UNIVERSITY OF ALBERTA MICROFUNGUS COLLECTION AND HERBARIUM (UAMH)

A Division of the Devonian Botanic Garden, Faculty of Agriculture, Forestry and Home Economics
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SUMMARY OF ACTIVITIES FOR 2004

Staff, Students

Professor (Curator) - **L. Sigler**
.66 FTE Devonian Botanic Garden/UAMH, Fac. Agriculture, Forestry & Home Economics
.33 FTE Medical Microbiology & Immunology, Fac. of Medicine
Consultant in Mycology, PLNA/UAH Microbiology & Public Health
& Adj. Prof. Biol. Sci.
Assistant Curator (.5 FTE Non-academic, .5 FTE trust, NSERC) – **C. Gibbs** (since Nov. 1)
Technical or laboratory assistants (trust): -**A. Hashimoto, R. Gibas** (part-time), **V. Jajczay** (casual)
Ph.D. student- **C. F. C. Gibas**
Volunteer - **M. Packer**

Affiliate
R. Currah, Professor, Biological Sciences, Faculty of Science

Academic Teaching & Graduate Supervision

L. Sigler

- MLSCI 240 Pathogenic Bacteriology (4 lectures)
- BIOL 306 Biology of the Fungi (1 lecture)

Graduate Supervision (Sigler)
Connie Fe C. Gibas, Ph.D. candidate, Biological Sciences, Supervisors L. Sigler & R. Currah, Biol. Sci.

- Teaching Assistant for BIOL 107 winter session
- Thesis entitled "Systematics of the genus *Arachnomyces* having a predilection for the human nail" submitted Dec. 17, 2004

Graduate Supervisory Committee (Sigler)
A. Rice, Biological Sciences, Supervisor, R. Currah
M. Calvo-Polanco, Renewable Resources, Supervisor, J. Zwiazek,
V. Jacob-Cervantes, Renewable Resources, Supervisor, J. Zwiazek.
M. Day, Biological Sciences, Supervisor, R. Currah

Cultures Received, Distributed and Accessioned

Cultures received for identification, deposit or in exchange (**Table 1**) **186**

Cultures distributed on request or in exchange (**Table 2**).....**178**

Culture Collection and Herbarium Accessions

New accessions.....**134**

Total accessions.....**10520**

Information on Accessions available through print and on-line CATALOGUES

Catalogue of the University of Alberta Microfungus Collection and Herbarium. 3rd Ed. 1998
http://www.devonian.ualberta.ca/uamh/search

In-house and Collaborative Research

Refereed Journal Articles

1. Gibas CFC*, Sigler L, Currah RS. 2004. Mating patterns and ITS sequences distinguish the sclerotial species *Arachnomyces glareosus* sp. nov. and *Onychocola sclerotica.* Studies in Mycology 50:525-531.

   * This is the third publication arising from Connie's dissertation research.

   Abstract
   Mating patterns among twelve strains of *Onychocola sclerotica* demonstrated that the ex-type was genetically distinct from all other strains. Ten strains, when crossed, produced an *Arachnomyces* state. A re-examination of morphology and an analysis of nuclear ribosomal internal transcribed spacer (ITS) region sequences supported recognizing the interfertile strains and one infertile strain as a species distinct from *O. sclerotica. Arachnomyces glareosus* (anamorph *O. glareosa*) *sp. nov.* and *O. sclerotica* are similar in producing a sclerotial synanamorph but they are phylogenetically distinct.

2. Paré JA*, Sigler L, Rypien KL, Gibas CF. 2003. Survey for the *Chrysosporium* anamorph of *Nannizziopsis vriesii* on the skin of healthy captive squamates reptiles and notes on their cutaneous fungal mycobiota. J. Herpetol. Med. Surg. 13:10-15.

   *Surgical Sciences, School of Veterinary Medicine University of Wisconsin, Madison, WI

   Abstract
   The *Chrysosporium* anamorph of *Nannizziopsis vriesii* (CANV) is a fungus that has been implicated in several recent cases of reptile dermatomycoses. A survey was conducted to investigate whether this fungus was present on the skins of healthy squamate reptiles. Skin was collected as aseptically as possible from actively shedding lizards (n = 36) or from freshly shed snake exuvia (n = 91) and placed on fungal culture media for selective recovery of cycloheximide-tolerant fungi. The CANV was cultured from only one animal, an African rock python, *Python setae*. Fungi belonging to 50 genera were identified from 127 reptiles: *Aspergillus* spp., *Penicillium* spp., and *Paecilomyces lilacinus* were most frequently isolated. Keratinophilic fungi isolated from reptiles did not belong to zoophilic or anthropophilic species, inferring that the potential for acquisition of dermatophytosis from handling squamate reptiles is low.

3. Sigler L. 2004. Culture collections in Canada: perspectives and problems. Canadian Journal of Plant Pathology 26:39-47.

Abstract
Culture collections are custodians of microbial resources of vital importance to science and society. These facilities are essential in enabling contemporary and future research in basic and applied sciences, and in integrating more than 75 years of records on Canadian microbial diversity. Culture collections often carry on because of dedicated efforts of key individuals. However, they become vulnerable to loss or dismantling when individuals retire or shift research direction in response to program reorganization or loss of funding. The need for conservation of, and long-term access to, microbial resources has long been recognized, and since 1962, six workshops have been held to address concerns about their future. In 1988, a report by the Task Force on the Status of Culture Collections in Canada made several recommendations. Key among these were that (1) specialized collections of strategic importance be supported, (2) an advisory committee be established to include members from different sectors of the scientific community, (3) government agencies allow user fees to be charged for access to collections, which would then be used for operational support, (4) the Natural Sciences and Engineering Research Council of Canada expand the infrastructure program to fund culture collections, and (5) technologies for improved access to vital data on strain history and properties be developed. Follow-up meetings resulted in a recommendation that an expert committee on plant and microbial genetic resources be established under the Canadian Agricultural Research Council. Although these activities resulted in increased recognition and support for some collections, in general, the situation of Canadian collections is no better, and is probably more dire, than in 1988. A national strategy is urgently needed to ensure the long-term care of valuable microbial genetic material.

4. Sigler L, Zuccaro A, Summerbell RC, Mitchell JI, Paré JA. 2004. *Acremonium exuviarum* sp. nov., a lizard-associated fungus with affinity to *Emericellopsis*. Studies in Mycology 50:409-413.

Abstract
In a survey of cycloheximide-tolerant fungi growing from shed reptile skins, an *Acremonium*-like fungus was isolated that was distinctive in producing relatively large conidia in chains from phialides that tended to collapse after forming a number of conidia. Phylogenetic analysis based on ribosomal internal transcribed spacer and β-tubulin sequences revealed that the isolate represented an undescribed and relatively phylogenetically isolated member of the clade containing the teleomorph genus *Emericellopsis* van Beyma as well as related anamorphs in *Acremonium* Link and *Stanjemonium* W. Gams, O'Donnell, Schoers & M. Chr. The species is here described as *Acremonium exuviarum* sp. nov. It has been isolated only on a single occasion and its ecology is unknown. Discovery of such new species in the pharmaceutically important *Emericellopsis* clade is potentially of practical significance.

5. Tucker DL*, Beresford CH, Sigler L, Rogers K. 2004. Disseminated *Beauveria bassiana* infection in a patient with acute lymphoblastic leukemia. Journal of Clinical Microbiology 42:5412-5414.

*Department of Hematology, Dunedin Hospital, Dunedin, New Zealand.

Abstract
We describe a case of disseminated *Beauveria bassiana* infection in a patient with acute lymphoblastic leukemia. Her infection was successfully treated with amphotericin B and itraconazole. B. bassiana is rarely reported as a human pathogen. It is commonly found in soil and because of its pathogenicity to many insect species is incorporated into several pesticides.

6. Untereiner WA*, Scott JA, Naveau FA, Sigler L, Bachewich J, Angus A. 2004. The *Ajellomycetaceae*, a new family of vertebrate-associated *Onygenales*. Mycologia 96:811-820.

