophyllum abietinum*: **14**; *Grandinia alutaria*: I; *Grandinia granulosa*: **10**; *Grandinia nespori*: II; *Haplotrichum conspersum*: III; *Hyphoderma setigerum*: III; *Hypocrea lactea*: II; *Hypocrea rufa*: **III**; *Irpex lacteus*: **II**; *Lachnellula willkommii*: **6**; *Laxitextum bicolor*: **2**; *Lycoperdon pyriforme*: **III**; *Nectria ditissima*: III; *Peniophora nuda*: 2; *Peniophora* sp.: II; *Phellinus hartigii*: II; *Piptoporus betulinus*: **6**; *Postia fragilis*: **11**; *Resinicium bicolor*: **6**; *Trametes multicolor*: **II**; *Trechispora christiansenii*: I; *Xylaria carpophila*: **13**

	I	II	III	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Saprophytic other species – Agaricales s. l.																		
Galerina hypnorum	+	+	+	.	.	+	.	.	.	.	.	+	.	.	+	+	.	+
Collybia tuberosa	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	+
Rickenella fibula	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.
Strobilurus esculentus	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+
Baeospora myosura	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Galerina paludosa	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	+

Species present in only 1–2 plots: *Collybia cookei*: I, **9**; *Hypholoma elongatum*: **7**, **9**; *Stropharia semiglobata*: **I**, **III**; *Crepidotus epibryus*: III; *Flammulaster* sp. 2: 3; *Conocybe* sp.: I; *Galerina* sp.: III; *Mycena* cf. *lohwagii*: **3**; *Mycena pterigena*: **13**; *Rickenella setipes*: **13**

Saprophytic other species – other groups of macromycetes

Dasyscyphus bicolor: II, **III**, **3**; *Dasyscyphus virgineus*: II, III; *Rutstroemia bulgarioides*: I, II; *Hymenoscyphus scutula*: **13**; *Inermisia aggregata*: I; *Mitrula paludosa*: **9**; *Peziza* cf. *fimetii*: **III**; *Rhytisma acerinum*: 6; *Typhula erythropus*: II

Parasitic species

Sepedonium chrysospermum: 8; *Byssonectria luteovirens*: 15; *Cordyceps ophioglossoides*: **I**; *Polydesmia pruinosa*: II; *Cordyceps militaris*: 3

probably caused by the presence of beech wood rests and by a practical absence of lignicolous fungi on spruce. Spruce plots are more dispersed than the beech plots. The distinctive difference between plots 6 and 8 and the other plots is explained by the small number of lignicolous fungi and the presence of fungi associated with larch or birch (e.g. *Piptoporus betulinus, Lachnellula willkommii*).

Spruce forest plots create a more compact cluster than beech plots in the ordination diagram of saprophytic terrestrial fungi (Figs. 6 and 9). The common species for spruce forest plots are e.g. *Marasmius wettsteinii, Clitocybe vibecina* and *Marasmiellus perforans*. Beech plot 1 and mixed plot II are similar to these spruce plots. The group of beech plots is very dispersed and includes some mixed plots. The main differences in species composition in beech plots are between plots 3 and 4. The species composition of plot 13 is closer to the beech and mixed forest group than the spruce forest group and it is probably influenced by beech forest in the vicinity. This trophic group of fungi is practically absent in plot 12, which is therefore found by itself in the diagram.

DISCUSSION

Quantitative parameters

The number of species found in single permanent plots during a defined period of time is a basic parameter for species richness comparison. It is strongly influenced by the sampling procedure (Arnolds 1992). In the case of the studied plots, it was strongly correlated with visit frequency. The effect of area differences between the main plots I-III and additional plots did not appear to be very evident.

The hypothesis that more natural forest is more species-rich was partly confirmed except for the young spruce forest on a former meadow. Beech forests are better characterised by the presence of more groups of macromycetes than are spruce forests (see Table 2, Fig. 2). Species of Agaricales s.l. distinctively prevailed in spruce forests, where species richness is correlated to the presence of water and vascular plant species diversity. It can be stated that plots in artificial forests in the study area interesting from the floristic viewpoint are also interesting mycofloristically.

The percentage of trophic groups is an important indicator which characterises the state of mycoflora in forests. Mycorrhizal fungi, especially, are disappearing in pollution-impacted areas (Arnolds 1987, Schlechte 1987, Fellner and Soukup 1991). Contrary to the low number of species in the studied plots, the percentage of trophic groups does not correlate with visit frequency.

Fellner (1993) distinguishes three stages of disturbance of ectotrophic forest stability based on the percentage mycorrhizal and lignicolous macromycetes. According to this scale, plots 7, 11 and 15 are stable, plots I, 8, 9 and 12 are suffering latent disturbance of ectotrophic forest stability, plots II, 2, 3, 4, 6, 10 and 14 are acutely disturbed and plots III, 1 and 5 are lethally disturbed. Plot 13 is unclassified. These results are unlikely, because plots that are located near each other on the same hillside (5, II, I, 10) are classified in 3 different stages of ectotrophic forest stability. All beech forests plots are classified as acutely and lethally disturbed. In the plots studied, this classification expresses the natural differences between the mycoflora composition of spruce and beech forests more than the stage of ectotrophic stability. Fellner's scale is probably useful only for a small area and specific phytocoenoses, mainly spruce forests and acidic beech forests. Similar results not confirming Fellner's theory (1993) were reported from Italy, where the percentage of mycorrhizal fungi was most influenced by altitude (Laganå et al. 1999).

Characteristics of mycoflora of cultural forests in the studied area

Spruce forests

Artificial spruce forests substituting former beech forests of the *Dentario enneaphylli-Fagetum* association predominate in the study area. Their mycoflora was studied in six plots.

According to Kost (1992), the mycoflora of cultural spruce forests is reduced in species number when compared with natural forests. This reduction depends on the intensity of forestry management. Mycoflora reduction, especially in mycorrhizal fungi, appears in natural spruce forests in regions with extreme atmospheric pollution (Gulden et al. 1992), as well. Unfortunately, because of a lack of comparable results from natural forests in Beskydy Mts. and methodological differences in literature data, it is not possible to draw some definite conclusions about the state of artificial forests in Beskydy Mts.

The numbers of species found in the studied plots are in the range noted by other authors (Table 5). The number of species recorded in plot I during 60 visits conforms to the number of species in a species-rich natural spruce forest recorded during 10 visits (Holec 1997). The numbers of species noticed in other spruce plots in the study area are comparable to results from the Krušné hory Mts. (Šteklová 1977, Fellner and Soukup 1991). The percentage of mycorrhizal fungi in studied plots is slightly higher than in plots in the Krušné hory Mts. and the Českomoravská vysočina hills. The number of lignicolous fungi corresponds to literature data and the number of saprophytic terrestrial fungi is lower.

Tab. 5. Comparison of results of studies of similar permanent plots in spruce forests
Numbers in brackets refer to the total number of macromycetes noted

	Area	Type of forest	Altitude	Number of visits	Period of study	Size of plot (m^2)	Number of fungal taxa	Number of mycorrhizal fungal taxa	Percentage of mycorrhizal fungal taxa	Number of lignicolous fungal taxa	Number of saprophytic terrestrial fungal taxa
Šmarda (1972)	Českomoravská vrchovina (ČR)	Artificial forest (*Picea* + + *Abies*)	610	39	1961–63	2000	–	70(72)	–	–	63(74)
		Artificial spruce forest	600	35	1961–63			70(72)			40(47)
			625	34	1961–63			54(56)			42(50)
			575	50	1960–63			106(109)			40(46)
		Artificial spruce forest	650	51	1961–65			89(93)			24(30)
			650	47	1961–65			96(99)			32(35)
			590	31	1960–62			71(75)			22(23)
		Bazzanio-Piceetum	710	35	1962–65			112(118)			44(50)
			630	18	1964–65			117(122)			38(48)
Gulden et al. (1992)	Black Forest (Germany)	*Vaccinio-Abietetum*	970	20	1987–89	10 x 225	(122)	(68)	(55.7)	(18)	(34)
Šteklová (1977)	Krušné hory (ČR)	*Calamagrostio villosae-Piceetum*	1029	2-week intervals	1975–76	900	36(37)	9	25	7(8)	18
			1030		1975–76		28(31)	10	35.7	5(8)	13
			1030		1975–76		25(26)	7	28	4(5)	14
Lepšová (1988)	Šumava (ČR)	Artificial spruce forest	900	8	1988	2500	–	28(31)	–	–	–
		Calamagrostio villosae-Piceetum	1190	12	1987–88	2500		20(21)			
			1300	11	1987–88	3 x 900		17			
			1300	11	1987–88	3 x 900		20			
			1140	8	1987–88	2 x 900		20(21)			
		Athyrio alpestris Piceetum	1350	8	1987–88	3 x 900		15			

Tab. 5. – continuation.

