About this Issue

The abstracts of papers for the MSA Annual Meeting are included in this issue of *Inoculum*. “Mycology Online” has moved to the front page for this issue to highlight the debut of the MSA Home Page. Other important electronic information resources are also announced and several new meetings and workshops have been added to the calendar.

The deadline for the next issue is July 15. The editor needs your help. Think ahead to the upcoming school term, the fall collecting season, important meetings and workshops and send me the news! See the masthead on page 10 for details.

Ellen Farr

Mycology Online

MSA Home Page

<http://www.erin.utoronto.ca/soc/msa/>

The MSA now has a home page! Turn to it for easy access to our Directory, the MSA Bulletin Board, back issues of *Inoculum* beginning with volume 46, Instructions to Authors for *Mycologia*, information on our upcoming meeting and all manner of other bits of information. Also browse the links for information on commercial mushroom sites, access to GenBank, national granting agencies in the US and Canada, plus lots of information that we hope will be fun and useful for teaching mycology. The site was set up by Linda Kohn, MSA Secretary, assisted by Raphael Chow. Raphael is a talented undergraduate with a flair for Internet communication. Linda will update approximately every other month.

[Editors Note: Members can use the links from MSA home page to access MSA resources maintained on other servers. Gopher client software can still access the MSA Bulletin Board (<gopher://huh.harvard.edu/ilm/project_information/msa-bbs>) or back issues of *Inoculum* (<gopher://mmnhgoph.si.edu/11/botany/myco/.inoculum>) directly. Announcements are posted to the MSA Bulletin Board by submitting news as an e-mail message to <msa-news@huh.harvard.edu>.

Index to the Names in *Index of Fungi*

An index to the *Index of Fungi* as been made available by The International Mycological Institute. World Wide Web access is being provided by the Systematic Botany and Mycology Laboratory of the U.S. Department of Agriculture. Visit the Lab’s home page at <http://nt.ars-grin.gov/> and look under “databases and documents.”
ING Online

For many years I have been one of the editors of the Index Nominum Generorum (ING), an index of generic names in all plant and fungal groups. ING was published in 1979 and a supplement followed in 1986. Now using the World Wide Web you can search the database online. The URL is: <http://nmnh.www.si.edu/ing/>.

ING is a project of the International Association for Plant Taxonomy and the Smithsonian Institution and has had over 100 participating collaborators. Please take time to read ING's home page where the history and limitations of the index are described and be sure to notify us of errors and omissions. [Ellen Farr]

Online Geographic Databases

There are now several excellent sources of geographical data available to those with WWW access. The massive data set of place names and other features of the world maintained by the U.S. Board on Geographic Names is available through the U.S.G.S. Geographic Names Information system home page at <http://www-nmd.usgs.gov/www/gnis/index.html>. The U.S. data are available online through the "GNIS Online Data Base", maintained by USGS, and data for all other countries are available through the "GEONET Names Server", maintained by the Defense Mapping Agency.

The Canadian equivalent of USBGN maintains a more detailed gazetteer of that country at: <http://ellesmere.ccm.emr.ca/egndb/english/Home.html>. [condensed from a message submitted to Taxacom by A. F. Newton]

URLs Briefly Noted

<http://muse.bio.cornell.edu/~fungi/>

Those of you looking for information about fungi on the WWW can probably find what you need through my web pages, which form a branch of the World-Wide Web Virtual Library. If you know of an Internet mycological resource that is not listed on my pages, please do let me know. [Kathie T. Hodge <kh11@cornell.edu>]

<http://userwww.sfsu.edu/~ded>

Web page on the Agaricales of the Hawaiian Islands project, designed and operated by Dennis E. Desjardins and Brian Perry. Includes an introduction to the NSF-funded project, Tables of taxa reported from the region, and numerous photographs and commentaries on Hawaiian agarics, boletes and other fleshy hymenomycetes.

<http://zoosporic-fungi.dme.maine.edu/>

We now have replaced the Newsletter of Zoosporic Fungi with a web site that will be updated weekly. Have a look and send us news and other items related to these fungi. [Mel Fuller <mel@dogwood.botany.uga.edu>]

<http://www.nsf.gov/>

NSF Home Page. News releases and tipsheets are also available electronically on NSFnews. To subscribe, send an e-mail message to listmanager@nsf.gov. In the body of the message, type "subscribe nsfnews" and then type your name.

<http://users.caribnet.net/~lec/myrg.html>

The University of the West Indies Mycorrhizae Research Group.

<http://ix.urz.uni-heidelberg.de/~tstein1/dgfm.html>

The German Mycological Society (Deutsche Gesellschaft fuer Mykologie, DGfM). Most of the information is written in German, but some information - the tables of contents of the Journal of the German Mycological Society (Zeitschrift fuer Mykologie, ZfM) is also available in English.

<http://www.wdcm.riken.go.jp/wdcm/MMM8.html>

A trial web page for Matsushima Mycological Memoirs No. 8. It is part of a very useful WWW server of the WFCC World Data Centre for Microorganisms <http://www.wdcm.riken.go.jp>. [Gen Okada <okada@ulmus.riken.go.jp>]

TRED Survey Responses due 30 June 1996

Taxonomic Resources & Expertise Directory (TRED) is collecting data on taxonomists for an on-line database of taxonomic experts. The project, headed by the Association of Systematics Collections (ASC), will analyze the data to help government agencies assess gaps in out taxonomic knowledge and human resource needs. A strategy to fill the gaps should be one result! The questionnaire should take 10 minutes to complete. It can be filled out on-line at <http://www.ascoll.org/TRED/> or the form can be obtained from <ascinfo@ascoll.org> (put the word TRED in the subject line).