*Department of Botany, Brandon University, Brandon, Manitoba

Abstract

Phylogenies inferred from the analysis of DNA sequence data have shown that the Onygenales contains clades that do not correspond with previously described families. One lineage identified in recent molecular phylogenetic studies includes the dimorphic pathogens belonging to the genera *Ajellomyces*, *Emmonsia* and *Paracoccidioides*. To evaluate the degree of support for this lineage and determine whether it includes additional taxa, we examined relationships among the members of this clade and selected saprobic onygenalean taxa based on maximum-parsimony analyses of partial nuclear large RNA subunit (LSU) and internal transcribed spacer (ITS) sequences. A clade distinct from the Onygenaceae was found to encompass Ajellomyces (including the anamorph genera *Blastomyces, Emmonsia* and *Histoplasma*) and *Paracoccidioides brasiliensis*. The members of this lineage are saprobic and pathogenic vertebrate-associated taxa distinguished by their globose ascomata with coiled appendages, muricate globose or oblate ascospores, and lack of keratinolytic activity. Anamorphs are solitary aleurioconidia or irregular alternate arthroconidia. Based on molecular data and on morphological and physiological similarities among these taxa, we propose the new family, *Ajellomycetaceae*.

Refereed Articles In Press

7. Bertelsen, MF., G.J. Crawshaw, L. Sigler & D.A. Smith. Fatal cutaneous mycosis in tentacled snakes (*Erpeton tentaculatum*) caused by *Chrysosporium* anamorph of *Nannizziopsis vriesii*. Journal of Zoo & Wildlife Medicine (acc 25-6-04).
8. Brandt ME, Gaunt D, Iqbal N, McClinton S, Hambleton S, Sigler L. 2005. False-positive *Histoplasma capsulatum* Gen-Probe chemiluminescent test caused by a *Chrysosporium* species. Journal of Clinical Microbiology (acc 26-10-04).
9. Hambleton S, Sigler L. A new anamorph genus for root-associated fungi with phylogenetic affinities to *Rhizoscyphus ericae* (=*Hymenoscyphus ericae*), *Leotiomycetes*. Studies in Mycology 51 (acc 22-11-04)
10. Sigler L, Gibas CFC. Utility of a cultural method for identification of the ericoid mycobiont *Oidiodendron maius* confirmed by ITS sequence analysis. Studies in Mycology 51 (acc. 25-11-04)
11. Sigler L, Allan T, Lim SR, Berch S. Berbee M. Two new *Cryptosporiopsis* species from roots of ericaceous hosts. Studies in Mycology 51 (acc. Dec 04)

Book Chapters In Press

12. Sigler, L. Adiaspiromycosis and other infections caused by *Emmonsia* species. IN: Topley & Wilson's Microbiology and Microbial Infections, 10th ed. (Vol Eds. R. Hay and W. Merz) Edward Arnold, London, U.K. (In press)
13. Paré, J.A. & L. Sigler. Fungal Diseases of Reptiles. (Mader, D. ed.) (In press, subm Mar, 02).

Presentations († invited speaker)

14. †Sigler, L. 2004. Point-counterpoint: classic phenotypic mycology has gone – or has it? Focus on Fungus Infections New Orleans, LA, p 51.
15. †Sigler, L. 2004. The situation of Canadian culture collections. Canadian Research Technology Initiative –Agriculture and Agri-Food Canada sponsored workshop on Canadian Culture Collections, Ottawa Nov 22-23, 2004

Identification, Advisory and Depository Services

Cultures are received from medical laboratories, individuals or other agencies for identification, verification or deposit. We provide advice on fungus biology or significance of mold growth, and assistance with problems of fungal contamination or deterioration. Listed are some examples of individuals or agencies using these services in 2004.

- Au, A. (P. Pieroni), Westman Regional Laboratory, Brandon, MB, isolate of *T. mentagrophytes* (nodular variant) from toenail
- Berbee, M. (P. Inderbitzin), Dept. of Botany, Univ. British Columbia, deposit and verification of ericoid mycorrhizal fungi and members of the genus *Pleospora*.
- Brandt, M., Centers for Disease Control & Prevention (), Atlanta, GA, a *Chrysosporium* isolate from bronchial washing (see **Ref. 8**)
- Congly, L., Saskatchewan Provincial Laboratory (), Regina, SK, *Metarhizium anisopliae* from biopsy of left axilla
- Dykstra, M., College of Veterinary Medicine, N. Carolina State Univ., Raleigh, NC, *Exophiala* sp. in kidney lesions of a lumpfish
- Evans, I., Agri Trend Technologies, Red Deer, AB, identification of *Botrytis* isolates causing blight of martagon lilies (see **Ref 19**: Kinnikinnick 2004)
- Jang, S. (M.M. Fry), Univ. California, Davis, an isolate causing osteomyelitis in a dog
- Kinahan, C. (J. Thair), Clinical Microbiology, Royal Univ. Hospital, Saskatoon, SK, isolates from skin scraping and lung tissue
- Owen, J.,Texas Depart. of Health, Austin, TX, nonsporulating isolate from lung
- Paré, J., Veterinary Medicine, Univ. Wisconsin, Madison, WI, isolate from lesion on bearded dragon lizard
- Sutton, D.A. (Rinaldi, M.), Fungus Testing Lab. Univ. Texas Health Science Center, San Antonio, TX, isolates from sinus, endocarditis, deep lesions
- St. Germain, G., Laboratoire de Santé Publique du Quebec, St. Anne de Bellevue, PQ, nonsporulating isolate obtained from skin biopsy of a kidney transplant patient
- Woodgyer, Microbiology & Immunology, Univ. Melbourne, Melbourne, Australia, isolates from aquatic file snakes in a zoo, and from human specimens of blood or peritoneal fluid.

We continue to provide consulting service to the National Reference Centre (NRC), Microbiology & Public Health, Univ. of Alberta Hospitals, Dr. R. Rennie, Director. Twenty six isolates were received for identification in 2004. Many of these isolates are referred to the NRC from other public health laboratories including the BC Centres for Disease Control, Vancouver, and Ontario Ministry of Health Laboratory, Toronto.

Environmental

Various public and private agencies and members of the public contact us concerning assessment, significance and control of molds in the indoor environment. In addition to providing advice by telephone, we examine bulk and air samples for presence of molds and evaluate numbers and types, and potential health hazards of exposure. In 2004, about 23 reports were prepared on samples from homes, commerical or public buildings in British Columbia, Alberta and Saskatchewan.

Presentations, Travel, Visitors

Mar 24-26 L. Sigler attended the Focus on Fungus Infections in New Orleans, LA, and presented the "against position" in a debate on "Point-Counterpoint –the time of classical

laboratory (phenotypic) mycology has gone – a molecular era is here."

July 8 L. Sigler attended the 25th session of the United Nations Sub-Committee of Experts on the Transport of Dangerous Goods in Geneva, Switzerland, with Dr. Christine Rohde, committee chair, to represent a position paper on behalf of the World Federation of Culture Collections committee on Postal Quarantine and Safety Regulations.

May-Oct As part of the Matsukaze Chanoyu group, Atsumi Hashimoto offered the traditional Japanese tea ceremony monthly during the summer at the DBG Ozawa Pavilion.

Sept 22 Dr. Akira Suzuki, Department of Science Education, Chiba Univerisity, Chiba, Japan

Nov 23-24 L. Sigler spoke at, and particpated in developing a plan for a national organization and strategy at the CRTI sponsored Canadian Culture Collection workshop in Ottawa.

Other Activities

Editorial Boards and peer review of papers and grant applications (LS): Editorial Board, Medical Mycology (International Society for Human and Animal Mycology) (3), Journal of Clinical Microbiology, American Society for Microbiology (9), Canadian Journal of Microbiology (1), Studies in Mycology (1), Mycologia (1), NSERC Industrial Research Chair (1).