	Area	Type of forest	Altitude	Number of visits	Period of study	Size of plot (m^2)	Number of fungal taxa	Number of mycorrhizal fungal taxa	Percentage of mycorrhizal fungal taxa	Number of lignicolous fungal taxa	Number of saprophytic terrestrial fungal taxa
Fellner and Soukup (1991)	Šumava (ČR) Krušné hory (ČR) Českomoravská vysočina (ČR)	spruce stands	590–1300	(2)3–4 week intervals	1986*	2500	(89), (41), (58), (79) (115), (27), (27), (22), (60), (58)	–	(34.5), (18.5), (23.5), (40.9), (43.6), (26.6), (27.9) (23.6) (27.8), (25.9)	–	–
Holec (1997)	Šumava (ČR)	*Calamagrostio villosae-Piceetum*	1190–1210	11	1994–96	2500	63(84)	30(32)	47.6(38.1)	13(16)	20(36)
Vašutová (this study)	Vsetínské vrchy (ČR)	Artificial spruce forest	810	60	1998–2000	3600	69(90)	31(33)	44.9(38.1)	19(34)	19(22)
	Beskydy (ČR)	Artificial spruce forest	760	10	1999–2000	2500	23(29)	14	60.9(48.2)	4(9)	5
			890	10		2500	22(29)	10	45.5(34.5)	9(15)	3(4)
			810	10		2500	24(35)	15(17)	62.5(48.6)	5(14)	4
			800	10		2500	10(20)	9(10)	90(50)	0(7)	1(3)
			690	10		2500	32(44)	16	50(36.3)	8(19)	8(9)

* only the year when the study was started is mentioned

The number of species recorded by Šmarda (1972) in plots in the Českomoravská vysočina hills is distinctly higher. His plots were established in forests close to artificial ones, in lower altitudes than the plots of other authors and they were visited more often than most other ones, but his results are hard to explain by these dissimilarities. They could be explained by a higher species diversity in the past than at present, but results from the Českomoravská vysočina Mts. from 1963–1968 (Hlůza 1988) are comparable with those published by other authors.

The mycoflora of the studied cultural spruce forests was relatively homogenous, especially the species composition of saprophytic terrestrial fungi and widespread lignicolous fungi. It included most of the typical species of cultural forests according to Kost (1992): e.g. *Russula ochroleuca, Hygrophorus pustulatus, Inocybe assimilata, Lactarius necator, Cystoderma amiantinum, Mycena galopus, Mycena pura, Clavulina cristata, Marasmiellus perforans, Marasmius androsaceus, Clitocybe ditopa* and *Clitocybe vibecina*. Because of the high altitude of the studied plots, the mycoflora was enriched by some mountainous species: *Lactarius lignyotus* and *Russula mustelina* (typical species of mountain spruce forests according to Kost 1992), *Hygrophorus olivaceoalbus, Hygrophorus pustulatus, Mycena viridimarginata* and *Phellinus viticola* (mountain elements according to Šteklová 1977), *Pholiota subochracea* and *Pleurocybella porrigens* (typical species of climax spruce forests according to Holec 2000).

Cultural forests in the Czech Republic were mycocoenologically studied by Šmarda (1973). He recognised three mycoassociations. It was not possible to compare the mycoflora of the studied plots with his mycosociological units, because in the spruce forest plots in the Beskydy Mts. and the Vsetínské vrchy hills, the characteristic, subcharacteristic and abundant species of the genera *Cortinarius*, *Hebeloma* and *Tricholoma* were practically absent.

The main differences in species composition between artificial spruce forests in the Beskydy Mts. and climax spruce forests in the Šumava Mts. (Holec 1997) are the small number of species of the genera *Cortinarius, Russula* and *Galerina* and the presence of species not clearly associated with spruce in cultural forests. This can be caused by heterogeneity of the neighbouring forests and the effect of previous tree species composition described by Watling (Watling in Nantel and Neumann 1992).

Artificial waterlogged spruce forests

Two plots in waterlogged spruce forests were studied. The mycoflora of waterlogged spruce forests is richer than the mycoflora of other cultural spruce forests. This observation agrees with the results of Fellner and Soukup (1991). This may be caused by the high groundwater level and lack of slope of the studied plots. In addition, the massive occurrence of *Sphagnum* can be an advantage

in dry periods. Percentages of trophic groups and species composition are very close to those of other artificial spruce forests. Except for the cultural spruce forest species and some mountainous forest species, several species characteristic of waterlogged spruce forests (Lazebníček 1989) were observed here: *Galerina paludosa, Hypholoma elongatum, Lactarius helvus, Mitrula paludosa, Russula emetica, Russula paludosa* and *Tephrocybe palustris*.

Young spruce forests

Young spruce forests were studied in one plot only. They are the most species rich forests in the studied area. The high percentage of saprophytic species and different species composition in comparison with old spruce forests are very interesting. The succession of fungi in newly forested plots was studied by Ricek (1981). He observed that an association of meadow fungus species (previously terrestrial saprophytes) completely changed into an association of fungi of mature forests over a period of 30 years. Rapid succession is typical of this type of forest. Newly planted forest creates densely closed stands, suitable for species of mature forest. In that stage, small grassy plots can persist, and they can form a niche for forest margin species and some less sensitive meadow species having broader ecological valence. Other micro-habitats are formed by ferns and herbs.

Some of the species characteristic of these types of forest (according to Ricek) were recorded here: *Lactarius deterrimus, Russula queletii, Russula nauseosa, Cortinarius delibutus, Laccaria laccata, Laccaria amethystea, Collybia confluens, Marasmiellus perforans, Mycena epipterygia, Hemimycena delicatula, Mycena rosella, Mycena aurantiomarginata, Marasmius androsaceus, Ramaria cristata, Clitocybe gibba, Collybia asema* and *Marasmius bulliardii*. Some fungi of mature forests which prevail in later stages (affter about 40 years) have been noticed sporadically, for example: *Hygrophorus pustulatus, Clitocybe ditopa and Hygrophorus olivaceoalbus*.

Beech forests

Beech and mixed forests are natural climax vegetation in the studied region (Neuhäuslová et al. 1998). They were very rich in number of macromycete species. A total of 220 species of macromycetes were found during 27 years of extensive study (Kuthan 1990) in a fir-beech forest in Salajka Nature Reserve. Recent managed subnatural beech forests of the *Dentario enneaphylli-Fagetum* association were studied in five plots. They show low substrate diversity (stumps, logs and trunks only) in comparison with natural forests.

Tab 6. Comparison of the results of studies in similar permanent plots in beech forests.
Numbers in brackets refer to the total number of macromycetes noted.

	Area	Type of forest	Altitude	Number of visits	Periods of study	Size of plot (m^2)	Number of fungal taxa	Number of mycorrhizal fungal taxa	Percentage of mycorrhizal fungal taxa	Number of lignicolous fungal taxa	Number of saprophytic terrestrial fungal taxa
Šmarda (1973)	Českomoravská vrchovina (ČR)	Herb-rich beech forest	500 450 410	86 65 51	1960–65 1960–63 1960–63	2000	–	86 (89) 75 (77) 78 (83)	–	–	41 (48) 46 (60) 66 (85)
Hlůza (1988)	Českomoravské mezihoří (ČR)	Herb-rich beech forest	510 570 540	81 86 100	1963–68	3000	51 (68) 53 (67) 63 (88)	23 22 30	45.1 (33.8) 41.5 (32.8) 47.6 (34.1)	10 (22) 13 (23) 14 (27)	18 18 19
Fellner and Soukup (1991)	Krušné hory Českomoravská vysočina Křivoklátsko (ČR)	Beech forests	110–380	(2)3–4 week intervals	1986*	2500	(23) (85) (43), (44), (61), (43), (46), (27), (41), (33), (42)	–	(38.6) (10) (25.3), (22), (44.6), (19), (64), (65), (55.2), (80.9), (71)	–	–
Holec (1992)	Šumava (ČR)	*Dentario enneaphylli-Fagetum* *Calamagrostio villosae-Fagetum*	960–990 940 900–940 930–950 850–880 600–640 1110–1120 1060–1100	2–4 week intervals	1988–90 1989–90 1989–90 1989–90 1988–90 1988–90 1988–90 1988–90	2500	102 (107) 82 (88) 71 (74) 62 (66) 57 (61) 50 (55) 102 (108) 87 (91)	36 (37) 18 (19) 15 22 16 32 (35) 28 (30) 24	35.3 21.1 21.2 35.5 28.1 64 27.5 27.5	31 (32) 32 (33) 29 (31) 18 (19) 24 (25) 5 30 22 (23)	35 (38) 32 (36) 27 (28) 22 (25) 17 (20) 13 (15) 44 (48) 41 (44)

Tab 6. – continuation.