ASC is trying to publicize the need for taxonomists and you can help by filing the form. Please seriously consider completing the questionnaire. [Jim Ginn]
Minutes
MSA Executive Council Mid-Year Meeting

The meeting took place on March 9 under unusual conditions dictated by the difficult winter of 1996. Present at the Farlow Herbarium, Harvard University, were President Donald Pfister, President Elect James Ginns, and representing the New York Botanical Garden, publishers of *Mycologia* in collaboration with the MSA, Sandi Frank and Patricia Holmgren. Due to the closing of Logan Airport on March 8, three members were stranded together in Philadelphia and participated by phone: Vice President Mary Palm, Treasurer Richard Howard and Past President Amy Rossman. Secretary Linda Kohn was unable to depart from Pierson Airport in Toronto and returned to home and hearth. Notes taken by Jim Ginns and Don Pfister have been modified by Linda Kohn following consultation and subsequent Executive Committee and Council action.

1. Vice President Palm presented the ballot: Vice President, George C. Carroll and David McLaughlin; Councilors, Cell Bio/Phys, Robbie Robertson, Ian Ross; Eco/Path, Jeff Stone, Jim Worrall; Genetics/Molec Biol, Mary Berbee, Scott Rogers; Syst/Evol, Dennis Desjardin, Harold Keller. The ballot was approved.

2. There was extensive discussion of *Mycologia* business. President Pfister will request an internal audit of the *Mycologia* account from the New York Botanical Garden. More complete financial information on the *Mycologia* account should be available for the Council Meeting in July. It was agreed that Volume 87 (1995) would be rebilled at the higher rate of $22.50 per MSA member which had been previously approved by Council but never implemented. It was suggested that Sandi Frank should run Past Editor-in-Chief McLaughlin’s bills, approx. $2,500, through the *Mycologia* budget. Sandi Frank will write up a procedure for postage reimbursements for Associate Editors with the assistance of Editor-in-Chief Griffin. Page charges will be made mandatory with an option of waiver; the policy will be outlined in a future issue of *Mycologia*. Those voting were deadlocked on the issue of whether page charges should be mandatory for contributed papers; see addenda for subsequent Council Vote. As of July 1, 1996, Sandi Frank will serve as Managing Editor; she is now revising the job description for this position. Roy Halling was approved as Index Editor. A report from Editor-in-Chief Griffin was received. Computer expenditures for the Editor-in-Chief were approved.

3. A report from *Inoculum* Editor Ellen Farr was received. Deadlines for submission to *Inoculum* are now on the 15th of the odd-numbered months. Archival copies of Volume 46 go to the New York Botanical Garden, NSF, ASC and the National Agricultural Library. Notify Ellen Farr with any suggestions for other organizations that should be on the distribution list. Abstracts for the Annual Meeting are planned to go into the June issue and will be organized by Program Chair Elwin Stewart. We hope to post the abstracts on the MSA Home Page. We are looking for a volunteer to edit the new “Dialogue” section in *Inoculum*—contact Ellen Farr (or any MSA Officer) if you are interested. Controversial exchanges, when they arise for possible publication in the Dialogue section, will be referred on a case-by-case basis to suitable referees. Each such case will be mediated by a MSA Officer. Jim Ginns will work with Ellen Farr on this. $200.00 was granted to Editor Farr toward a computer upgrade. Jim Ginns is arranging for an article on Helen Smith to be prepared for *Inoculum*.

4. A proposal was received from David and Ellen Farr to produce a hardcopy Membership Directory each year. Since David and Ellen have been putting up an online version, it will be easy and economical for them to produce photo ready copy that can be printed by Allen Press. They project an approximately 39 page booklet produced like *Inoculum*. Allen Press provided an informal quote (based on 36 pages) of $1,171.40. This was approved with the understanding that phone and email would be included. The first of these would not be until February, 1997. The idea of substituting the directory for an issue of *Inoculum* was discussed. Jim Ginns will follow up.

5. A report from Endowment Committee Chair Jeffrey Stone was received. Donations so far this year total $4,897.96, of which $2,325.00 represent contributions to the named travel funds. It was a very good year for the 1995 annual meeting auction; proceeds from the auction and T-shirt sales were $6,350.00. The combined balances of the mentor travel funds total $29,599.44. We are targeting $30,000 before the annual meeting. The number of mentor travel awards for 1996 was determined by an e-mail vote (see addenda).

6. A report on the upcoming Annual Meeting in Indianapolis was received from Program Chair Elwin Stewart. Details have been published in the April *Inoculum*, Vol. 47(2). The advanced registration deadline will be 21 June 1996. Elwin writes, “I have provided the essential ingredients for such an approach (developing a more professional approach) by scheduling a meeting for all MSA committee members. Hopefully they will be asked to come to that meeting with proposals and ideas for the next year’s program.\n
Group consensus can work wonders in generating both excitement and quality.” A report on the MSA Foray was received from Foray Committee Chair Jim Adaskaveg; the announcement was published in the April *Inoculum*. Annual Lecture Committee Chair Jim Anderson reports that the first annual John Karling Lecture will be presented by Dr. Barbara Valent on “The Rice Blast Fungus—From the Field into the Laboratory.”

7. Supplementary support for some Symposia was vetoed on the basis that the playing field has not been level. We will endeavor to work out a future policy that allows for support of perhaps one symposium and a resulting publication. See addenda for Council action on specific items.