Offices in Societies and Committee work (LS)

- Member of the International Union of Biological Sciences (IUBS) World Federation of Culture Collections (WFCC) Committee on Postal, Quarantine and Safety Regulations, 1995- present
  - Report entitled Postal, Quarantine and Safety Regulations: Activities, Developments and Concerns was published Oct 2004.
  - A primary concern of this WFCC committee has been to lessen constraints on, and improve access to microorganisms by the world scientific community by deregulating less hazardous microorganisms. We submitted a position paper and obtained observer status at the United Nations Sub-Committee of Experts on the Transport of Dangerous Goods, 25th session on July 8, 2004 in Geneva, Switzerland. Dr. Christine Rhode (Chair) and I attended this meeting to represent the WFCC position. Our proposal for deregulation was supported by agencies including the World Health Organization and Transport Canada, and by several microbiological societies including Federation of European Microbiol. Soc., American Soc. Microbiol., Int. Union Microbiol. Soc.
  - The WFCC proposal to modify the UN Model Regulations was adopted. Once fully implemented by IATA and ICAO, cultures of infectious substances, including most Risk Group 2 and 3 organisms intended for laboratory or investigational work will be transported under a new shipping name, **Category B Biological substance** according to regulation UN3373. This regulatory change will be a huge step forward in alleviating the current difficulties faced by culture collections in shipping these microorganisms. It will eliminate the need for dangerous goods training and certification, reduce paperwork and lower costs.
- Chair, Mycological Society of America Committee on Culture Collections.
  - The MSA committee monitors and reports on activities affecting culture collections mainly in North America. As Chair, I focussed on a liason with the WFCC committee mentioned above.

University Committees (LS)

- Advisory committee for National Reference Centre in Mycology, UAH Microbiol. & Public Health

Microbial Culture Collections Canada (MCCC) Initiative (LS)

- In June 2003, the Canadian Phytopathological Society and Canadian Agricultural Research Council (CARC) sponsored a workshop on the "Status of Microbial Genetic Resources and Culture Collections in Canada" (**see Ref. 3**). Following the workshop, an ad-hoc working group, of which I am a member, developed a proposal entitled **Microbial Culture Collections Canada**. The MCCC outlines a strategy to ensure the continuation and funding of strategic Canadian culture collections. Financial support for further development of the MCCC proposal was obtained from Canadian Research Technology Initiative (CRTI) by Dr. A. Lévesque (Agriculture & Agri-Food Canada). A portion of these funds was used to hold a second workshop on Nov. 23-24 in Ottawa of stakeholders from Health, Environment, Forestry, Agriculture and Agri-Food Canada, Canadian Food Inspection Agency, and National Defense. I was asked to speak on the situation of Canadian collections. One mandate of CRTI is to strengthen Canada's preparedness to prevent and respond to biological attack. Central to this mandate is knowledge of, and access to, microbial resources held in Canadian collections to ensure adequate procedures for recognizing and responding to threats to human, animal and plant health. Two outcomes of the Ottawa workshop were to develop a request for a proposal to conduct a feasibility study for the proposed MCCC based on models for microbial resource centres in Belgium and UK, and to develop a questionnaire for compiling an updated inventory of Canadian collections.

Upgrade to UAMH Database and Website

- The UAMH database is fundamental to collection management and information on accessions is accessed by researchers worldwide through the website. Operating in MS SQL server and Visual basic, the database is undergoing a major upgrade with assistance of a programmer consultant. We continuously annotate accession information but keeping information up-to-date is often challenging due to cumbersome updating procedures arising from conversion of the database from an initial heirarchical to a relational information management system. The upgrade will reduce these problems, allow for viewing data in multiple windows, and provide for a more seamless transfer of data to the website.

External Funding (Grants/Fees for Services)

NSERC. Systematics of Fungi in the Human Environment	29,000
NSERC. Major Facilities Access (1999-2002). The University of Alberta Microfungus Collection and Herbarium (UAMH).	42,000
ARAV Assoc of Reptilian & Amphibian Veterinarians (2003-04) (J.A. Paré, J.A., D.R. Andes, D.R., L. Sigler) Susceptibility of fungal isolates from reptiles to antifungal drugs.	2,325 US
U of A Small Faculties Fund. Cryofreezer for long-term preservation of fungus cultures (cost to be shared with NSERC MFA)	4,000
Income from all services cultures, safe deposit and preservation services, identifications, environmental assessments and consultation	14,500
Consultation to UAH National Reference Centre (Microbiology & Public Health)	4,500

Publications Citing UAMH Cultures or Assistance

16. Barratt SR, Ennos AR, Greenhalgh M, Robson GD, Handley PS. 2003. Fungi are the predominant micro-organisms responsible for degradation of soil-buried polyester polyurethane over a range of soil water holding capacities. Journal ofApplied Microbiology. 95: 78-85.

    Abstract To investigate the relationship between soil water holding capacity (WHC) and biodegradation of polyester polyurethane (PU) and to quantify and identify the predominant degrading micro-organisms in the biofilms on plastic buried in soil. Methods and Results: High numbers of both fungi and bacteria were recovered from biofilms on soil-buried dumb-bell-shaped pieces of polyester PU after 44 days at 15-100% WHC. The tensile strength of the polyester PU was reduced by up to 60% over 20-80% soil WHC, but no reduction occurred at 15, 90 or 100% soil WHC. A PU agar clearance assay indicated that fungi, but not bacteria were, the major degrading organisms in the biofilms on polyester PU and 10-30% of all the isolated fungi were able to degrade polyester PU in this assay. A 5.8S rDNA sequencing identified 13 strains of fungi representing the three major colony morphology types responsible for PU degradation. Sequence homology matches identified these strains as Nectria gliocladioides (five strains), Penicillium ochrochloron (one strain) and Geomyces pannorum (seven strains). Geomyces pannorum was the predominant organism in the biofilms comprising 22-100% of the viable polyester PU degrading fungi. Conclusions: Polyester PU degradation was optimum under a wide range of soil WHC and the predominant degrading organisms were fungi. Significance and Impact of the Study: By identifying the predominant degrading fungi in soil and studying the optimum WHC conditions for degradation of PU it allows us to better understand how plastics are broken down in the environment such as in landfill sites.

17. Bidochka MJ, Menzies FV, Kamp AM. 2002. Genetic groups of the insect-pathogenic fungus Beauveria bassiana are associated with habitat and thermal growth preferences. Archives of Microbiology 178:531-537.

    Abstract A persistent paradigm in insect pathology is one that relates the insect host to certain genetic groups of insect-pathogenic fungi. This paradigm assumes that the genotype of an insect-pathogenic fungus coevolves with a certain taxon of insect host that it infects. The insect-pathogenic fungus Beauveria bassiana shows a wide host range and is considered to be a facultative insect pathogen. In this study, a population genetics analysis of B. bassiana from forested and agricultural habitats as well as from the Canadian Arctic showed distinct genetic groups associated with the three different habitats. Within each group, recombining population structures and clonally reproducing lineages were observed. The B. bassiana isolates were also assessed for their abilities to grow at 8, 15, 25 and 37 °C and for their tolerances to UV exposure. The genetic groups from the Arctic and from the forested habitats grew at lower temperatures, while the genetic group from the agricultural habitat grew at 37 °C and was tolerant to UV exposure. There were no clear associations between the genetic group and the ability to infect coleopteran or lepidopteran insect larvae. There is increasing evidence that such studies represent a significant paradigm shift; habitat selection, not insect host selection, drives the population structure of deuteromycetous insect-pathogenic fungi. We suggest that adaptation to a certain habitat type is an important criterion for identifying insect-pathogenic fungal strains for use in insect biocontrol efforts.

18. Castlebury LA, Rossman AY, Sung GH, Hyten AS, Spatafora JW. 2004. Multigene phylogeny reveals new lineage for Stachybotrys chartarum, the indoor air fungus. Mycological Research 108:864-872.

Abstract Stachybotrys chartarum is an asexually reproducing fungus commonly isolated from soil and litter that is also known to occur in indoor environments and is implicated as the cause of serious illness and even death in humans. Despite its economic importance, higher level phylogenetic relationships of Stachybotrys have not been determined nor has a sexual state for S. chartarum been reported. DNA sequences from four nuclear and one mitochondrial gene were analyzed to determine the ordinal and familial placement of Stachybotrys within the Euascomycota. These data reveal that species of Stachybotrys including S. chartarum, S. albipes, for which the sexual state Melanopsamma pomiformis is reported, species of Myrothecium, and two other tropical hypocrealean species form a previously unknown monophyletic lineage within the Hypocreales. These results suggest that Stachybotrys and Myrothecium are closely related and share characteristics with other hypocrealean fungi. In addition, S. chartarum may have a sexual state in nature that consists of small, black, fleshy perithecia similar to Melanopsamma.