	Area	Type of forest	Altitude	Number of visits	Periods of study	Size of plot (m^2)	Number of fungal taxa	Number of mycorrhizal fungal taxa	Percentage of mycorrhizal fungal taxa	Number of lignicolous fungal taxa	Number of saprophytic terrestrial fungal taxa
Mihál (1993)	Kremnica uplands (SR)	Beech forest	450–475	29 29 29 29 29	1990–92	5000– –4100	(78) (58) (48) (68) (43)	(16) (11) (14) (14) (16)	(20.5) (19) (29.2) (20.6) (37.2)	(47) (40) (27) (35) (20)	(15) (7) (7) (19) (7)
Pavlík (1999)	Žiarská kotlina (SR)	Polluted beech forest	470		1994–1996	10 x 225	(88)	(32)	(36.4)	(31)	(25)
Vašutová (this study)	Moravskoslezské Beskydy (ČR)	*Dentario enneaphylli-Fagetum*	740 750	10 10	1999–2000	2500	19 (36) 36 (57)	8 (8) 15 (16)	42.1 35.1	8 (25) 9 (29)	3 (3) 12 (12)
	Vsetínské vrchy (ČR)	*Dentario enneaphylli-Fagetum*	790 930	60 10	1998–2000 1999–2000	3600 2500	61 (112) 37 (61)	18 (19) 13 (13)	29.5 41.7	21 (67) 10 (28)	22 (26) 14 (19)

* only the year when the study was started is mentioned

The mycoflora of these forests is more variable than that of artificial spruce forests. This variability is most expressed in terrestrial fungi composition and roughly agrees with the variability in vascular plant composition (Vašutová 2001). It supports results from roadside verges planted with beech in the Netherlands. Keizer (1993) found that the community of vascular plants corresponds with that of saprotrophs better than that of ectomycorrhizal fungi. The case of plot 1 is an interesting situation. The tree layer is dominated by beech with ten per cent spruce and the composition of lignicolous species is close to that of other beech plots. On the other hand, the floristic composition and composition of mycorrhizal and saprophytic terrestrial fungi is close to that of mixed plots. The number of species and percentage of mycorrhizal fungi found in the studied plots is within the range recorded by other authors (Table 6). The number of saprophytic terrestrial species is smaller than in the literature data, and comparable with results from the Kremnické vrchy Mts. (Mihál 1993). The number of lignicolous species is similar to results from the Českomoravské mezihoří hills (Hlůza 1988) and Žiarská kotlina (Pavlík 1999).

Characteristic species, which according to Lisievska (1972, 1974) are typical of beech forest, occur here: *Lactarius subdulcis, Lactarius vellereus, Russula fellea, Russula cyanoxantha, Collybia peronata, Collybia butyracea var. asema, Mycena stylobates, Marasmius bulliardii, Mycena galericulata, Oudemansiella radicata* and *Megacollybia platyphylla.*

There were no distinct differences between species composition of the studied plots and a polluted beech plot in Slovakia (Pavlík 1999). The observed differences were caused mainly by different altitudes and plant communities.

The main difference between species composition (Agaricales s.l.) of species-rich, managed subnatural forests (plots III, 3 and 4) and near-natural forests (two plots of the *Dentario enneaphylli-Fagetum* association) in Šumava (Holec 1992) is found in the number of species of all trophic groups, especially in the genera *Russula, Mycena* and *Psathyrella*. Expected differences in the number of lignicolous species between cultural (Vašutová 2001) and natural beech forest plots (Holec 1992) were not confirmed. According to Holec (1992) this may be due to the small area of the studied plots, in which natural forests cannot provide all the substrate types in various stage of decay needed for the growth of some lignicolous species, whereas substrate diversity in cultural forests is reduced because of forestry management.

Mixed forests

Mixed forests were studied in three plots. Although they were similar in floristic composition, they varied in mycofloristic composition. The main differences were observed in the overall number of macromycetes (129, 22, 37) and the composition

of lignicolous fungi. Plot II was interesting because of the presence of fir. According to Pilát (1969) and Kałucka (1995), characteristic fir species are confined to dead fir wood. This was represented by some old stumps and one fresh branch. Only the characteristic fir species *Aleurodiscus amorphus, Trichaptum abietinum, Dacrymyces stillatus* and *Gymnopilus sapineus* were observed, and none of them are strictly confined to fir.

It is difficult to compare mixed forests because of their heterogeneity. The main differences between artificial mixed forests and natural ones are that artificial mixed forests have a homogeneous age structure and a deficient in wood substrates. But as can be seen in plot II, these forests can be very species rich. The mycoflora of these species-rich cultural forests and the mycoflora of a natural mixed forest in Šumava (Holec 1997) are different. Lignicolous fungi dominated in forests of both regions. There are more mycorrhizal fungi (especially from the genus *Russula*) in cultural forests, whereas saprophytic terrestrial fungi (especially in the genera *Clitocybe* and *Collybia*) are more important in natural mixed forests. But these differences can be more influenced by differences in environmental factors and plant communities.

Alder forests

Alder forests in the studied area are confined to wet terrain depressions and streams only and are surrounded by planted spruce forests. They probably replace former meadow springs after afforestation. They were studied in 1 plot. Its vegetation belongs to the *Arunco silvestris-Alnetum glutinosae* association (alliance *Alnion incanae*, suballiance *Alnenion glutinoso-incanae*).

A review of mycofloristical research in alder forests was given by Bujakiewicz (1992). Quantitative parameters were studied in Germany (Winterhoff 1993). The number of species noted in the plot in the Moravskoslezské Beskydy Mts. was lower than that in Winterhoff's study (1993). He recorded 89–159 species per plot in alder forests (association *Carici elongatae-Alnetum*), but his plots were 4000–5000 m^2 large and were visited 12–29 times. Lignicolous fungi were the dominant group (69–75.8 %). However, in the Moravskoslezské Beskydy Mts. the dominant group was formed by mycorrhizal fungi (46 %) in the cultural managed alder plot. This may have been caused by a deficient in wood substrates and the presence of mycorrhizal fungi on spruce. As in the case of the cultural spruce forest plots, the species composition in cultural alder plots was influenced by neighbouring forests and the species associated with them, and it was more similar to that of spruce forests than that of deciduous forests. No species characteristic of the *Carici elongatae-Alnetum* association were found in the studied plot and only 12 species were among those found in the alder plots studied by Winterhoff. Species

characteristic of alder recorded in the studied plot were typical of the *Alnion glutinosae* alliance (according to Bujakiewicz 1992). On the other hand, species characteristic of the *Alnion incanae* alliance were absent. The studied community is obviously a transitional, very impoverished community.

CONCLUSIONS

The mycoflora of cultural (artificial and managed subnatural) forests (beech, spruce and mixed) was studied on 18 permanent plots in the Moravskoslezské Beskydy Mts. and Vsetínské vrchy hills (Czech Republic). A total of 314 species of mainly common macromycetes was recorded in 18 permanent plots. The most species-rich forest communities are young forests, waterlogged spruce forests and some mixed and beech forests. The number of species of macromycetes in individual plots varied from 19 to 129 and correlated slightly positively with the degree of naturalness of the forest.

Mycorrhizal fungi are the dominant group in old spruce and alder forest. The scale of disturbance of ectotrophic forest stability based on the percentage of mycorrhizal and lignicolous fungi does not seem to be suitable for an evaluation of these types of forests. The percentage of mycorrhizal fungi in the studied plots correlated positively most with the presence of spruce, and the percentage of lignicolous fungi correlated positively with the presence of beech.

Species composition (especially of mycorrhizal species) is most influenced by the tree layer composition. Regrettably, environmental variables describing soil characteristics were not measured. It seems that the mycoflora composition of spruce forests in the studied area is less variable (mainly in the case of mycorrhizal and saprophytic terrestrial fungi composition) than that of beech forests. Namely, the occurrence of saprophytic terrestrial fungi shows differences between various types of beech forests.

The main differences between natural forests and artificial forests are in species composition, especially in the occurrence of sensitive mycorrhizal genera (*Cortinarius, Russula*, etc.), rather than in quantitative parameters, which are influenced by the methods used in individual studies. It would be useful to study the relationships between quantitative parameters and species composition in plots with strictly defined vascular plant communities and environments, as well as to record characteristic species of single natural forest communities.

ACKNOWLEDGEMENTS

I wish to thank Aleš Lebeda for thesis supervision and for technical support, Jan Holec for fruitful discussions on the topic and comments on the manuscript, and Radim J. Vašut for his assistance in the field and comments on the manuscript. Alois Vágner, Slavomír Adamčík, Vladimír Antonín, Miroslav Beran, Jan Holec and Michal Tomšovský kindly revised or identified some herbarium specimens, Lubomír Kincl helped with phytocoenology. Martin Duchoslav provided me with invaluable help with statistical methods. Sierra D. Stoneberg Holt kindly revised the English text.

REFERENCES

ARNOLDS E. (1987): Decrease of ectomycorrhizal fungi in the Netherlands in relation to air pollution. – In: Kolektiv, Ekologie mykorrhiz a mykorrhizních hub. Imise a mykorrhiza, p. 72–81, Pardubice.

BUJAKIEWICZ A. (1992): Macrofungi on soil in deciduous forests. – In: Winterhoff W. (ed.), Fungi in vegetation science, p. 49–78, Dordrecht.

FELLNER R. (1985): Ektomykorrhizní houby klimaxových lesních společenstev při horní hranici lesa v imisních oblastech Krkonoš (mykocenologická studie). – 295 p. ms. [dissertation; depon. in: Agriculture University, Prague].

FELLNER R. (1993): Air pollution and mycorrhizal fungi in Central Europe. – In: Pegler D. N., Boddy L., Ing B. and Kirk P. M. (eds.), Fungi of Europe: investigation, recording and conservation, p. 239–250, Royal Botanic Gardens, Kew.