8. Vice President Palm is investigating sites for the 1998 Annual Meeting. These will be reviewed by Council in July.

9. A report from Liaison Meredith Blackwell on International Mycological Association (IMA) meeting arrangements was received. Note that information on IMC 6 in Jerusalem (23-28 August 1998) can be accessed from the MSA Home Page, <http://www.erin.utoronto.ca/soc/msa/>. Meredith reports that “the organizing committee is doing a wonderful job and the meeting will be an exciting one for international mycology. If you would like copies of the attractive poster for display, let me (Meredith Blackwell <bbblac@unix1.sncc.lsu.edu>) know and they will be mailed to you.” Also, the IMA is soliciting proposals for IMC 7 in 2002; the deadline is 1 May 1996.

10. Awards Committee Chair Dennis Desjardin delivered a gentle prodding for awards submissions. Dennis has done a superb job of publicizing our awards in a variety of publications.

11. A report from the Committee on Honorary Members was discussed.

12. Three issues pertaining to teaching were discussed. Amy Rossman introduced the issues of MSA membership in the Coalition for the Education about Environment, Agriculture, and Renewable Resources (CEEFAR) and a proposal from Gary Leatham to develop educational material and demonstration kits on fungi. Also, distribution of MSA teaching slides must be expedited. No action was taken due to the circumstances under which the meeting was conducted.

Addenda

i. Approved unanimously by Executive Committee by e-mail vote, 10 March 1996: expenditure to set up MSA Home Page. Estimated at $200.00 for student help in coding.

ii. Approved unanimously by Executive Committee by email vote, 13 March 1996: Endowment Committee Chair, Jeff Stone reported that 10 Travel Awards were fully funded. Last year we awarded 15. An additional 5 travel awards were approved to be funded from a transfer of $750.00 from the General Endowment (5 x $150. = $750.00 total). We will award 15 mentor travel awards in 1996.

iii. Approved by Council by email vote, 14 March 1996:

(a) $500.00 to pay registration fees for two symposium speakers (Annual Meeting, July 1996) who are not MSA members.

(b) The MSA will waive page charges for authors of invited papers (Annual Lecture and Reviews). Symposium papers require further discussion.

(c) The MSA, not the authors, will pay page charges for the Annual Lecture and Reviews to the Mycologia account.

Respectfully submitted by L. M. Kohn, MSA Secretary.

(Department of Botany, University of Toronto, Erindale College, Mississauga, Ontario L5L 1C6. Tel. 905-828-3997.)

---

**Mycological News**

**News of Mycologists**

**New name for CLBRR.** We, for many years, were BRI, then for the past few years it was CLBRR, as of April we are ECORC (Eastern Cereals & Oilseed Research Centre). The rest of the mail address is the same. My new email is: <ginnsj@em.agr.ca>. The same format applies for my colleagues here: Bissett, Barr, Babcock, Corlett, Dalpe, Seifert, Redhead. [Jim Ginns]

**Dennis Desjardin** received a Presidential Award from San Francisco State University for excellence in research. The award was a full semester release from teaching (Spring 1996). Dennis will be on sabbatical for academic year 1996–1997 working on the Agaricales of the Hawaiian Islands project and designing a new project to document the diversity of agarics and boletes from Indonesia in collaboration with Drs. Egon Horak and Mien Rifai.

**Richard Korf** reports that Emile Boudier’s Famous *Icones Mycologicae* are again available. The supply of the 1981–1982 four-volume reprint of Boudier’s *Icones Mycologicae*, long believed to have been lost, was recently discovered and rescued by a Swiss amateur mycologist, just prior to its planned destruction. He is now selling these. This reprint edition was published by Editions Piantanida Lausanne, in Switzerland and according to Korf, the reprint edition clearly...
A group of biologists from five countries and numerous branches of the biological sciences formed the Mesoamerican Society for Biology and Conservation in January 1996. The new society will serve biologists throughout Central America and southern Mexico by publishing a quarterly Spanish/English bulletin called Mesoamericana, and by sponsoring annual meetings in Mesoamerica. The first meeting of the new society is tentatively planned for June 1996. For further information contact Oliver Komar, Department of Zoology, Ohio Wesleyan University, Delaware 43015. 614-369-0175. <ookomar@cc.owu.edu>.

Union of Concerned Scientists Begins Sound Science Initiative: Participants Sought

The Union of Concerned Scientists has started a Sound Science Initiative that is designed to help scientists present accurate, credible information about global issues to the media and policy makers, and to counter misinformation about environmental science. They have developed a quick-response network on the Internet that allows participants to respond to fast-breaking political and media developments. The SSI seeks additional scientists who are willing to respond to alerts that appear on the network. Participants also monitor their local media and send SSI relevant clippings.

Participants also monitor their local media and send SSI relevant clippings. The SSI network focuses on four issues: biodiversity, climate change, ozone depletion, and population growth. A team of UCS staff monitors the media and policy making arenas and sends out electronic alerts providing scientifically sound analysis and reacting to misinformation. Participants receive guidance on monitoring the media and policy makers. They then take action on one or more of the four issue areas of their choice. In order for the network to be effective, each participant commits to respond to at least half of the alerts in his/her chosen area. The average number of alerts is one per month. "Responding" to an alert involves writing a letter, writing op-eds for newspapers, or becoming a "resource scientist" for local reporters; other responses might involve public speaking or talking with a policymaker. ASC serves as a source of information and occasionally asks its members to respond in similar ways on biodiversity issues, but the SSI program has more resources for monitoring and coordinating on a larger scale. We therefore think it would be useful for ASC members to be involved in the SSI program as appropriate to their interests, and to share information back with ASC (such as op-ed pieces that they produce).