19. Evans, I. R. 2004. Martagons and myths. Kinnikinnick 19(4):5, 2004
(Publication of the Devonian Botanic Garden in association with the Friends of the Devonian Botanic Garden)

20. Grönberg H, Paulin L, Sen R. 2003. ITS probe development for specific detection of Rhizoctonia spp. and Suillus bovinus based on Southern blot and liquid hybridization-fragment length polymorphism. Mycological Research 107:428-438

Abstract Development of specific DNA probes targeting rDNA internal transcribed spacer (ITS-1 or -2) sequences is described for the detection of strains representing uninucleate and binucleate Rhizoctonia spp. and Suillus bovinus. Discriminatory taxon/species-specific target sequences were identified following full length ITS sequence alignment of the test fungal sequences and those of other root associated pathogenic or mycorrhizal fungi. Both long (124–151 bp) and shorter (20–25 bp) probes were generated for assessment in Southern dot blot and liquid hybridization ITS capture-fragment length polymorphism assays. Fungal genomic DNA was presented as the target in dot blot protocols using the longer DIG (digoxigenin) labelled probes whilst the shorter 3[prime prime or minute] biotin-labelled oligonucleotide probes were hybridized to PCR amplified full length ITS (ITS1-5.8S-ITS2) in both dot blot and liquid hybridization assays. The optimal hybridization temperatures for dot blot detection also produced maximal target specific signals in the liquid hybridization protocol. The latter protocol was found to be more discriminatory as target fungi were detected on the basis of combined probe hybridization-ITS capture and 5[prime prime or minute] Cy-5 labelled ITS length polymorphism analysis (±5 bp) following denaturing sequencing gel electrophoresis in a ALFexpress DNA sequencer.

21. Hausner G., Eyjólfsdóttir GG, Reid J. 2003. Three new species of Ophiostoma and notes on Cornuvesica falcata Canadian Journal of Botany 81:40-48

Abstract Sampling of beetles, beetle galleries, and stained tree tissues by ourselves and others to obtain isolates of ophiostomatoid fungal species yielded three Ceratocystiopsis-like entities. Using partial rDNA sequences, these were previously identified as being different from both each other and all other described species of Ceratocystiopsis and Ophiostoma. As Ceratocystiopsis Upadhyay et Kendrick has been reduced to synonymy with Ophiostoma Syd. et P. Syd., and sufficient dried material is now available, these are described herein as Ophiostoma carpenteri sp. nov., Ophiostoma rollhansenianum sp. nov., and Ophiostoma manitobense sp. nov. We found O. carpenteri to be closely related to Ophiostoma retusum (R.W. Davidson et T.E. Hinds) Hausner et al., and that both species may actually be fungal

symbionts and could represent a discrete genus. Although morphologically O. rollhansenianum appears similar to Ophiostoma minutum Siemaszko, a clearly variable species, and O. manitobense to Ophiostoma minus (Hedgc.) Syd. et P. Syd., earlier rDNA data indicate that O. rollhansenianum and O. manitobense are actually more closely related to Ophiostoma coliferum (Marmolejo et Butin) Hausner et al., and Ophiostoma ranaculosum (J.R. Bridges et T.J. Perry) Hausner et al. We also comment on some morphological features that have previously been overlooked or misreported in Cornuvesica falcata (E.F. Wright et Cain) C.D. Viljoen et al., such as the ascospores actually being hyaline and the presence of two distinct Chalara anamorphs.

22. Hausner G, Reid J. 2003. Notes on Ceratocystis brunnea and some other Ophiostoma species based on partial ribosomal DNA sequence analysis. Canadian Journal of Botany 81:865-876.

Abstract Ribosomal gene sequence data were obtained from a nonfruiting culture originally identified as *Ceratocystis brunnea* R.W. Davidson; this species was considered a nomen dubium by Upadhyay (1981) due to a presumptive lack of teleomorph material. The data showed that *C. brunnea* is a valid species that should be transferred to *Ophiostoma*, demonstrating that DNA data can compensate for the presumed or actual lack of morphological features lost during either long-term culturing or disintegration of holotype specimens. Use of partial large ribosomal sequence data to assess the relationship of *C. brunnea* to other *Ophiostoma* spp. showed that it is not a synonym of *Ophiostoma piliferum* (Fr.:Fr.) Syd. & P. Syd. as has been suggested; instead, it appears to be distantly related to *Ophiostoma piceae* (Münch) Syd. & P. Syd. The data obtained for the *Ophiostoma piliferum* strains included in this study suggest that hardwood-derived isolates may be distinct from those obtained from conifers. In addition, molecular characters support transferring *Ceratocystis pseudonigra* Olchow. & Reid, *Ceratocystiopsis concentrica* (Olchow. & Reid) Upadhyay, *Ceratocystiopsis pallidobrunnea* (Olchow. & Reid) Upadhyay, and *Ceratocystiopsis crenulata* (Olchow. & Reid) Upadhyay to *Ophiostoma*.

23. Ikehata, K., Buchanan, I.D. and Smith, D.W. 2003. Treatment of oil refinery wastewater using crude Coprinus cinereus peroxidase and hydrogen peroxide. Journal of Environmental Engineering and Science 2:463-472.

Abstract Enzymatic treatment of a strong oil refinery wastewater was investigated using crude *Coprinus cinereus* peroxidase (CIP) from *C. cinereus* UAMH 4103 and hydrogen peroxide. Phenolic compounds in the refinery wastewater were enzymatically converted to coloured polymeric products, which were subsequently removed by coagulation with alum. Unlike previously reported studies with synthetic phenolic wastewaters, neither the purity of enzyme nor the addition of poly(ethylene glycol) had an effect on the phenol transformation catalyzed by CIP. As a result of enzymatic treatment ($[CIP]_0$=2 U mL^{-1}) and alum coagulation of the wastewater containing 6.4 mM total phenol, the chemical oxygen demand and 5-d biochemical oxygen demand were reduced by 52% and 58%, respectively. Although these oxygen demands were reduced in the wastewater by the enzymatic treatment and subsequent coagulation, the dissolved organic materials in the crude CIP were apparently not affected by either process and tended to remain in the treated wastewater.

24. Ikehata K, Buchanan ID, Smith DW. 2004. Recent developments in the production of extracellular fungal peroxidases and laccases for waste treatment. Journal of Environmental Engineering and Science 3: 1-19.

Abstract The use of enzymes for the treatment or the removal of environmental and industrial pollutants has attracted increasing attention because of their high efficiency, high selectivity, and environmentally benign reactions. Of these enzymes studied for such purposes,

extracellular fungal peroxidases, such as lignin peroxidase, manganese peroxidase and *Coprinus cinereus* peroxidase, and fungal laccases are the two major classes of enzymes that have been evaluated for the removal of toxic phenolic compounds from industrial wastewater and the degradation of recalcitrant xenobiotics. Numerous reports have been published recently on the improvements of the production of these enzymes, such as discovery of new fungal strains, modification of growth conditions, use of inducers, and use of cheaper growth substrates such as agricultural and food wastes. In this review, these recent advances in the production of extracellular fungal peroxidases and laccases, along with brief summaries of background of these enzymes and their applications, are discussed.

25. Ikehata K, Buchanan ID, Smith DW. 2004. Extracellular peroxidase production by Coprinus species from urea treated soil. Canadian Journal of Microbiology 50:57-60.

    Abstract Thirteen strains of inky-cap mushroom Coprinus species were evaluated for the production of extracellular peroxidase. The liquid fermentation was carried out in shake flasks containing 1% glucose, 0.5% peptone, 0.3% yeast extract, and 0.3% malt extract broth at 25 degrees C. Peroxidase activity was detected in the liquid culture of several Coprinus species, including C. echinosporus NBRC 30630; C. macrocephalus NBRC 30117; Coprinus spp. UAMH 10065, UAMH 10066, UAMH 10067, and 074, after 10 days of growth. Peroxidase production by Coprinus sp. UAMH 10067, a Coprinus species isolated from urea-treated soil, was comparable to that of C. cinereus and reached 15 U.mL(-1) after 10 days. In addition, the peroxidase from Coprinus sp. UAMH 10067 was apparently more thermally stable than the enzyme produced by C. cinereus.