FELLNER R. and SOUKUP F. (1991): Mycological monitoring in the air-polluted regions of the Czech Republic. – Commun. Inst. Forest. Cech. 17: 125–137.

GULDEN G., HØILAND K., BENDIKSEN K., BRANDRUD T. E., FOSS B. S., JENSSEN H. B. and LABER D. (1992): Fungi and air pollution. Mycocoenological studies in three oligotrophic spruce forests in Europe. – 81 p. Berlin.

HANSEN L. and KNUDSEN H. (eds.) (2000): Nordic Macromycetes vol. 1, Ascomycetes. – 309 p. Copenhagen.

HLŮZA B. (1988): Příspěvek k mykoflóře bučin v severomoravském kraji. – In: Kuthan J. (ed.), Houby bučin v Československu, Sborník referátů ze semináře ČSVM, p. 25–29, Praha.

HÖFLER K. (1955): Zur Pilzvegetation aufgeforsteter Fichtenwälder. – Sydowia 9: 246–255.

HOLEC J. (1992): Ecology of macrofungi in the beech woods of the Šumava mountains and Šumava foothills. – Čes. Mykol. 46: 163–202.

HOLEC J. (1997): Studium makromycetů na trvalých plochách v hlavních klimaxových společenstvech Šumavy. – Příroda 10: 15–48.

HOLEC J. (2000): Mykoflóra Šumavy – základní literární prameny a shrnutí biodiverzity makromycetů v nejvýznamnějších biotopech. – Silva Gabreta 5: 69–82.

KALUCKA I. (1995): Macromycetes in the forest communities of the Jodly Laskie nature Reserve (Central Poland). – Acta Mycol. 30: 3–26.

KIRK P. M., CANNON P. F. and DAVID J. C. (eds.) (2001): Ainsworth and Bisby's Dictionary of the Fungi. 9th ed. – 624 p. Oxford.

KOST G. (1992): Macrofungi on soil in coniferous forests. – In: Winterhoff W. (ed.), Fungi in vegetation science, p. 49–78, Dordrecht.

KREISEL H. (1987): Pilzflora der Deutschen Demokratischen Republik. – 281 p. Jena.

KEIZER P. J. (1993): The ecology of macromycetes in roadside verges planted with trees. – 290 p. Wageningen.

KUTHAN J. (1990): Mykoflóra SPR "Salajka" v Moravskoslezských Beskydech. – In: Kuthan J. and Kotlaba F. (eds.), Výzkum a ochrana hub v přírodních rezervacích – I, Sborník referátů ze semináře ČSVM, p. 21–31, Praha.

LAGANÀ A., LOPPI S. and DE DOMINICIS V. (1999): Relationship between environmental factors and the proportions of fungal trophic groups in forest ecosystems of the central Mediterranean area. – Forest. Ecol. Man. 124: 145–151.

LAZEBNÍČEK J. (1989): Podmáčené a rašelinné lesy v Československu a jejich typologie. – In: Kuthan J. (ed.), Houby rašelinišť a bažinatých lesů v Československu, Sborník referátů ze semináře ČVSM, p. 33–38, Praha.

LEPŠOVÁ A. (1988): Význam studia plodnic makromycetů pro biomonitorování změn v lesním ekosystému. – 152 p. ms. [dissertation; depon. in: Dept. of Botany, Charles University].

LISIEWSKA M. (1974): Macromycetes of beech forests within the eastern part of the Fagus area in Europe. – Acta Mycol. 10: 3–72.

MEISEL-JAHN S. and PIRK W. (1955): Über das soziologische Verhalten von Pilzen in Fichten--Forstgesellschaften. – Mitteilungen der Floristisch-soziologischen Arbeitsgemeinschaft 5: 59–63.

MIHÁL I. (1993): Mycofloristical conditions and dominant species of macromycetes of beech forest ecosystem on EES Kremnica Uplands. – Ecology (Bratislava) 12: 459–466.

MORAVEC J., BALÁTOVÁ-TULÁČKOVÁ E., BLAŽKOVÁ D., HADAČ E., HEJNÝ S., HUSÁK Š., JENÍK J., KOLBEK J., KRAHULEC F., KROPÁČ Z., NEUHÄUSL R., RYBNÍČEK K., ŘEHOŘEK V. and VICHEREK J. (1995): Rostlinná společenstva České republiky a jejich ohrožení. – Severočes. Přír., suppl. 1995: 1–206.

NANTEL P. and NEUMANN P. (1992): Ecology of ectomycorrhizal-basidiomycete communities on a local vegetation gradient. – Ecology 73: 99–117.

NEUHÄUSLOVÁ Z. et al. (1998): Mapa potenciální přirozené vegetace České republiky. (Map of potential natural vegetation of the Czech Republic) – 341 p. + 1 map, Praha.

PAVLÍK M. (1999): Mykoflóra imisnej bučiny. (Mycoflora of the polluted beech stand). – In: Jankovský L., Krejčíř R. and Antonín V. (eds.), Houby a les, Sborník referátů MZU Brno, p. 209–214.

PILÁT A. (1969): Houby Československa ve svém životním prostředí. – 268 p. Praha.

RICEK E. W. (1981): Die Pilzgesellschaften heranwachsender Fichtenbestände auf ehemaligen Wiesenflächen. – Z. Mykol. 47: 123–148.

SCHLECHTE G. (1987): Ecological studies on mycorrhiza-forming fungi of forest stands exposed to different levels of air pollution. – In: Kolektiv, Ekologie mykorrhiz a mykorrhizních hub. Imise a mykorrhiza, p. 82–92, Pardubice.

SKALICKÝ V. (1988): Regionálně fytogeografické členění. – In: Hejný S. and Slavík B. (eds.), Květena ČSR, p. 103–121, Praha.

ŠMARDA F. (1972): Die Pilzgesellschaften einiger Laubwälder Mährens. – Acta Sci. Nat. Brno 6(6): 1–53.

ŠMARDA F. (1973): Die Pilzgesellschaften einiger Fichtenwälder Mährens. – Acta Sci. Nat. Brno 7(8): 1–44.

ŠTEKLOVÁ A. (1977): Příspěvek k poznání mykoflóry SPR Božídarské rašeliniště. – 158 p. ms. [dipl. thesis; depon. in: Dept. of Botany, Charles University].

TER BRAAK C. J. F. and ŠMILAUER P. (1998): CANOCO reference manual and user's guide to Canoco for Windows. Software for canonical community ordination (version 4). – 352 p. Ithaca.

VAŠUTOVÁ M. (2001): Mykofloristický výzkum na vybraných lokalitách v pramenné oblasti Rožnovské Bečvy a Bílé. – 92 p. ms. [dipl. thesis; depon. in: Dept. of Botany, Palacký University].

VAŠUTOVÁ M. (2004): Některé vzácnější makromycety Rožnovska (CHKO Beskydy). – Mykol. Listy no. 88: 19–26.

WINTERHOFF W. (1993): Die Großpilzflora von Erlenbruchwäldern und deren Kontaktgesellschaften in der nordbadischen Oberrheinebene. – Beih. Veröff. Naturschutz Landschaftspflege Bad.-Württ. 74: 1–100.

CZECH MYCOL. 56 (3–4), 2004

Distribution and ecology of the rare polypore Pycnoporellus fulgens in the Czech Republic

JAN HOLEC

National Museum, Mycological Department, Václavské nám. 68, 115 79 Praha 1, Czech Republic
jan.holec@nm.cz

Holec J. (2004): Distribution and ecology of the rare polypore Pycnoporellus fulgens in the Czech Republic. – Czech Mycol. 56: 291–302

Untill 1998, the rare polypore *Pycnoporellus fulgens* (Fungi, Basidiomycetes, *Polyporaceae*) was known in the Czech Republic from 5 localities situated in northeastern Moravia and Silesia. No records from Bohemia (western part of the Czech Republic) were known. At present, 11 localities from Bohemia and 6 from Moravia and Silesia are known, which means that the species has spreaded rapidly in Bohemia during the last 7 years. The fungus occurs almost exclusively on old decaying trunks in natural forests minimally influenced by man (mostly nature reserves) composed of *Fagus, Abies* and *Picea*. It was found mainly in August and September on *Picea*, less frequently on *Fagus* and *Abies*. Most records are situated in submontane and montane belts (alt. 500–1000 m), however, two finds are from areas with climatic inversion (deep stream valleys) in the hilly country. The reported finds from Bohemia fill the gap between the previously known distribution areas in southern Germany and in the Western Carpathians in Moravia, Silesia, Poland and Slovakia. They show that *Pycnoporellus fulgens* is currently well established in Central Europe.