If you are interested, you can receive more information on how to join by sending an e-mail message to <ljackson@uscsusa.org>. This network is available only to scientists who have an email address. If you decide to participate, please let us know, so that we can have an estimate of the activity of ASC members in this regard.

Media Opportunity

The National Public Radio program "Fresh Air", a personality interview show hosted by Terry Gross, is looking for guests who have devoted passion to a particular subject over a long period of time. Guests can be interviewed by phone with a local radio station that has a public station satellite hookup. Send a letter noting your unusual life, area of expertise, and a reason why the story is important at this time. If possible, include print and broadcast clips (VHS format). Contact the show's producer, Amy Salit, at WHYY-FM, 150 N. Sixth Street, Philadelphia, PA, 19106, 215-351-1242, for further information.
Calendar of Events

27–31 July, 1996. American Phytopathological Society/ Mycological Society of America, Indianapolis, IN. MSA program chair is Elwin Stewart. <els4@psu.edu>.

4–8 August, 1996. AIBS, Seattle, WA.

4–9 August, 1996. International Conference on Mycorrhizae, Berkeley, CA. Meetings and seminars will cover all aspects of mycorrhizal research. Preconference workshops and field trips are being planned for the period of July 31 though August 3rd, 1996.

If you would like to be placed on the mailing list for registration, housing, and abstract forms, please e-mail your name, address, telephone and FAX number to <ICOM@mendel.berkeley.edu>. By contacting ICOM directly by e-mail you can help save the cost of mailing the first circular, which simply repeats the information given here. Information will be periodically updated at the following World Wide Web site: <http://mendel.berkeley.edu/boletus/icom.html>. Contact: Dr. Tom Bruns, 108 Hilgard Hall, Dept. ESPM, Univ. Calif., Berkeley, CA, 94720-3110. Fax: 510-643-5098.

5–8 August 1996. 3rd Symposium of the International Working Group on Plant Viruses with Fungus Vectors (IWGPVFV), University of Dundee, Scotland. Papers and posters are invited on molecular biology of viruses with fungal vectors, virology and viral pathology, mycology of vector fungi, interaction between viruses and vectors, disease resistance, and epidemiology and management. Additional information about IWGPVFV and the August '96 meeting can be found on the Web page at <http://www.res.bbsrc.ac.uk/plantpath/Iwgpvfvr/>.


19-20 August 1996. The First Fungal Genome Workshop. Stillwater, Oklahoma. The workshop will highlight current research in biology, biotechnology and genome sciences as they are applied to filamentous fungi. The goal is to demonstrate the urgent need of large-scale DNA sequencing in the complex integration process of fundamental research with biotechnology and industry. The workshop will bring together investigators from academia and industry and the discussions will focus on genome technology applied to filamentous fungi. For program and registration information available on the Web at <http://www.okstate.edu/artsci/micro/ffgw/ffgw.htm> or contact: Darlene Brooks, Coordinator, Extension Programs, Arts & Sciences Extension, Oklahoma State University, Stillwater, OK 74078. Fax: 405-744-6992. <dbrooks@okway.okstate.edu>.


25–29 August 1996. 6th International Fungal Spore Conference. Konstanz, Germany. The conference will include topics such as fungal sporulation, spore germination, mating, spore release, spores in biotechnology. Persons wishing to organize small groups for research discussions or demonstration of techniques are welcome. Contact: Kurt Mendgen, Phytopathologie,Universitat Konstanz, Postfach 5560, D-78464 Konstanz, Germany.

25–29 August 1996. 8th International Congress for Culture Collections, “Culture Collections to Improve the Quality of Life,” Veldhoven, The Netherlands. Dr. Dirk van der Mei, Chairman, Organizing Committee. Contact: Secretariat ICCC-8, Centraalbureau voor Schimmelcultures, PO Box 273, 3740 AG Baarn, The Netherlands Phone: +31-2154-81211. Fax: +31-2154-16142. <iccc8@csbc.nl>.

29 August–September 1, 1996. NAMA/North East Mycological Fed. Foray, Ascutney Mountain Resort, Brownsville, VT. Contact: David W. Fischer, 343 Randolph St., Syracuse, NY 13205-2357. <xprtmshr@aol.com>.

30–31 August 1996. A Workshop to Discuss “Access to Microbial Genetic Resources Within The Framework of the Convention on Biological Diversity.” Organised by the World Federation for Culture Collections (WFCC) and the Forum of Industrial Microbiologists (FIM). The workshop will take place in Veldhoven, The Netherlands, immediately following the International Congress for Culture Collections (ICCC8). The aim of the workshop is to consider the implications of the Convention on Biological Diversity on access to microbial genetic resources, both from the point of view of the microbial resource centres and the user community. Information is available through the WFCC Web site, <http://www.wdcm.riken.go.jp/wfcc/wfcc.html>, or from Barbara Kir sop, WFCC Biodiversity Committee. Phone: 44 1778 570618. Fax: 44 1778 570175. <barbara@biostrat.demon.co.uk>.
1–7 September, 1996.  Progress and Problems in Lichenology in the Nineties (3rd International Association for Lichenology Symposium), Salzburg. Contact: Dr. Roman Türk, University of Salzburg, Institute of Plant Physiology, Hellbrunnerstr. 34, A-5020 Salzburg, Austria. Phone: +43 662 8044 5588. Fax: +43 662 8044 5010. <tuerk@edvz.sbg.ac.at>. WWW announcement at <http://www.sbg.ac.at/pfl/projects/lichen/index.htm>.