26. Kano R, Nakamura Y, Watanabe S, Hasegawa A. 2003. Molecular taxonomy of dermatophytes and related fungi by chitin synthase 1 (CHS1) gene sequences. Antonie van Leeuwenhoek 83:11-20, 2003

    Abstract In the present study, the nucleotide sequences of the CHS1 gene from dermatophytes and related fungi in the genera Chrysosporium, Epidermophyton, Microsporum and Trichophyton were investigated using molecular methods. About 440-bp genomic DNA fragments of the CHS1 gene from 21 species were amplified by polymerase chain reaction (PCR) and sequenced. The CHS1 nucleotide sequences of these fungi showed more than 83% similarity. The molecular taxonomy of the CHS1 gene sequences revealed that Microsporum was genetically distinct from Chrysosporium and Trichophyton, as classified by morphological characteristics

27. Kuga-Uetake Y, Purich M, Massicotte HB, Peterson RL. 2004. Host microtubules in the hartig net region of ectomycorrhizas, ectendomycorrhizas, and monotropoid mycorrhizas. Canadian Journal of Botany 82:938-946.

    Abstract Various categories of mycorrhizas are recognized primarily by the structural changes that occur between fungi and roots. In all mycorrhiza categories, cytological modifications of root cells accompany the establishment of the functional symbiosis, and among these are alterations in the organization of the cytoskeleton. Using immuno labelling combined with confocal scanning laser microscopy, this study documents changes in microtubules (MTs) in root cells of ectendomycorrhizas and monotropoid mycorrhizas; in addition, ectomycorrhizas were reinvestigated to determine the effect of fungal colonization on host root cells. In Pinus banksiana L. – Laccaria bicolor (Maire) Orton ectomycorrhizas, MTs were present in epidermal and cortical cells adjacent to the Hartig net. The remaining cortical MTs had a different organization when compared with those of cortical cells of control roots. MTs were present in Hartig net hyphae. In ectendomycorrhizas formed when roots of P. banksiana were colonized

by the ascomycete, Wilcoxina mikolae var. mikolae Yang & Korf, MTs were present adjacent to intracellular hyphae and host nuclei, but few cortical MTs were present. MTs were present within Hartig net and intracellular hyphae. In field-collected roots of Monotropa uniflora L., MTs were associated with fungal pegs, intracellular extensions of inner mantle hyphae within epidermal cells. The close association between MTs and fungal pegs may be related to the formation of the highly branched host-derived wall that envelops each fungal peg. The development of exchange interfaces in the three systems studied involve changes in the organization of microtubules.

28. Lee S, Kim JJ, Fung S, Breuil C. 2003. A PCR-RFLP marker distinguishing Ophiostoma clavigerum from morphologically similar Leptographium species associated with dark beetles. Can. J. Bot. 81:1104-1112.

Abstract Ophiostoma clavigerum, carried by Dendroctonus ponderosae and Dendroctonus jeffreyi, has morphological characteristics that are similar to other Ophiostoma and Leptographium species. The partial β-tubulin gene of 45 strains belonging to seven species was amplified by PCR and digested by the restriction enzyme HinfI. The specific restriction fragment length polymorphism obtained for O. clavigerum provided the means for its reliable identification. We are also reporting that O. clavigerum ascocarps have short necks; this fact has not been shown previously.

29. Middelhoven WJ, Scorzetti G, Fell JW. 2004. Systematics of the anamorphic basidiomycetous yeast genus Trichosporon Behrend with the description of five novel species: Trichosporon vadense, T. smithiae, T. dehoogii, T. scarabaeorum and T. gamsii. International Journal of Systematic and Evolutionary Microbiology 54:975-986.

Abstract Phylogenetic trees of the anamorphic basidiomycetous yeast genus Trichosporon Behrend, based on molecular sequence analysis of the internal transcribed spacer region and the D1/D2 region of the large subunit of ribosomal (26S) DNA, are presented. This study includes three novel species from soils, Trichosporon vadense sp. nov. (type strain, CBS 8901(T)), Trichosporon smithiae sp. nov. (type strain, CBS 8370(T)) and Trichosporon gamsii sp. nov. (type strain, CBS 8245(T)), one novel species from an insect, Trichosporon scarabaeorum sp. nov. (type strain, CBS 5601(T)) and one species of unknown origin, Trichosporon dehoogii sp. nov. (type strain, CBS 8686(T)). The phylogenetic positions and physiological characteristics that distinguish the new taxa from related species, based partly on growth tests that are not traditionally used in yeast taxonomy (uric acid, ethylamine, L-4-hydroxyproline, tyramine and L-phenylalanine as sources of carbon and nitrogen, and polygalacturonate, quinate, 4-ethylphenol, phloroglucinol, 2,3-dihydroxybenzoate and orcinol as sole carbon sources), are discussed. Assimilation of L-rhamnose and erythritol and maximum growth temperature were also used to delineate species.

30. Mostert L, Crous PW, Groenewald JZ, Gams W, Summerbell RC. 2003. Togninia (Calosphaeriales) is confirmed as teleomorph of Phaeoacremonium by means of morphology, sexual compatibility and DNA phylogeny. Mycologia 95:646-659.

Abstract Petri disease, or black goo, is a serious disease of vines in most areas where grapevines are cultivated. The predominant associated fungus is Phaeomoniella chlamydospora (Chaetothyriales). Several species of Phaeoacremonium also are associated, of which Pm aleophilum is the most common. Although no teleomorph is known for Phaeoacremonium, the genus Togninia previously has been linked to phaeoacremonium-like anamorphs. To investigate the possible anamorph-teleomorph connection of Phaeoacremonium to Togninia anamorphs of Togninia minima, T. fraxinopennsylvanica and T. novae-zealandiae morphologically were

compared with Pm aleophilum and some representative cultures were mated in all combinations. Although no interspecies mating proved fertile, matings between isolates of Pm aleophilum produced a Togninia teleomorph within 3–4 weeks. Certain field isolates of Pm aleophilum commonly produced the teleomorph, demonstrating that both mating types can occur in the same vine and thus also explaining the genetic diversity observed for this fungus in some vineyards. To elucidate the phylogenetic relationships among these taxa, isolates were subjected to sequence analysis of the nuclear ribosomal internal transcribed spacers (ITS1, ITS2) and the 5.8S rRNA gene, as well as portions of the translation elongation factor 1 alpha (EF-1a) gene. The generic placement of teleomorphs within Togninia (Calosphaeriales) further was confirmed via phylogenetic analyses of 18S small subunit (SSU) DNA. From these sequences, morphological and mating data, we conclude that T. minima is the teleomorph of Pm aleophilum, and that it has a biallelic heterothallic mating system. An epitype and mating type tester strains also are designated for T. minima.

31. Piercey MM, Graham SW, Currah RS. 2004. Patterns of genetic variation in Phialocephala fortinii across a broad latitudinal transect in Canada. Mycol Res. 108:955-964.

Abstract Dark septate root endophytes (DSE) are an artificial assemblage of fungi that have darkly pigmented, septate hyphae and that are frequent or distinctive intracellular associates of roots of apparently healthy plants. Based on isolates obtained from the roots of *Salix* spp., the distribution of a common DSE fungus, *Phialocephala fortinii*, was examined along a latitudinal transect in Canada running from the high arctic to the 49° N parallel. Non-sporulating isolates were provisionally identified as *P. fortinii* through analysis of DNA sequence data of the ITS2 region of rDNA. *P. fortinii* was isolated frequently from boreal and arctic habitats, but rarely from grassland habitats. Patterns of genetic variation were examined through analysis of amplified fragment length polymorphisms (AFLP). All AFLP profiles were unique with the majority of genetic variation occurring among individuals within the collecting sites at each latitude. Neighbour-joining analysis of genetic distances yielded eight well-supported clusters, three of which included individuals from more than one latitude. Some linkage disequilibrium, possibly due to partial clonality, was detected.

32. Proia LA, Hayden MK, Kammeyer PL, Ortiz J, Sutton DA, Clark T, Schroers HJ, Summerbell RC. 2004. *Phialemonium*: an emerging mold pathogen that caused four cases of hemodialysis-associated endovascular infection. Clin Inf Dis 39:373-379.

Abstract Phialemonium species are emerging as fungal opportunistic pathogens of humans; infections caused by these fungi often have a fatal outcome. We report a series of 4 patients undergoing chronic hemodialysis who developed intravascular infection with Phialemonium curvatum. All isolates were of a distinct morphological type but were shown by partial ribosomal sequencing to be closely related to reference isolates of P. curvatum. Two patients in our case series died; both developed overwhelming infection associated with fungemia and endocarditis. Recent literature corroborates our experience that Phialemonium infection presents unique diagnostic challenges and that optimal management, particularly with regard to antifungal therapy, is not known.