Key words: lignicolous fungi, *Polyporaceae*, natural forests

Holec J. (2004): Rozšíření a ekologie vzácného choroše Pycnoporellus fulgens v České republice. – Czech Mycol. 56: 291–302

Vzácný choroš *Pycnoporellus fulgens* byl do roku 1998 znám v České republice jen z 5 lokalit na severovýchodní Moravě a ve Slezsku. Z Čech nebyly známy žádné nálezy. V současné době víme o 11 lokalitách z Čech a 6 z Moravy, což znamená, že tento nápadný a těžko přehlédnutelný druh se v Čechách v posledních 7 letech rychle rozšířil. Vyskytuje se téměř výhradně na starých tlejících kmenech v lesních porostech jen minimálně ovlivněných člověkem (převážně v rezervacích), tvořených bukem, jedlí a smrkem. Většina nálezů je z podhůří a horských poloh (z nadmořských výšek 500–1000 m), ale dva nálezy pocházejí z pahorkatinného stupně (hluboká údolí potoků ovlivněná klimatickou inverzí). Publikované nálezy vyplňují mezeru mezi dříve známými oblastmi výskytu v jižním Německu a v Západních Karpatech na území Moravy, Slezska, Polska a Slovenska. Zároveň ukazují, že *Pycnoporellus fulgens* je v současné době ve střední Evropě dobře etablován.

INTRODUCTION

Pycnoporellus fulgens (Fr.) Donk (Basidiomycetes, *Polyporaceae*) is an interesting polypore remarkable for the orange colour of its pilei. In Europe, Ryvarden and Gilbertson (1994) characterise it as a "rare continental species apparently

restricted to the natural area of *Picea* and distinctly restricted to old forests with high continuity". Recently, its distribution in Poland and in Europe was summarised by Piątek (2002). The species is also widespread in North America (Gilbertson and Ryvarden 1987) and Asia (see summary by Kotlaba 1984: 107), always in mountains or northern areas.

Older finds from the Czech Republic (CR) were published by Kotlaba (1984: p. 107, map 62). Five localities reported by him are concentrated in natural ("virgin") forests of northeastern Moravia and Czech Silesia (eastern part of the CR). The only published find from Bohemia (western part of the CR) is from Soudný forest near Blatná in southern Bohemia (Kosina 1999: 24). A short note on its occurrence in the Šumava Mts. was published by Holec (2003).

In the last seven years, I collected *Pycnoporellus fulgens* at four new localities in Bohemia and further finds were made by other Czech and Moravian mycologists. The aim of this paper is to summarise the current knowledge on the distribution and ecology of this remarkable species in the Czech Republic.

MATERIAL AND METHODS

Voucher specimens are deposited in herbaria PRM and BRNM and in several private herbaria. Fresh fruitbodies collected by J. Holec were mostly documented by colour slides or digital photographs stored at PRM.

Abbreviations: CR: Czech Republic; dia: the fruitbodies were photographed using colour slides; JH: collection made by Jan Holec; MTB: Central European mapping grid.

RESULTS AND DISCUSSION

Recent finds of Pycnoporellus fulgens (Fr.) Donk from the Czech Republic

Bohemia

Šumava Mts. (= Bohemian Forest)

Site called Debrník (part of 1st zone of the Šumava National Park called Medvědí jámy), 1.7 km S of the church in the village of Železná Ruda, SW slope of Debrník mountain, alt. 800 m, MTB 6845, small remnant of an old, natural montane forest composed of *Fagus, Abies* and *Picea*, with many fallen trunks in various stages of decay, on decaying fallen trunk of *Picea abies*, 21 Sep. 1998 leg. J. Holec, JH 603/1998, det. Z. Pouzar (PRM 897321).

Dračí skály rocks (1st zone of the Šumava National Park), ca. 1.2 km NNE of site called Čeňkova Pila, 3.5 km NNE of the village of Srní, SWW slope S of the main stone ridge of the rocks, alt. 730 m, MTB 6846, old *Abies* forest on stony slope with admixture of *Picea abies* and *Fagus sylvatica*, on decaying fallen trunk of *Picea abies*, 10 Oct. 2002 leg. et det. J. Holec, JH 459/2002, dia (PRM 900761).

Jilmová skála (nature reserve in the Šumava Protected Landscape Area), Boubín area, ca. 1 km N of the village of Zátoň near Lenora, steep S slope, alt. 980 m, MTB 7048, on fallen trunk of *Picea abies* in a *Picea-Abies* forest, 30 July 2004 leg. et det. Josef Vlasák (private herb. J. Vlasák 0407/29a,b).

Žlebský vrch mountain (1st zone of the Šumava National Park), 0.5 km SW of the village of České Žleby near Lenora, E slope, alt. 950 m, MTB 7148, natural ravine forest (*Acer pseudoplatanus, Fagus, Picea, Sorbus, Abies*) on stony slope, on fallen trunk of *Picea abies* without bark, 6 Oct. 2004 leg. et det. A. Vágner (PRM).

Medvědice virgin forest (1st zone of the Šumava National Park), 0.4 km NE of the top of Stožec mountain near Volary, NW part of the 1st zone, NE slope, alt. 920 m, MTB 7148, old managed *Picea* forest with admixture of *Fagus* (at the place of an native montane mixed forest which survived in the vicinity), on fallen trunk of *Picea abies* without bark, 29 March 2003 leg. J. Holec et P. Balda, JH 5/2003, det. J. Holec (PRM 900815).

Malá Niva peat-bog (1st zone of the Šumava National Park), at the SW margin of the 1st zone (48°54'42.2"N, 13°48'44.4"E), c. 1.7 km SE of the centre of Lenora near Volary, alt. 755 m, MTB 7048, moist cultural spruce forest with *Calamagrostis villosa, Carex brizoides*, *Pleurozium schreberi, Hylocomium splendens, Polytrichum formosum* etc., on bottom surface and felling area of fallen trunk of *Picea abies* with bark, 7. Oct. 2004 leg. et det. D. Dvořák (private herb. D. Dvořák).

Černý les mountain (nature reserve in the Šumava Protected Landscape Area), 2 km SEE of the village of Záhvozdí between Volary and Horní Planá, near the top of the mountain, alt. 1000 m, MTB 7149, on fallen trunk of *Picea abies*, 23 Sep. 2002 leg. Petr Balda, det. Petr Vampola (private herb. P. Vampola 41b/02).

Central Bohemia

Chynínské buky Nature Reserve, Brdy hills, 9 km W of Rožmitál pod Třemšínem, 3 km NE of the village of Chynín, SE slope, alt. 750 m, MTB 6448, old natural *Fagus* forest (association *Dentario enneaphylli-Fagetum*) with many fallen and decaying trunks, on freshly fallen, partly decorticated trunk of *Fagus sylvatica*, 2 July 2004 leg. et det. J. Holec, JH 101/2004), digital photo (PRM). – ditto, 28 Aug. 2004: on decaying fallen trunk of *Fagus sylvatica*, JH 121/2004

(PRM); on fallen and decorticated trunk of *Picea abies*, JH 124/2004, dia, digital photo: Figs. 1, 2 (PRM); on decaying fallen trunk of *Picea abies* (not collected); on decaying fallen trunk of *Picea abies*, digital photo: Fig. 3 (not collected); on decaying fallen trunk of *Fagus sylvatica*, digital photo: Fig. 4 (not collected).

Chlumská stráň National Nature Reserve on slopes of Berounka river valley, former Rokycany District, 1 km N of the village of Kladruby, alt. 300 m, MTB 6047, near the confluence of an unnamed stream and Radubice stream, in a deep, moist valley, on fallen trunk of *Picea abies*, 1 July and 17 Sep. 2004 leg. et det. Anna Lepšová, rev. J. Vlasák (private herb. A. Lepšová).

Southern Bohemia

Soudný forest near Staňkovský rybník fish-pond, near the village of Kocelovice, 5 km N of Blatná, alt. 501 m, MTB 6549, on decaying felled trunk of *Picea abies*: moist lower part of the felling area, 20 Sep. 1998 leg. et det. Cyril Kosina (PRM 892759, published by Kosina 1999).

Fabián Nature Reserve, former Jindřichův Hradec District, c. 3.5 km SE of the village of Příbraz near Lásenice, S part of the reserve: Homolka hill, alt. 600 m, MTB 6955, old natural *Fagus* forest (association *Dentario enneaphylli-Fagetum*) with many fallen and decaying trunks, on young, partly decorticated fallen trunk of *Fagus sylvatica*, 7 Sep. 2002 leg. et det. Josef Vlasák (private herb. J. Vlasák 0209/8a,b).

Moravia

Moravian Karst

Vývěry Punkvy National Nature Reserve, Suchý žleb, near the village of Vilémovice near Macocha (49°22'25"N, 16°43'50"E), alt. 350 m, MTB 6666a, mixed forest: *Picea abies, Fagus sylvatica, Acer pseudoplatanus*, on a fallen trunk of *Picea abies*, 20 Aug. 2000 leg. J. Kramoliš, det. V. Antonín 00.110 (BRNM 652871).

Moravskoslezské Beskydy Mts.

Salajka National Nature Reserve, near the village of Bílá, MTB 6576, on decaying fallen trunk of *Abies alba*, 2 Aug. 2004 leg. et det. V. Antonín (04.151) et D. Janda, dia (BRNM 691388).

Fig. 1. *Pycnoporellus fulgens*, Chynínské buky Nature Reserve, *Picea abies*, JH 124/2004 (PRM), for details on the find see Results.

Fig. 2. *Pycnoporellus fulgens*, Chynínské buky Nature Reserve, *Picea abies*, JH 124/2004 (PRM), for details on the find see Results.

Fig. 3. *Pycnoporellus fulgens,* Chynínské buky Nature Reserve, typical habitat: on old fallen trunk of *Picea abies* in a natural forest (association *Dentario enneaphylli-Fagetum*), not collected.