1–7 September 1996. Society for Invertebrate Pathology 29th Annual Meeting and 3rd Colloquium on Bacillus thuringiensis. Cordoba, Spain. Contact: Wendy Gelernter, Secretary, Soc. for Invertebrate Pathology, Phone: 619-272-9897. <pacenet@delphi.com>.

16–20 September, 1996. First World Congress On Allelopathy, A Science For The Future will be held in Cadiz, Spain. Information available at <http://www2.uca.es/dept/quimica_organica/allelopathy.htm>. [posted on MSA Bulletin Board; Editor has no additional information]

23–26 October 1996. 2nd Latin American Congress of Mycology, Havana, Cuba. Contact: Lic. Mayra Camino, Jardin Botanico Nacional, Carretera del Rocio Km 3 1/2, C.P. 19230, Calabazar, Boyeros, C. Habana, Cuba. Fax: (53-7) 33-5350. <hajb@ceniai.cu> or Dr. Rolando Tapanes, Inst. Medicina Tropical "Pedro Kouri," Apartado 601, Marianao 13, C. Habana, Cuba. <ciipk%infomed.sld.cu@gn.apc.org>.


13–14 October 1996. The Taxonomic Databases Working Group (TDWG) Annual Meeting and Symposium will take place on at the Vascular Plant Herbarium (TRT), Royal Ontario Museum, Toronto, Canada. For additional program information contact either: Timothy Dickinson, Vascular Plant Herbarium (TRT), Center of Biodiversity and Conservation Biology, Royal Ontario Museum, 100 Queen's Park, Toronto, Canada M5S 2C6. Fax: 416-586-5516. <timd@rom.on.ca> or TDWG Secretariat, Real Jardin Botanico - CSIC, Plaza de Murillo 2, 28014 Madrid, Spain, Fax: +34 (1) 420-0157. <pando@ma-rrj.csic.es>.

29–31 October 1996. The First International Fusarium Biocontrol Workshop, Beltsville, MD. Sponsored by the Beltsville Agricultural Research Center, Biocontrol of Plant Diseases (BPDL) and Systematic Botany and Mycology (SBML). A complete range of topics concerned with biological control of diseases caused by Fusarium spp. and use of F. oxysporum as a mycoherbicide will be discussed from exploitation and biosystematics to host-parasite interactions/molecular biology to development/implementation. Each session will consist of a core program of informal keynote presentations supported by short contributed presentations, comments, and discussion. The program will be flexible so that more time can be devoted to a particular topic if needed. For information or registration, please contact: Robert D. Lumsden, Research Leader, Biocontrol of Plant Diseases Laboratory, Plant Sciences Institute, Bldg. 01A, Room 275, BARC-West, 10300 Baltimore Avenue, Beltsville, MD 20705 USA.

1997 (January 29–31). Federal and International Scientific Permits: A Workshop for Natural History Museums and Collectors, San Diego, California. Sponsored by the San Diego Natural History Museum and the Association of Systematics Collec-tions. Contact: Sally Shelton, Director, Collections Care and Conservation, San Diego Natural History Museum, P.O. Box 1390, San Diego, California 92112 Phone: 619-232-0248. <libsdnhm@class.org>. Note that the date of the workshop, which was originally scheduled for 25–27 September 1996, has been changed.

1997 (February 13–18). AAAS, Seattle, WA.

1997 (March 18–23), The 18th Fungal Genetics Meeting, Asilomar, CA. Contact: Dr. N. Louise Glass, Biotechnology Laboratory, University of British Columbia, Vancouver, B.C. V6T 1W5 Canada; <glass@unixg.ubc.ca>. Fax: 604 822 6097 or to Dr. Michael J. Hynes, Department of Genetics, University of Melbourne, Parkville, Vic. 3052 Australia; <hynes_lab@muwayyf.unimelb.edu.au>. Fax: 613 9344 5139.

1997 (August 3–7). AIBS/Mycological Society of America, Montreal, Quebec. MSA program chair is Steve Miller.


1998 (August 23–28), 6th International Mycological Congress, Jerusalem. The Council of the British Mycological Society invites constructive suggestions on the format for IMC6. Comments received will be collated by the General Secretary and forwarded to Professor Margalith Galun, Organizer of IMC6. Comments should be sent to the Society’s General Secretary, Dr. Stephen Moss, School of Biological Sciences, University of Portsmouth, King Henry 1 Street, Portsmouth, Hampshire, PO1 2DY.


Read the Mycological Classifieds for announcements of courses, employment opportunities, positions wanted, and mycological goods and services offered or needed.

Funding Opportunities

1997-98 Fulbright Awards for U.S. Faculty and Professionals. Opportunities for lecturing or advanced research in over 135 countries are available to college and university faculty and professionals outside academia. U.S. citizenship and a Ph.D. or comparable professional qualifications are required. For lecturing awards, university or college teaching experience is expected. The deadline for lecturing or research grants for 1997–98 is August 1, 1996 and for Fulbright seminars for international education and academic administrators (November 1). Contact USIA Fulbright Senior Scholar Program, Council for International Exchange of Scholars, 3007 Tilden Street, N.W., Ste 5M, Box GNEWS, Washington, DC 20008-3009. Phone 202/686-7877. Web Page (on-line materials): <http://www.cies.org>. Application materials may be requested by e-mail from <ciesl@ciesnet.cies.org>.