33. Sharma J, Zettler LW, van Sambeek JW. 2003. A survey of mycobionts of federally threatened Platanthera praeclara (Orchidaceae). Symbiosis 34:145-155.

Abstract Terrestrial orchids require mycobionts for critical nutritional support during germination and growth. Despite the importance of such fungi, little is known of their identity and ecological roles. In the United States, the destruction of midwestern prairie ecosystems has resulted in the decline of the native Platanthera praeclara Sheviak and Bowles and its

associated mycobionts. Mycobionts of P. praeclara from six populations across Minnesota and Missouri were isolated from protocorms and mature plants and were identified to the genus level. Hyphal morphology, colony appearance, rate of growth, and monilioid cell morphology including septal pore ultrastructure were examined to characterize the isolates. Results indicate that P. praeclara is primarily associated with Ceratorhiza isolates at various growth stages. Few Epulorhiza isolates were recovered from roots and protocorms indicating this genus may be less critical for the orchid. Worldwide, Epulorhiza have been documented as orchid mycobionts more frequently but species of Ceratorhiza seem to be more prevalent in the North American prairie ecosystems. Preservation of prairies with special attention to conserving mycobionts of P. praeclara is needed if viable populations of both organisms are to persist.

34. Stadler M, Tichy HV, Katsiou E, Hellwig V. 2003. Chemotaxonomy of Pochonia and other conidial fungi with Verticillium-like anamorphs. Mycological Progress 2:95-122.

Abstract Pochonins are antiviral and antiparasitic resorcylic acid lactones (RAL) structurally related to monorden. They were found in the invertebrate-associated fungus *Pochonia chlamydosporia*. Their production and distribution was studied by means of High Performance Liquid Chromatography with UV-visual and mass spectrometric detection (HPLC-UV/Vis and HPLC-MS) in cultures of *Pochonia* species and further conidial fungi with *Verticillium*-like anamorphs that had until recently been included in *Verticillium* sect. *Prostrata*. The results support the recent generic segregation by Gams, Zare and co-workers because pochonins were found to occur exclusively in species of the genus *Pochonia*. With few exceptions, the production of RAL appeared to be a rather constant feature in cultures of P. *chlamydosporia* from around the world. According to preliminary results, secondary metabolite profiles in strains of allied genera such as *Lecanicillium*, *Haptocillium* and *Rotiferophthora* are different from those encountered in *Pochonia*. The alkaloid pseurotin A was found as main metabolite in several of the P. *chlamydosporia* isolates examined. As inferred from HPLC profiling data, strains of P. *suchlasporia* clustered into at least three chemotypes. The ex-type strain of P. *suchlasporia* var. *catenata* produced monorden, while several other strains produced metabolites whose HPLC-UV and HPLC-MS characteristics were similar to the mycotoxins, aurovertin B and citreoviridin A. Yet different metabolites were detected in a third chemotype of P. *suchlasporia*. Differences in secondary metabolite profiles were also found in two strains of *P. bulbillosa*. While the ex-type strain was found devoid of all aforementioned compounds, CBS 247.68 contained the aurovertin-related metabolites detected in part of the P. suchlasporia isolates. The sequence of the ITS nrDNA of CBS 247.68 was different from that of the type strain but identical to the sequences of P. *suchlasporia* var. *catenata*. Several strains of the latter variety showed identical sequences, despite considerable variations in their HPLC metabolite profiles. Minisatellite PCR fingerprinting was found useful to segregate *Pochonia* at species and strain level, pointing toward the existence of further, cryptic species. The possible chemo-taxonomical importance and ecological functions of secondary metabolites in these fungi is discussed.

35. Sutton, DA, Rinaldi MG, Kielhofner M. 2004. First U.S. report of subcutaneous phaeohyphomycosis caused by Veronaea botryosa in a heart transplant recipient and review of the literature. J. Clin. Microbiol. 42:2843-2846.

Abstract Veronaea botryosa is a rare agent of human phaeohyphomycosis. We describe the first case of subcutaneous disease occurring in the United States, alert clinicians to the second report of a transplant-associated mycosis in a heart transplant recipient, extend the previously defined area of endemicity, and review the literature.

36. Tsuneda A, Currah RS. 2004. Ascomatal morphogenesis in Myxotrichum arcticum supports the derivation of the Myxotrichaceae from a discomycetous ancestor. Mycologia 96: 627-635.

    Abstract Electron microscopy shows that ascomata of Myxotricum arcticum bear a striking resemblance to discocarps in morphogenesis and in previously overlooked aspects of gross morphology. Although mature ascomata of M. arcticum superficially resemble reticuloperidial cleistothecia common in the Onygenales, the bramble-like aggregation of thick-walled hyphae, previously considered to represent a closed peridium, forms a basket-like apothecium that overarches a distinct hymenium of stipitate, protunicate asci interspersed with paraphyses. There is no evidence of asci developing in chains and at different levels as is characteristic of the centrum of many Eurotiomycetes. Instead, more or less globose, stipitate and evanescent asci arise individually from penultimate cells of croziers and develop almost synchronously across a distinct hymenial layer derived from a richly branched network of crozier-bearing hyphae. After dissolution of the ascus wall, ascospores adhere to a membranous sheath that underlies the hymenium. These observations provide strong support for prior suggestions based on molecular phylogenetic comparisons that the Myxotrichaceae recently are derived from a helotialean ancestor. Observations of conidiogenesis show that the typical Oidiodendron anamorph is accompanied by a second conidiogenous form with ampullae and botryose clusters of blastic conidia.

37. Tsuneda A, Hambleton S, Currah RS. 2003. Conidiogenesis and phylogenetic status of Capnobotryella renispora. Report of the Tottori Mycological Institute 41:1-12.

    Abstract A dematiaceous, microsclerotium-forming hyphomycete isolated from Sphagnum fuscum had a 100% ITS sequence match with data for a culture derived from the type strain of Capnobotryella renispora. However, the identification of the Sphagnum fungus remained provisional because it lacked the two-celled, reniform, blastic conidia, the most important taxonomic characteristic of C. renispora, and there were marked discrepancies among the SSU sequences available for the ex-type strain of C. renispora. Our comparative cultural study revealed that the Sphagnum fungus was indistinguishable from all three examined strains of C. renispora, including the ex-type strain, in colony and hyphal morphology and production of thallic and endogenous conidia. Endoconidiogenesis in the C. renispora strains is shown for the first time here. The production of two-celled, blastic conidia varied among strains. The two-celled, blastic conidia in C. renispora were previously reported to be solitary and holoblastic, but light and scanning electron microscopy revealed that they developed successively from each locus and formed spore balls. Conidiogenous cells did not proliferate during successive conidial production and thus they were regarded as analagous to phialides. Judging from the molecular and morphological data, we determined that the Sphagnum fungus is a blastospore-less strain of C. renispora.

38. Tsuneda A, Hambleton S, Currah RS. 2004. Morphology and phylogenetic placement of Endoconidioma, a new endoconidial genus from trembling aspen. Mycologia 96: 1128-1135.

    Abstract Endoconidioma populi gen. et sp. nov. is described from black subicula on twigs of trembling aspen, Populus tremuloides, in Alberta, Canada. Pycnidium-like conidiomata are produced on twigs and in culture, but, unlike pycnidia, conidiomata of E. populi have a closed peridium and a locule filled with conidiogenous cells that form conidia endogenously. These endoconidia are hyaline, unicellular and released by the dissolution of the peridial cell wall. In addition to endoconidia, mostly two-celled conidia that form blastically from undifferentiated

hyphae occur often in culture but are observed only occasionally on Populus twigs. No coelomycetous taxa have been reported to produce endoconidia, and both the morphological features and DNA sequence data demonstrate that Endoconidioma is distinct from the previously established endoconidial genera. Parsimony analyses of portions of the nuclear ribosomal RNA gene (SSU and ITS) suggest that Endoconidioma is closely related phylogenetically to members of the Dothideales and allied anamorphs in Hormonema and Kabatina.