Fig. 4. *Pycnoporellus fulgens,* Chynínské buky Nature Reserve, typical habitat: on old fallen trunk of *Fagus sylvatica* in a natural forest (association *Dentario enneaphylli-Fagetum*), not collected.

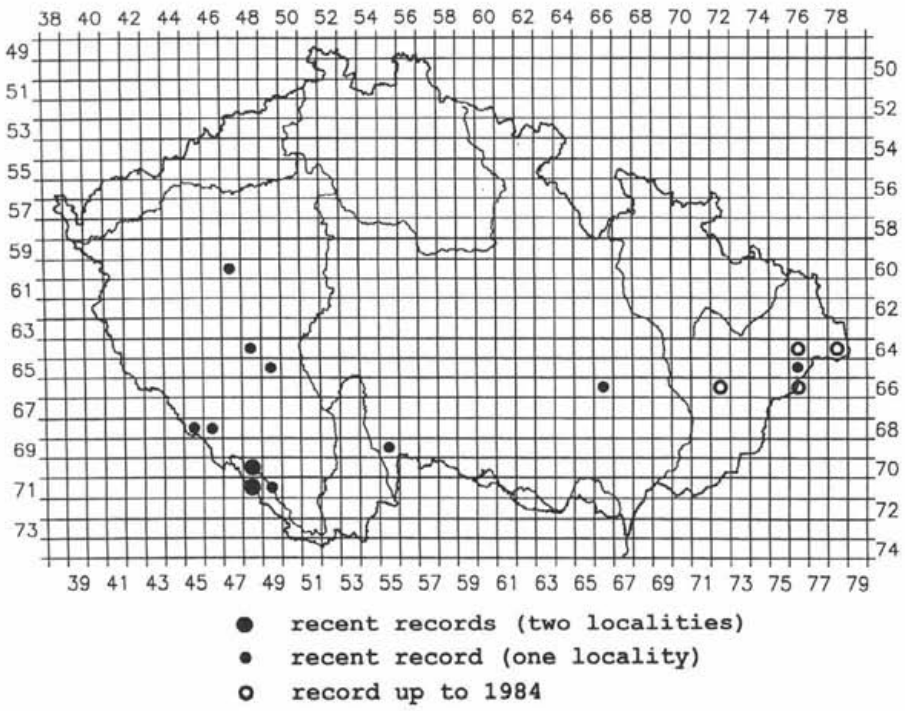

Fig. 5. Distribution of *Pycnoporellus fulgens* in the Czech Republic. Empty dots: localities known till 1984 and mapped by Kotlaba (1984); full dots: localities discovered in the period 1998–2004, small dots: one locality, big dots: two localities. The map uses the MTB grid.

Older records from Moravia and Czech Silesia

5 localities (see below, data kindly provided by F. Kotlaba), mapped by Kotlaba (1984: p. 107, map 62).

Salajka National Nature Reserve, Moravskoslezské Beskydy Mts., near the village of Bílá, alt. 770 m, MTB 6576, on dead trunk of *Picea abies*, 18 Aug. 1966 leg. et det. F. Kotlaba.

Mionší National Nature Reserve, Moravskoslezské Beskydy Mts., near Jablunkov, alt. 850 m, MTB 6478, on fallen trunk of *Abies alba*, 23 Aug. 1966 leg. et det. F. Kotlaba et Z. Pouzar (PRM 628182) – ditto, 7 Sep. 1969 leg. et det F. Kotlaba (PRM 682069).

Mazák National Nature Reserve, Moravskoslezské Beskydy Mts., near the village of Staré Hamry, alt. 650 m, MTB 6476, on dead trunk of *Abies alba*, 20 Aug. 1966 leg. et det. F. Kotlaba et Z. Pouzar (PRM 628183).

Razula National Nature Reserve, Javorníky Mts., near the village of Velké Karlovice, alt. 750 m, MTB 6676, on fallen trunk of *Fagus sylvatica*, 28 Aug. 1970 leg. et det. F. Soukup.

Stream valley below the site called Hrubá jedle, between cottages Na Tesáku and Troják, Hostýnské vrchy hills, near the village of Hošťálková, alt. 580 m, MTB 6672, on fallen trunk of *Abies alba*, 15 Aug. 1981 leg. A. Vágner, det. A. Černý (BRNM).

Distribution in the Czech Republic

number of localities	Bohemia (western part of the CR)	Moravia and Silesia (eastern part of the CR)
number of localities known before 1984	0	5
current number of known localities	11	6
Total	11	6

Based on 5 Moravian and 8 Slovak localities known at that time (no finds from Bohemia), Kotlaba (1984) wrote that *Pycnoporellus fulgens* has a Carpathian distribution character in the former Czechoslovakia. Kotlaba and Pouzar (1963) considered the species a remarkable polypore of the Slovakian Carpathians. However, in this study 11 recent localities of *Pycnoporellus fulgens* from Bohemia are reported. Consequently, it is necessary to correct Kotlaba's statement and to say that *Pycnoporellus fulgens* is not a Carpathian element in the mycoflora of the Czech Republic. However, the survey of finds from Slovakia made by Škubla (2003) shows that *Pycnoporellus fulgens* really is commoner in the Slovakian Carpathians than in the Czech Republic, but this is due to a higher percentage of natural forests – the appropriate habitat for this species – in Slovakia.

In Bohemia, the richest area of occurrence are the Šumava Mts. (7 localities). In other areas only one or two localities are known (see above): Southern Bohemia (Soudný forest, Fabián), Central Bohemia (Chlumská stráň, Chynínské buky), Central Moravia (Vývěry Punkvy), Javorníky Mts. (Razula) and Hostýnské vrchy hills (below Hrubá jedle). A second area with richer occurrence of *Pycnoporellus fulgens* are the Moravskoslezské Beskydy Mts. in northeastern Moravia (Kotlaba 1984: Mionší, Mazák, Salajka; + recent find from Salajka). The species is not known from Northern and Eastern Bohemia and from Southern and Northwestern Moravia where remnants of near-natural forests are rare. In general, the richest single locality is Chynínské buky Nature Reserve in Brdy hills (Central Bohemia) where the species was found at 6 places in 2004.

It is interesting that *Pycnoporellus fulgens* was never found in Bohemia before the year 1998 in spite of a long and intensive study of polypores made in the

second half of the 20^{th} century especially by Pilát, Kotlaba, Pouzar, Černý, Soukup, and Vampola. Its fruitbodies are so striking that it is almost unthinkable that some of these polyporologists would have overlooked them in the field. *Pycnoporellus fulgens* has enlarged its distribution area, but the reasons remain unclear. A spread of the species (to southern Germany and Les Vosges) was also described by Krieglsteiner (1981). Similarly, Niemelä (1980) observed that *Pycnoporellus fulgens* became less rare in Finland in recent decades. There are several possible explanations. First, the search for it was low in the past and the species was omitted, but this seems unlikely. Second, the spread of *Pycnoporellus fulgens* is a consequence of changing habitat conditions (global climate changes). Last but not least, the spread is a demonstration of the natural dynamics of the species. A detailed and goal-directed study in future decades could help us to resolve this problem. In spite of this fact, *Pycnoporellus fulgens* is included in Red Lists of several European countries, e.g. Germany (Benkert et al. 1992, as strongly endangered), Denmark (Stoltze and Pihl 1998; as endangered), Sweden (Gärdenfors 2000, as a vulnerable species) and the Czech Republic (in preparation; as a vulnerable species). I consider this correct because *Pycnoporellus fulgens* remains a rare species preferring remnants of natural forests which are rare in European nature.

Piątek (2002) concludes that the distribution of *Pycnoporellus fulgens* (in Poland) is determined by climate (either boreal or cold mountainous) and the occurrence of old natural forests. I fully agree with his second statement, but based on data from the CR, I would prefer the microclimate (stable, moist, rather cold; see next paragraph) instead of climate.

The recent finds of *Pycnoporellus fulgens* in Bohemia fill the gap between the published records from the hilly country and mountains of southerm Germany (e.g. Enderle 2004; Krieglsteiner 1991, 2000; Luschka 1993) and the Western Carpathians in Moravia, Silesia, Poland and Slovakia (Kotlaba 1984, Piątek 2002, Škubla 2003). It means that *Pycnoporellus fulgens* remains rare but is currently well established in appropriate habitats of Central Europe.

Altitude

	up to 200 (lowlands)	200–500 (hilly country)	500–800 (submontane belt)	800–1100 (montane belt)
number of localities	0	2	9	6

Pycnoporellus fulgens is distributed from altitudes of 300 m to 1000 m, i.e. from the hilly country to the mountains. Most finds are from the submontane to

montane belt (alt. 500–1000). The two finds from the hilly country (alt. 300 and 350 m) originate from deep, moist stream valleys (sites with climatic inversion) with (semi)natural occurrence of *Picea abies* where the presence of *Pycnoporellus fulgens* is probably enabled by a cold microclimate.