Mycological Goods and Services

Mold Identification Services. We identify molds and other fungi for industry, agriculture and academia. Information is available via e-mail at <microbe@pioneer.net> or by writing Cascade Research Associates & Abbey Lane Laboratory, P.O. Box 1665, Philomath, OR 97370. [Steven Carpenter]

The Outdoor Bookstore has a new list of mycology books in our latest online catalog of out-of-print natural history books. They can be viewed at <http://www.outdoorbooks.com>.

Positions Available

The Agricultural Research Service (Beltsville, MD) is seeking a Research Plant Pathologist/Zoologist/Biochemist to conduct research on the interactions of plant-parasitic nematodes and fungal biocontrol agents of nematodes. Work will include determining the molecular basis for the antagonism of specific fungi, including Verticillium lecanii, to root-knot and cyst nematodes and developing bioassays for evaluation of the effects of purified compounds against nematodes. Candidate must have a knowledge of nematodes and/or fungi, and a knowledge of biochemical analysis methods, including skill with chromatographic isolation and with identification of natural products. Ph.D. is required. GS-11/12 salary is commensurate with experience, beginning at $37,094 per annum. For further information and application procedures, contact: Dr. David Chitwood or Dr. Susan Meyer, USDA, ARS, Nematology Laboratory, Building 011A, Room 165B, BARC-West, Beltsville, Maryland 20705. Phone: 301-504-5660. Fax: 301-504-5589. <dchitwoo@asrr.arsusda.gov>. An Equal Opportunity Employer.

Postdoctoral Fellowship, Population Genetics of Medical Fungi. A postdoctoral position is available immediately on a project to investigate the population genetics of Candida albicans, C. neoformans, and related medical fungi. The research will involve the generation, sequencing, and mapping of genotypic markers. Inquiries should be addressed to either T. G. Mitchell, Dept. of Microbiology, Duke University Medical Center, Durham, NC 27710, Phone: 919-684-5792, Fax: 919-682-8911, <tgm@rpiv.mc.duke.edu> or to R. Vilgalys, Dept. of Botany, Duke University, Durham, NC 27708, Phone: 919-684-2870, Fax: 919-684-5412, <fungi@acpub.duke.edu>. Duke is an equal opportunity employer.

Postdoctoral Position: A postdoctoral position is available to study fungal pathogenesis and/or quantitative genetics using genetic and molecular approaches with Saccharomyces cerevisiae as a model system. Extensive molecular biology expertise is required and experience with yeast or other fungal genetic systems is desirable. Duke is an EOAAE. Please send curriculum vitae with three references to: Dr. John H. McCusker, Dept. of Microbiology, 3020, Duke University Medical Center, Durham, NC 27710. Phone: 919-681-6744. Fax: 919-684-8735. <mccusker@abacus.mc.duke.edu>

Graduate Assistantship in Fungal Molecular Biology. West Virginia University, Morgantown. Research: Molecular genetics of ergot alkaloid biosynthesis by plant-pathogenic or mutualistic fungi; research could be approached from a molecular structure-function angle, or more from a plant-fungus interaction angle. Student may enroll in one of three curricula: Genetics, Plant Pathology, or Environmental Microbiology. Assistantship at $9000 for M.S. level and $10,500 for Ph.D. level includes full
tuition waiver. Direct entry from B.S. to Ph.D. program is only possible in Genetics program. Entry date: July 1, 1996, August 16, 1996, or Jan. 1, 1997. Interested students should send brief description of research, interests and experience, and request for application materials (by any means) to: Dr. Daniel Panaccione, West Virginia University, 401 Brooks Hall – P.O. Box 6057, Morgantown, WV 26506-6057.

Wyeth-Ayer division of American Home Products (formerly Lederle Laboratories of American Cyanamid) in Pearl River, NY is looking for a fungal biologist to run a fungal screening program.

Contact: Beth Cunningham at Excaliber Human Resources. 1-800-922-5427 ext. 22. Fax 717-629-575. Hiring Manager is Bill Mays.

## Publications Available

**Boudier's Icones Mycologicae.** The complete 5-volume reprint is available at 800 Swiss francs, plus postage and handling. (When issued, the 1985 price was 1750 Swiss francs.) Postage for the set will cost between 43 and 127 francs, depending on postal zones, while handling charges now run 8 francs. Since many libraries that possess the original 1904-1911 edition lack the material of the important fifth volume, that volume may be ordered alone, at 75 Swiss francs. Single volumes 1 through 4 are 180 Swiss francs. Postage for single volumes runs between 22 and 39 francs at current rates. If your institutional library is lucky enough to have the original printing, be sure they also order volume 5 of the reprint. If they don’t have the original, do all you can to get them to order the whole set! To order, please contact Mr. R. Morier-Genoud, Av. Senal=E8che 23a, CH-1009 Pully, Switzerland. He can be reached by fax at 41-21-320-09-06. He accepts checks or bank transfers, but not credit cards.