39. Tsuneda, A., Tsuneda I, Currah RS. 2004. Endoconidiogenesis in Endoconidioma populi and Phaeotheca fissurella. Mycologia 96: 1136-1142.

Abstract Details of the development of endoconidia were basically the same in Endoconidioma populi and Phaeotheca fissurella. In both species, endoconidiogenesis involved (i) subdivision of conidiogenous mother cells by septation to form two to several daughter cells; (ii) accumulation of an electron-dense material between the daughter and mother cell walls; and (iii) separation of the daughter cells by septum schizolysis, accompanied by the dissolution of mother cell wall. Conidiomata of E. populi were unique in having a closed peridium and a locule filled with conidiogenous mother cells and, therefore, we proposed the new term, cleistopycnidium (pl. -a), for this structure. In the cleistopycnidium of E. populi, endoconidiation usually began in the core of the locule and spread outward. Release of endoconidia was by the degeneration of peridial cell walls.

40. Van Hamme JD, Wong ET, Dettman H, Gray MR, Pickard MA. 2003. Dibenzyl sulfide metabolism by white rot fungi. Appl Environ Microbiol. 69:1320-4.

Abstract Microbial metabolism of organosulfur compounds is of interest in the petroleum industry for in-field viscosity reduction and desulfurization. Here, dibenzyl sulfide (DBS) metabolism in white rot fungi was studied. Trametes trogii UAMH 8156, Trametes hirsuta UAMH 8165, Phanerochaete chrysosporium ATCC 24725, Trametes versicolor IFO 30340 (formerly Coriolus sp.), and Tyromyces palustris IFO 30339 all oxidized DBS to dibenzyl sulfoxide prior to oxidation to dibenzyl sulfone. The cytochrome P-450 inhibitor 1-aminobenzotriazole eliminated dibenzyl sulfoxide oxidation. Laccase activity (0.15 U/ml) was detected in the Trametes cultures, and concentrated culture supernatant and pure laccase catalyzed DBS oxidation to dibenzyl sulfoxide more efficiently in the presence of 2,2'-azinobis(3-ethylbenzthiazoline-6-sulfonate) (ABTS) than in its absence. These data suggest that the first oxidation step is catalyzed by extracellular enzymes but that subsequent metabolism is cytochrome P-450 mediated.

41. Villarreal-Ruiz L, Anderson IC, Alexander IJ. 2004. Interaction between an isolate from the Hymenoscyphus ericae aggregate and roots of Pinus and Vaccinium New Phytologist 164:183-192.

Abstract A fungal isolate was obtained from Piceirhiza bicolorata-like ectomycorrhizas on Pinus sylvestris in a 160-yr-old natural woodland. The fungus was identified by sequencing the PCR-amplified rDNA ITS regions. The sequence was compared with similar known taxa and grouped with Cadophora finlandia in the Hymenoscyphus ericae aggregate. The fungus formed P. bicolorata-like ectomycorrhizas in aseptic synthesis with P. sylvestris seedlings. When seedlings of Vaccinium myrtillus were exposed to mycelium arising from these ectomycorrhizas, or to mycelium in pure culture, the hyphae entered the cells of the hair roots and formed coils characteristic of ericoid mycorrhizas. The presence of the fungus stimulated Vaccinium root growth and altered root architecture. This is the first full report of the ability of a fungus from the H. ericae aggregate simultaneously to form both ectomycorrhizas and what appear to be ericoid mycorrhizas.

42. Wang Y, Vazquez-Duhalt R, Pickard MA. 2003. Manganese-lignin peroxidase hybrid from Bjerkandera adusta oxidizes polycyclic aromatic hydrocarbons more actively in the absence of manganese. Can J Microbiol 49:675-682.

    Abstract We studied polycyclic aromatic hydrocarbon (PAH) oxidation using whole cells and purified manganese-lignin peroxidase (MnLiP) from Bjerkandera adusta UAMH 8258. Although the metabolism of PAHs by B. adusta has been previously demonstrated, less than 5% mineralization of 14C-labelled PAHs occurred in this study over a 40-day period. Oxidation of PAHs was examined by a purified MnLiP hybrid isoenzyme in the presence and absence of manganous ions. The rate of PAH oxidation was decreased by the presence of Mn. The substrates were anthracene and its methyl derivatives, pyrene and benzo[a]pyrene, PAHs with ionization potentials of 7.43 eV or lower. The PAH metabolites of the Mn-independent reaction were identified as the corresponding quinones. The pH optimum of the Mn- 3. The kinetic constants for the Mn-independent oxidation of 2-methylanthracene independent oxidation was generally about 4, while for the Mn-dependent reaction it was at pH 4 were determined, and the values we obtained were a kcat of 145/min, KM,app of 23.8 mmol/L for the aromatic substrate, and KM,app of 0.2 mmol/L for hydrogen peroxide. This is the first report of PAH oxidation by a MnLiP hybrid isoenzyme from white rot fungi.

43. Wilson BJ, Addy HD, Tsuneda A, Hambleton S, Currah RS. 2004. Phialocephala sphaeroides sp. nov., a new species among the dark septate endophytes from a boreal wetland in Canada. Canadian Journal of Botany 82:607-617.

    Abstract Dark septate root endophytic fungi from plants growing on either side of an abrupt wetland–upland ecotone included isolates of *Phialocephala fortinii* Wang & Wilcox, *Leptodontidium orchidicola* Sigler & Currah, *Hetero conium chaetospira* (Grove) Ellis, and a hitherto undescribed fungus resembling *P. fortinii*. Six isolates of this species were recovered and were distinctive in (*i*) producing an orange–tan diffusible pigment in culture, (*ii*) causing a yellow colour shift on casamino acids medium containing bromocresol purple, (*iii*) having the ability to liquefy gelatin, and microscopically, (*iv*) forming hyaline conidia from phialides arranged in large spherical heads after prolonged incubation at 5 °C. First-formed or primary conidia are bullet shaped, 1–1.5 μm × 2–3 μm; subsequent conidia are spherical and 1–1.5 μm in diameter. Small subunit and internal transcribed spacer region sequence comparisons with *P. fortinii* and other *Phialocephala* species supported placing these six unique strains in a new species, *Phialocephala sphaeroides* B.J. Wilson sp. nov. Phylogenetic analyses also suggest that *P. sphaeroides* is affiliated with mollisioid taxa in the Dermateaceae. In contrast with *P. fortinii*, which was isolated on both sides of the ecotone, *P. sphaeroides* was obtained only from plants in the highly acidic, *Sphagnum*-dominated wetland habitat and not from the same species in the less acidic, aspen-dominated upland site.

44. Zuccaro A, Summerbell RC, Gams W, Schroers HJ, Mitchell JI. 2004. A new Acremonium species associated with Fucus spp., and its affinity with a phylogenetically distinct marine Emericellopsis clade. Studies in Mycology 50:283-297.

    Abstract We investigated the evolutionary relationships of terrestrial and marine *Emericellopsis* species, as well as related *Stanjemonium* species, to newly obtained *Emericellopsis* and *Acremonium* isoaltes from thalli of phaeophyte algae in the genus *Fucus*. Sequences of the internally transcribed spacer regions, the 5.8S rRNA gene and intron 2 of the β-tubulin gene from twenty-one species were analysed using maximum parsimony and quartet puzzling with maximum likelihood. The monophyly of this group with *Acremonium* and *Stanjemonium* species was supported. The group consisted of four clades, one of which

contained only isolates originating from marine sources or saline lakes. A new species, described here as *Acremonium fuci* sp. nov., was included within this clade. It was isolated independently from *Fucus serratus* in Europe and *F. distichus* in western North America. The germination of itsconidia occurred in the presence of *F. serratus* tissue or aqueous tissue homogenates, but not in seawater alone. Enzymatic activity and carbohydrate utilisation profiles were done for the species studied; results were found to correlate with clades and habitats. Specifically, polyphenol oxidase activity was found only in clades associated with terrestrial habitats, while assimilation of fucoidan and fucose, compounds commonly associated with phaeophytes, was found only in members of the marine clade.