Habitats

Concerning the character of localities, almost all finds are from near-natural to natural forests protected in nature reserves (exceptions: Soudný forest near Blatná – cultural forest, Malá Niva – cultural forest at the margin of natural habitats in the 1st zone of the Šumava National Park). Such forest reserves are almost the only sites in the Czech Republic rich in old, fallen trunks in various stages of decay. Fruitbodies of *Pycnoporellus fulgens* occur both on fallen decorticated hard wood trunks and on decaying soft wood trunks. Generally, *Pycnoporellus fulgens* can be considered a species preferring stands with seminatural to natural vegetation. This agrees well with data from other European countries (see e.g. summaries by Ryvarden and Gilbertson 1994, Piątek 2002). Consequently, *Pycnoporellus fulgens* is a useful bioindicator in nature conservation and mapping of ecosystems.

Kotlaba (1984) wrote that *Pycnoporellus fulgens* preferably grows in *Abies-Fagus* virgin forests (in the former Czechoslovakia). This habitat is certainly the best one for *Pycnoporellus fulgens*. However, some finds published here are not from typical mixed virgin forests (*Fagus, Abies, Picea*) but from slightly man-influenced stands where the tree layer is composed of these species but their ratio is increased in favour of *Picea* or *Abies*.

Substrate

	Picea	*Abies*	*Fagus*
number of finds	14	4	5
ratio	61 %	17 %	22 %

Pycnoporellus fulgens clearly prefers the wood of conifers. Kotlaba (1984) mentions *Abies* as the most frequent host species (data from Moravia and from the Slovak Republic). In Bohemia, the species is much more frequent on *Picea* (this paper). In almost pure beech stands (e.g. the nature reserves Chynínské buky or Fabián), *Pycnoporellus fulgens* was found either on *Fagus* only or both on *Fagus* and *Picea*. In Europe, *Pycnoporellus fulgens* is known from conifers (*Picea, Abies,*

Pinus) and less frequently from broadleaved trees (*Alnus, Betula, Fagus, Populus, Quercus, Tilia*) (Ryvarden and Gilbertson 1994, Piątek 2002).

Fructification

month	March	July	August	September	October
number of finds*	1	2	7	5	3

* repeated finds on one day at one locality are not included

Fructification of *Pycnoporellus fulgens* culminates in August and September. The only find in March represents dead, overwintered fruitbodies.

ACKNOWLEDGEMENTS

I like to thank František Kotlaba, Josef Vlasák, Petr Vampola, Anna Lepšová, Daniel Dvořák, Alois Vágner and Vladimír Antonín for providing data on their finds or herbarium specimens of *Pycnoporellus fulgens*. The work was financially supported by the Grant Agency of the CR (project no. GA 206/04/0356) and the Ministry of Culture of the CR (project no. MK0CEZ99F0201).

REFERENCES

BENKERT D. et al. (1992): Rote Liste der gefährdeten Großpilze in Deutschland. – 132 p. Eching.

ENDERLE M. (2004): Die Pilzflora des Ulmer Raumes. – 521 p. Ulm.

GÄRDENFORS U., ed. (2000): The 2000 redlist of Swedish species. – 393 p. Uppsala (Internet version: http://www-umea.slu.se/MiljoData/webrod/Sokning_English.cfm).

GILBERTSON R. L. and RYVARDEN L. (1987): North American polypores. Vol. 2. Megasporoporia – Wrightoporia. – p. 434–885, Oslo.

HOLEC J. (2003): Auf natürliche, vom Menschen nur minimal beeinflusste Vegetation beschränkte Großpilze. – Fritschiana 42: 25–27.

LUSCHKA N. (1993): Die Pilze des Nationalparks Bayerischer Wald. – Hoppea 53: 5–363.

KOSINA C. (1999): Oranžovec vláknitý v Čechách [Pycnoporellus fulgens in Bohemia]. – Mykol. Sborník 76(1): 24 (in Czech).

KOTLABA F. (1984): Zeměpisné rozšíření a ekologie chorošů (Polyporales s.l.) v Československu [Geographical distribution and ecology of polypores (Polyporales s.l.) in Czechoslovakia]. – 194 p. Praha (in Czech with English summary).

KOTLABA F. and POUZAR Z. (1963): Tři význačné choroše slovenských Karpat [Three noteworthy polypores of the Slovakian Carpathians]. – Čes. Mykol. 17: 174–185 (in Czech with English summary).

KRIEGLSTEINER G. J. (1991): Verbreitungsatlas der Großpilze Deutschlands (West). Band 1: Ständerpilze. Teil B: Blätterpilze. – 1016 p. Stuttgart.

KRIEGLSTEINER G. J. (2000): Die Großpilze Baden-Württembergs. Band 1. – 629 p. Stuttgart.
NIEMELÄ T. (1980): On Fennoscandian polypores 7. The genus Pycnoporellus. – Karstenia 20: 1–15.
PIĄTEK M. (2002): Pycnoporellus fulgens (Fr.) Donk. – In: Wojewoda W. (ed.), Atlas of the geographical distribution of fungi in Poland, p. 89–94, Kraków.
RYVARDEN L. and GILBERTSON R. L. (1994): European polypores. Part 2. Meripilus – Tyromyces. – In: Synopsis Fungorum, vol. 7, p. 388–743, Oslo.
STOLTZE M. and PIHL S., eds. (1998): Rødliste 1997 over planter og dyr i Danmark. – http://www.sns.dk/netpub/rodliste/rodliste1997.htm
ŠKUBLA P. (2003): Mycoflora Slovaca. – 1103 p. Šaľa.

CZECH MYCOL. 56 (3–4), 2004

Ing. Jiří Lazebníček – septuagenarian

BRONISLAV HLŮZA

Moravian mycologist J. Lazebníček was born on June 9^{th}, 1934 in Olomouc. Fundamental data of his life were published by Hlůza (1994a, 1994b, 1995) on the occasion of his 60^{th} birthday. Let us recall briefly some of them.

After his graduation at the Faculty of Forestry of the University of Agriculture in Brno in 1957 he worked as a forest typologist at the Forest Enterprise of the Faculty of Forestry until 1960 and then for a year in the same position at the Forest Management Institute in Olomouc.

In the years 1961–1963 he worked as a dendrologist at Nový Dvůr Regional Arboretum near Opava and in the years 1963–1969 as a mycologist at the Botanical Institute of the Czechoslovak Academy of Sciences in Brno. Here he started in 1969 his work at an International Biological Programme for the University of Agriculture in Brno concerning floodplain forests near Lednice na Moravě. All the changes in his employment were caused by reorganisations in the mentioned institutes.

From 1972 until his retirement in 1994, Jiří Lazebníček held again the position of forest typologist, this time at the Military Forest Management Institute in Velká Bystřice near Olomouc. There he worked also as an evaluator of forest stands for seed collections and as a designer and establisher of gene banks for forest trees, as a designer of seed plantations, and as a designer of plantings in the surroundings of airfields for military and industrial enterprises. In the course of all these jobs he dealt with mycofloristics and phytopathology.

For more than 40 years Jiří Lazebníček formed his mycological herbarium containing more than 32.5 thousand specimens. Unfortunately two parts of this herbarium were destroyed in fires (in 1983 and in 2001) in Velká Bystřice, the main part (21 500 specimens) was destroyed during the large flood in Olomouc and its surroundings at the beginning of July 1997. Many first, second or third finds for the Czech Republic, Slovakia, Poland or Europe were destroyed.

Only some results of his research were published in monographs of the Protected Landscape Areas Malá Fatra, Slovenský raj, Veľká Fatra, Vihorlat and Východné Karpaty, and in monographs of the National Parks Pieniny and Vysoké Tatry in the chapters "Fungi". Other phytogeographical districts were not elaborated because of the loss of most specimens of fungi and almost all field notebooks in the above mentioned fires and flood.

The total number of Lazebníček's published papers in the field of mycology, botany, forest typology and geography is about 280 items. Many contributions

are deposited as manuscripts. Some of these papers were published in Slovakia, Hungary, Italy and Norway.

From 1960 to 2003, J. Lazebníček prepared several mycological exhibitions with mycologists from Brno, Kuřim, Opava, Olomouc, Šumperk, Prostějov etc. For many years he worked with national reporter RNDr. F. Šmarda in the international project "The mapping of 100 species of macromycetes in Europe". He collaborated in mycological advice bureaus in Brno and Olomouc, he was the founder of such a bureau in Opava and since 1995 he has been managing such an advice bureau in Olomouc.

We offer our congratulations to J. Lazebníček, wishing him good health and a lot of success!

Mycological bibliography of J. Lazebníček since 1992

[For a complete bibliography until 1992, see Czech Mycol. 47(4): 311–317]

1992

Lazebníček J.: Houby Novohradských hor. – Mykol. Listy no. 47: 16–18.

Lazebníček J. and Gáper J.: Huby. – In: Vološčuk I. et al. (1992): Pieninský národný park, p. 75–81, Banská Bystrica.

1994

Lazebníček J. and Gáper J.: Huby. – In: Vološčuk I. et al. (1994): Tatranský národný park. Biosférická rezervácia, p. 114–117, Martin.

1995

Lazebníček J.: Hniloby dřevin, poškozených spárkatou zvěří ve vojenských lesích. – ČR a SR. – In: Mrkva R. (ed.), Škody zvěří a jejich řešení, p. 93–94, Fakulta lesnická a dřevařská MZLU, Brno.