**Mycotaxon.** Vols. 1–37, excellent condition, $350.00 or best offer plus shipping. Call 352-372-6809.

**Assorted mycological books,** $5.00 and up. Call 352-372-6809 for more information and/or list.

## Change of Address

Allen Press now handles such MSA membership services as maintaining the MSA mailing list, preparing mailing labels, and processing membership applications and renewals. Send all corrections of directory information, including e-mail addresses, directly to Allen Press. MSA’s contact at Allen Press, Karen Hickey, can by reached by any of the following:

- **Mycological Society of America**
  - phone: 800-627-0629 (U.S. and Canada) 913-843-1221
  - fax: 913-843-1274
  - e-mail: khickey@allenpress.com

**Note:** A copy of the directory is on the World Wide Web <http://nt.ars-grin.gov/>. A form is included and members may submit corrections to the directory which will be forwarded to Allen Press.
MSA Endowment Funds

Contributions

I wish to contribute $__________ to the following named fund(s):

Mentor Travel Funds:

___ Alexopoulos
___ Barksdale/Raper
___ Bigelow
___ Butler
___ Denison
___ Fitzpatrick
___ Fuller
___ Korf
___ Luttrell
___ Thiers

Research Funds:

___ Backus Graduate Award
___ Martin-Baker
___ A. H. and H. V. Smith Award

Other Funds:

___ Alexopoulos Prize
___ Uncommitted Endowment
___ Other (specify)

I wish to pledge $__________ a year for _______ years

___ to the following fund(s):

___ to the uncommitted endowment, or
___ to some other specified purpose:

Name and Address:

________________________________________

________________________________________

________________________________________

___ Check

___ Credit Card Type (Visa, Mastercard, etc.):

Credit Card No.: ________________________ Exp. Date: __________

Signature: ________________________________

Please send completed form and your contribution to:

Dr. Jeffrey Stone, Chair, MSA Endowment Committee
Department of Botany and Plant Pathology, Cordley 2082,
Oregon State University, Corvallis, OR 97331-2902
SUSTAINING MEMBERS
OF THE MYCOLOGICAL SOCIETY OF AMERICA

The MSA is extremely grateful for the continuing support of its Sustaining Members. Please patronize them and, whenever possible, let their representatives know of our appreciation.

Amgen Incorporated
Dr. Daniel Vapnek, Amgen Center
Thousand Oaks, CA 91320-1789
Biopharmaceutical research and development.

Amycel – Spawn Mate
P.O. Box 189
Watsonville, CA 95077-0189
Producers of quality Agaricus and specialty mushroom spawn, compost nutrient supplements and other technical services for commercial mushroom production.

Carolina Biological Supply Company
2700 York Road,
Burlington, NC 27215
Serving science education since 1927.

DuPont Company
Science and Engineering Laboratories
Life Sciences Division, E402/2231,
Wilmington, DE 19880-0402

field & forest products, inc.
N3296 Kosauzek Road,
Peshtigo, WI 54157
Producers of specialty mushroom spawn.

Fungi Perfecti
P.O. Box 7634, Olympia, WA 98507
phone 206-426-9292, fax 206-426-9377
Innovators in the domestication of wild edible fungi. Paul Stamets, President.

Janssen Pharmaceutica
P. O. Box 200,
Titusville, NJ 08560-0200

Lane Science Equipment Co.
225 West 34th Street, Suite 1412,
New York, NY 10122-1496
Complete line of mushroom storage cabinets, especially herbarium cabinets, airtight for permanent protection.

Merck Research Laboratories
Merck & Co., Inc.,
Rahway, NJ 07065-0900

Myco Pharmaceuticals Inc.
Suite 2200
One Kendall Square
Cambridge, MA 02139
Pharmaceutical development from a comprehensive base of mycology, fungal genetics, and chemistry.

Mycotaxon, Ltd.
P.O. Box 264, Ithaca, NY 14851
Publishers of Mycotaxon, an international journal of the taxonomy and nomenclature of fungi and lichens.

Mycosearch, Inc.
Five Oaks Office Park, Suite 6,
4905 Pine Cone Drive,
Durham, NC 27707

Pfizer, Inc.
Central Research Div., Eastern Point Rd.
Groton, CT 06340
Fine chemicals and pharmaceuticals by means of microorganisms.

Phillips Mushroom Farms
P.O. Box 190
Kennett Square, PA 19348 USA

Pioneer Hi-Bred International, Inc.
Attn: Dr. James A. Berry
Plant Breeding Division
P.O. Box 1004
Johnson, Iowa 50131-1004
World leader in genetic research for agriculture.

Rohm and Haas Co.
Research Laboratories, Dr. Willie Wilson
727 Norritown Road,
Spring House, PA 19477
Specialty monomers, industrial biocides, and agricultural chemicals.

Sandoz Pharma Ltd.
c/o Dr. M. M. Dreyfuss
Bldg. 506, Rm 402, Biotechnology
CH-4002 Basel, Switzerland

Schering-Plough Research Institute
2015 Galloping Hill Road,
Kenilworth, NJ 07033-0539
Pharmaceutical research and development.

Sylvan Spawn Laboratory, Inc.
Dr. R. W. Kerrigan, Dir. of Research
Research Department
1163 Winfield Road
Cabot, PA 16023
Specialists in the large-scale production of pure fungal inocula for the biotechnology and commercial mushroom industries, West Hills Industrial Park, Kittanning, PA 16201.

Triarch Incorporated
Ripon, WI 54971
Quality prepared microscope slides, catalog-listed, or custom-prepared to your specifications.

Uniroyal Chemical Company, Inc.
70 Amytal Road, Bethany, CT 06525
Producers of crop protection/production chemicals; fungicides, insecticides, miticides, herbicides, plant growth regulators, and foliar nutrients.