Table 1. Cultures Received in 2004

Person or industry or culture collection and address	*Reason for shipment*	*Total*
1. Andersen, B., Bio-Centrum-DTU, Technical Univ. Denmark, Lyngby, Denmark	EX	2
2. Au, A., (P. Pieroni), Westman Regional Laboratory, Brandon, MB	ID	1
3. Berbee, M. (T. Allen, P. Inderbitzin), Botany, Univ. British Columbia, Vancouver, BC	D	31
4. Brandt, M., Centers for Disease Control & Prevention, Atlanta, GA	ID	1
5. Breuil, C., Wood Science, Univ. British Columbia, Vancouver, BC	D	5
6. CBS, Utrecht, The Netherlands	EX	7
7. Congly, L., Saskatchewan Provincial Laboratory, Regina, SK	D/ID	10
8. Currah, R. S. (M. Greif, B. Wilson. A. Rice), Biological Sciences, Univ. Alberta, Edmonton	D	17
9. De la Cruz, T., Institut fur Mikrobiologie,Technische Universitat Braunschweig, Braunschweig, Germany	D	6
10. Dykstra, M., College of Veterinary Medicine; N. Carolina State Univ., Raleigh, NC	ID	1
11. Evans, I., Agri Trend Technology Ltd., Red Deer, AB	ID	2
12. Goettel, M., Agriculture & Agri-Food Canada, Lehtbridge, AB	D	1
13. Guest, R., Civil & Environmental Eng, Univ. Alberta, Edmonton	ID	6
14. Handley, P.S., Univ. Manchester, Manchester, UK	D	6
15. Kinahan, C., Clinical Microbiology, Royal Univ. Hospital, Saskatoon. SK	ID	1
16. Koster, B., Botany, Univ. Toronto, Toronto, ON	D	2
17. Krug, J., Royal Ontario Museum, Toronto, ON	D	1
18. KS Avicenna, Inc., (McDonald, J., S. Panteluk), Edmonton, AB	ID	13
19. Nakasone, K., Forest Products Laboratory, USDA, Madison, WI	D	2
20. Pare, J., Veterinary Medicine, Surgical Sci., Univ. Wisconsin, Madison, WI	ID	1
21. Priest, M., Orange Agric. Inst., Plant Pathology Herbarium, Forest Road, Orange, NSW, Australia	D	4
22. Rennie, R., National Center for Mycotic Diseases, Univ. Alberta Hospital, Edmonton, AB	D/ID	36
23. Rinaldi, M. (D. Sutton), Fungus Testing Lab., Univ. Texas Health Science Center, San Antonio, TX	D/ID	6
24. St. Germain, G., Laboratoire de Sante' Publique du Quebec, St. Anne de Bellevue, PQ	ID	1
25. Suzuki, A., Univ. Chiba, Chiba, Japan	D	5
26. Texas Department of Health (J. Owen), Austin, TX	ID	1
27. Thair, J., Bacteriology Section, Clinical Microbiology, Royal Univ. Hospital, Saskatoon, SK	ID	1
28. Tsuneda, A., Biological Sciences, Univ. Alberta, Edmonton, AB	D	5
29. Woodgyer, A., Microbiology & Immunology, Univ. Melbourne, Melbourne, Australia	D/ID	7
30. Zettler, L., Biology, Illinois College, Jacksonville. IL	D/ID	4

Total cultures received from:

Internal (Univ. Alberta/UA Hospitals)	64
External (North America & International)	122
Total cultures received	**186**

Codes: **D** - Deposit, **EX** – Exchange, **ID** – Identification

Table 2. Cultures Distributed in 2004

	Person or industry or culture collection and address	*Reason for shipment*	*Total*
1.	Aeromycology Assoc. of America/Mycotech Biological Inc.,(Wardlaw, C., S. Smith), Jewett, TX	IAQ	22
2.	Andersen, B., BioCentrum-DTU, Center for Microbial Biotechnol, Lyngby, Denmark	EX	2
3.	Berbee, M., Botany, Univ. British Columbia, Vancouver, BC	MB	4
4.	Butler, M., Biochemistry Dept., Univ. Otago, Dunedin, New Zealand	MB	2
5.	Bidochka, M.J., Biological Science, Brock University, St. Catharine, ON	B	4
6.	CBS, Utrecht, The Netherlands	EX	9
7.	Currah, R., (M. Day) Biological Sciences, Univ. Alberta, Edmonton, AB	MB/T	3
8.	De Hoog, G.S., CBS, Utrecht, The Netherlands	EX/MB	5
9.	De la Cruz, T.E., Institut fur Microbiologie,Techn. Univ. Braunschweig, Braunschweig, Germany	T	1
10.	Dixon, M. (J. Dorman), Environmental Biology, Univ. Guelph, Guelph, ON	FRT	3
11.	Entz, S. (D. Johnson), Agriculture & Agri-Food Canada, Lethbridge, AB	MB	6
12.	Gadagi, R., Chemistry, Univ. Saskatchewan, Saskatoon, SK	P	1
13.	Goettel, M., Agriculture & Agri-Food Canada, Lethbridge, AB	MB	4
14.	Guo, X.W. Institute for Microbiology, Chinese Academy of Sciences, Beijing, China	MR	2
15.	Hambleton, S., Agriculture & Agri-Food Canada, Ottawa, ON	CR/MB	10
16.	Insultech Inc., (Truksa, L.), Weston, ON	FRT	5
17.	Jany, J.L.(D. Khasa, A. Gagne), Centre de Reserche en Biologie Forestiere, Laval, PQ	MB	13
18.	Jeremic, D. (P. Cooper), Forestry, Univ. Toronto, Toronto, ON	BD?	1
19.	John, T., Concordia Univ., Montreal, QC	MB	1
20.	Kim, J.J. (C. Breuil), Wood Science, Univ. British Columbia, Vancouver, BC	BD/T	3
21.	Kuga, Y., Food Production Sci., Fac. Agric., Shinshu Univ., Nagano, Japan	MB/MR	6
22.	Liu, P., Biochemistry & Molecular Biology, Dalhousie University, Halifax, NS	MB	7
23.	McInerney, N., Chemistry & Biology Laboratory, Red Deer College, Red Deer, AB	TE	3
24.	Microbial Insights Inc., (Y. Piceno), Rockford, TN	MB	2
25.	Microbiologics, (Corrigan, J.), St. Cloud, MN	IAQ	1
26.	Miller, J., AquaScience, Davis, CA	MB	2
27.	Nash, C.J., Biology, IPFW, Ft. Wayne, IN	MR	1
28.	Pare, J.A., Veterinary Medicine, Surgical Sci., Univ. Wisconsin, Madison, WI	CR/ST	20
29.	Patel, S., Engineering & Fire Investigation, Technical Support Services, Kingwood, TX	MB	4
30.	Peterson, S., Microbial Properties Research, NCAUR, ARS-USDA, Peoria, IL	MB	9
31.	Pickard, M., Biological Sciences, Univ. Alberta, Edmonton, AB	BD/EZ	2
32.	Prairie Biological Laboratories Inc., (Bishnoi, R.K.), Edmonton, AB	IAQ	1
33.	Reid, J., Microbiology, Univ. Manitoba, Winnipeg, MB	T	4
34.	Reese, P.B., Chemistry, Univ. West Indies, Kingston, Jamaica	PS/M	1
35.	Sabuquillo-Castrillo, P., INIA, Madrid, Spain	M	1
36.	Smith, R.H., Kelsey Creek Laboratories, Issaquah, WA	MR	2
37.	Stewart, S., Environmental Horticulture Dept., Univ. Florida, Gainsville, FL	MR	1
38.	Taylor J (Johannesson, H.), Plant & Microbial Biology, Univ. California, Berkeley, CA	MB	4
39.	Untereiner, W.A., Brandon University, Brandon, MN	T/MS	2
40.	Vanderwel, W., Kung's University College, Edmonton, AB	ST	1
41.	Zettler, L.W., Biology, Illinois College, Jacksonville, IL	MR	3

Cultures distributed to:

Internal (Univ. Alberta/UA Hospitals)	5
North America	153
International	20
Total cultures distributed	**178**

Codes: **B** – Biocontrol, **BD** - Biodeterioration, **CR** – Collaborative Research, **EX** – Exchange, **EZ** - Enzyme, **FRT** – Fungus Resistance Testing; **IAQ** - Indoor Air Quality; **M** – Metabolites; **MB** – Molecular Biology; **MR** – Mycorrhizae, **PS** – Preservation Service, **ST** - Susceptibility Testing; **T** - Taxonomy, **TE** – Teaching