Kotlaba F. [ed.]: Červená kniha ohrozených a vzácnych druhov rastlín a živočíchov SR a ČR, 4. diel (Sinice a riasy, Huby, Lišajníky, Machorasty). – 221 p. Bratislava. (J. Lazebníček was a co-author).

1999

Lazebníček J. and Hlůza B.: Výstava hub v Tovačově. – Mykol. Sborn. 76(2): 78–79.

2000

Lazebníček J.: Professor RNDr. Bronislav Hlůza, CSc. – 70 years. – Czech Mycol. 52(1): 89–91.

Lazebníček J.: The endangered species of macromycetes of Moravia and Silesia (Czech Republic). – Čas. Slezs. Muz., Opava (A), 49: 105–110.

Lazebníček J.: Další lokalita vzácné kornatcovité houby Pulcherricium caeruleum v Řecku. – Mykol. Listy no. 73: 13–16.

Lazebníček J. and Škubla P.: Dřevokazné houby s malým počtem hostitelů a jejich rozšíření v ČR a SR. (Lignivorous fungi with small number of hosts and their distribution in Czech Republic and Slovak Republic. – In: Hýsek J. (ed.), Mykologická fytopatologie ve 20. a 21. století, p. 38–40, Ústav rostlinné výroby, Praha.

2001

Lazebníček J.: Houby léta a podzimu r. 2000 na střední (a severní) Moravě (okr. OL, PV, PR, SU, VS). – Mykol. Sborn. 78(2): 78–83. (This is just a summary; a complete list is deposited in the archive of the Czech Mycological Society).

Lazebníček J. and Hlůza B.: Tři houbařské výstavy na střední a severní Moravě v září 2000. – Mykol. Sborn. 78(1): 54–55.

2002

Lazebníček J.: Orlickohorský bioregion a houby. – Nové letopisy města Ústí nad Orlicí a jeho okolí, no. 1/2002: 14–16.

Lazebníček J.: O podzimních houbách Českého Švýcarska. – Česká silnice, Jetřichovice, no. 12/2002.

Lazebníček J.: Podzimní houby Orlickohorského regionu. – Nové letopisy města Ústí nad Orlicí a jeho okolí, no. 3/2002: 2–3.

2003

Lazebníček J.: Letní houby Orlickohorského bioregionu. – Nové letopisy města Ústí nad Orlicí a jeho okolí, no. 2/2003: 14–16.

References

Hlůza B. (1994a): Jiří Lazebníček – 60th birthday. – Czech Mycol. 47(4): 311–317. (Mycological bibliography 1962–1992).

Hlůza B. (1994b): K 60. narozeninám ing. Jiřího Lazebníčka. – Mykol. Listy no. 53: 25–27.

Hlůza B. (1995): Ing. Jiří Lazebníček (nar. 9.6.1934 v Olomouci). – Preslia 66: 378–379.

Acknowledgements

The Editorial Board of Czech Mycology is grateful to the following specialists who reviewed one or more manuscripts accepted for publication in Volume 56 or rejected in the year 2004.

V. Antonín	(Brno, Czech Republic)
C. Bas	(Leiden, The Netherlands)
A. Chlebicki	(Kraków, Poland)
P. Cortesi	(Milano, Italy)
R. Fellner	(Sv. Jan pod Skalou, Czech Republic)
M. Flieger	(Praha, Czech Republic)
J. Holec	(Praha, Czech Republic)
L. Homolka	(Praha, Czech Republic)
J. W. Jongepier	(Veselí nad Moravou, Czech Republic)
J. Kocourková	(Praha, Czech Republic)
M. Kolařík	(Praha, Czech Republic)
J. Krátká	(Praha, Czech Republic)
R. Krejčí	(Praha, Czech Republic)
A. Kubátová	(Praha, Czech Republic)
J. Kunert	(Olomouc, Czech Republic)
L. Luhová	(Olomouc, Czech Republic)
T. Majewski	(Warszawa, Poland)
J. Marková	(Praha, Czech Republic)
L. Marvanová	(Brno, Czech Republic)
D. Novotný	(Praha, Czech Republic)
R. H. Petersen	(Knoxville, USA)
O. Petrini	(Comano, Switzerland)
Z. Pouzar	(Praha, Czech Republic)
K. Prášil	(Praha, Czech Republic)
E. Prokinová	(Praha, Czech Republic)
J. A. Stalpers	(Utrecht, The Netherlands)
V. Šašek	(Praha, Czech Republic)
E. C. Vellinga	(Berkeley, USA)

Czech Mycology, published by the Czech Scientific Society for Mycology. Graphic design by B. Bednář, PISCES. Typeset by TEX. Printed by Čihák Press, Praha 10. Distributed by the Czech Scientific Society for Mycology, P. O. Box 106, 111 21 Praha 1, and Kubon & Sagner, P. O. Box 340108, 80328 München, Germany. Annual subscription: Vol. 56, 2004: US $ 86,–; EUR 83,–

INSTRUCTIONS TO AUTHORS

Preparation of manuscripts. Manuscripts are to be submitted in English, German or French. The text of the manuscript should be written on one side of white paper (A4, 210 × 297 mm) with broad margins (maximum 30 lines per page). Each manuscript must include *an abstract* (in English) not exceeding 100 words and a maximum of five key words. The paper will be followed by an abstract in Czech (or Slovak). The journal is responsible, however, for the translation of abstracts into Czech for foreign authors. Please send *two copies* of the typescript. The authors are asked to submit diskettes with *the accepted manuscripts* prepared on personal computers. The files should be in ASCII format, graphs in Excel. Avoid any special type of text formatting except for italic and bold options.

Illustrations and tables. All tables, black and white photographs and figures (in black indian ink on a separate sheet) combined with the legends should be self-explanatory. Legends to the figures must be typed on a separate sheet. Colour photographs can be accepted but the authors will be responsible for the costs. All drawings or photographs of microstructures should be provided with a scale. All illustration should be submitted as *the original drawing and one clear* copy. Output from computer graphics programmes produced on plotters or laser printers is quite acceptable. The dimension of any figure should not exceed 180 × 260 mm in size. References to illustrative matter in the text should be in parentheses, e.g. ... spore sizes (Table 1) or ... as shown in Fig. 2 ... Figs. 1–5 ... Map 1 ...

Nomenclature. Latin names should conform to the International code of botanical nomenclature. New taxa must be substantiated by a Latin diagnosis including a reference to the public herbarium where the type specimen is deposited. The authors are asked to use only the acronyms listed in the Index Herbariorum.

References. References are to be listed in alphabetical order according to the surnames of the first authors. The bibliography should be written as follows:

Moravec J. (1984): Two new species of Coprobia and taxonomic remarks on the genera Cheilymenia and Coprobia (Discomycetes, Pezizales). – Čes. Mykol. 38: 146–155. (*journal article*)

Ryvarden L. (1978): The Polyporaceae of North Europe, Vol. 2. Inonotus-Tyromyces. – 507 p. Oslo. (*book*)

Tommerup I. C., Kuek C. and Malajczuk N. (1987): Ectomycorrhizal inoculum production and utilization in Australia. – In: Sylvia D. M., Hung L. L., and Graham J. H. (eds.), Proceedings of the 7th North American Conference on Mycorrhizae, p. 93–295, Gainesville. (*book chapter, abstract, article in proceedings*)

The references *in text* should be Moravec (1984), or (Moravec 1984); or Kühner and Romagnesi (1974). When there are three or more authors use the form Tommerup et al. (1987).

Manuscript evaluation. All manuscripts will be reviewed by one or two reviewers, and the authors informed about their acceptance, rejection or necessary revisions within three months. If a manuscript is returned for revision, the authors should submit a revised version within two months.

Authors should preferably have their English language texts approved by a native – English speaker.

Proof corrections. Proofs of the paper will be sent to authors via mail or as a pdf file. If not returned within two weeks, the proof correction will be carried out by the editor. The principal author will receive 30 reprints free of charge.

Correspondence. All correspondence concerning the journal should be sent to the following address: Czech Mycology / Česká mykologie, National Museum, Mycological Department, Václavské náměstí 68, 115 79 Praha 1, Czech Republic. Phone: 00420/224497259, fax: 00420/224222550, e-mail: jan.holec@nm.cz, http://www.natur.cuni.cz/cvsm/

Czech Mycology, published by the Czech Scientific Society for Mycology. Graphic design by B. Bednář, PISCES. Typeset by TEX. Printed by Čihák Press, Praha 10. Distributed by the Czech Scientific Society for Mycology, P. O. Box 106, 111 21 Praha 1, and Kubon & Sagner, P. O. Box 340108, 80328 München, Germany. Annual subscription: Vol. 56, 2004: US $ 86,–; EUR 83,–

CZECH MYCOLOGY / ČESKÁ MYKOLOGIE

is an international scientific journal publishing papers in all aspects of mycology including taxonomy, ecology, physiology and mycofloristics as well as mycological topics in forestry, agriculture and medicine. Czech Mycology will publish full length papers and short communications reporting original research which make a significant contribution to mycology. Review articles are also published.

CONTENTS