Upjohn Company
c/o Joyce Cialdella 7295-25-228
Chemical & Biological Screening
Kalamazoo, MI 49001

Warner-Lambert Company
Pharmaceutical Research Division,
2800 Plymouth Road,
Ann Arbor, MI 48106-1047

You are encouraged to inform the Sustaining Membership Committee of firms or foundations that might be approached about Sustaining Membership in the MSA. Sustaining members have all the rights and privileges of individual members in the MSA and are listed as a Sustaining Members in all issues of Mycologia and Inoculum.
An Invitation to Join MSA
THE MYCOLOGICAL SOCIETY OF AMERICA
1996 MEMBERSHIP FORM

(Please print clearly)

Last name: ____________________________ First name: ____________________________ M.I.: __________

Dept./Street: ________________________________

Univ./Organization: ________________________________

City: __________________ State/Prov.: ____________ Country: ___________ ZIP: __________

Telephone: (___) _______ E-mail: __________________________ Fax: (___) _______

MSA member endorsing application:

Name (printed) ____________________________ Signature ____________________________

TYPE OF MEMBERSHIP

___ Regular $60 (includes Mycologia and MSA newsletter, Inoculum)

___ Student $30 (includes Mycologia and MSA newsletter, Inoculum) (needs endorsement from major professor or school)

___ Family $60 + $30 for each additional family member (fill out form for each each individual) (includes one copy of Mycologia and two copies of Inoculum)

___ Sustaining $250 (benefits of Regular membership plus listing in Mycologia and Inoculum)

___ Life $1,000 (one-time payment; includes Mycologia and Inoculum)

___ Associate $30 (includes only Inoculum)

___ Emeritus $0 (benefits of Regular membership except Mycologia; $30 with Mycologia)

AREAS OF INTEREST: [Mark most appropriate area(s)]

___ Cell Biology – Physiology (including cytological, ultrastructural, metabolic regulatory and developmental aspects of cells)

___ Ecology – Pathology (including phytopathology, medical mycology, symbiotic associations, saprobic relationships and community structure/dynamics)

___ Genetics – Molecular Biology (including transmission, population and molecular genetics and molecular mechanisms of gene expression)

___ Systematics – Evolution (including taxonomy, comparative morphology molecular systematics, phylogenetic inference, and population biology)

PAYMENT:

___ CHECK [Payable to The Mycological Society of America and drawn in US$ on a US bank]

___ CREDIT CARD: ___ VISA ___ MASTERCARD

Expiration Date: ____________________________

Account No.: ____________________________

Name as it appears on the card: ____________________________

Mail membership form and payment to:
Mycological Society of America
Attn: Karen Hickey
P.O. Box 1897
Lawrence, KS 66044-8897
phone: 800-627-0629
913-843-1221
fax: 913-843-1274
METABOLISM OF PHENANTHRENE BY MARINE FUNGI. Carmen Acevedo-Rios, Paul Bayman, and Yaitza Maldonado, Dept. of Biology, University of Puerto Rico-Rio Piedras, Box 23360, San Juan, PR 00931.

Contamination of coastal areas by petroleum and its derivates is a problem in Puerto Rico. Bioremediation by bacteria and terrestrial fungi is used to restore polluted soils; however, these organisms are not adapted to marine environments. Marine aenicolous and lignicolous fungi are adapted to this environment and may be able to degrade polycyclic aromatic hydrocarbons. In this study, fungi from two oil-contaminated coastal areas were isolated, including Corollospora, Lulworthia, Torpedospora and Lignicola. Once grown, phenanthrene was added to the liquid cultures. Metabolism of phenanthrene was determined by UV spectrophotometry and HPLC. Fungi metabolized phenanthrene at different rates and produced different metabolites.

THREE SPECIES OF LEPIOTA SENSU LATO SYNONYMOUS WITH LEUCOagaricus Hortensis. Brian P. Akers and Walter J. Sundberg, Department of Plant Biology, Southern Illinois University at Carbondale, Carbondale IL 62901-6509.

Three species of Lepiota sensu lato, described as new from Florida in 1943, have been determined to be synonyms of Leucoagaricus hortensis (Murr.) Pegler, originally described from Alabama in 1914. These three species are: L. humei Murrill, L. subfulvidisca Murrill, and L. mammillata Murrill. This conclusion was based upon comparative study of the types, and other collections determined by Murrill, of all four taxa. Morphologically, this species features an excoriating pileus cuticle, and a well-developed, double-edged, membranous annulus. Anatomically, it is characterized by abundant, long, thin cheilocystidia; bisporic basidia; a subhymeniform pileipellis with oleiferous hyphae forming an epicuticular mat at the disc; and fairly large, ovoid to elliptical basidiospores which are dextrinoid and metachromatic, and lack an apical pore as viewed under light microscopy.

BLIGHT INTRODUCTION INTO NORTH AMERICA, AND BIOLOGICAL CONTROL BY HYPOVIRULENCE VIRUSES. Sandra L. Anagnostakis, The Connecticut Agricultural Experiment Station, Box 1106, New Haven, CT 06504.

The chestnut blight fungus, Cryphonectria parasitica, came into the US on imported Japanese chestnut trees in the late 1800's. Native chestnuts, Castanea dentata and C. pumila, are easily killed by the cankers of this wound pathogen, but continue to sprout from the root collars. A disease of the blight fungus, caused by cytoplasmic, dsRNA viruses, makes C. parasitica hypovirulent. Biological control based on hypovirulence works well in an orchard, and new transgenic, hypovirulent strains may allow the biological control to succeed in the forest.

ECOLOGICAL ESSENTIALS IN BIOCONTROL. John H. Andrews, Plant Pathology Department, University of Wisconsin, 1630 Linden Dr., Madison, WI 53706.

From an industry perspective, the ideal biocontrol agent (BCA) is consistently effective, compatible with existing agricultural technology, and of high market potential and low environmental/health risk. The search for BCAs with more or less of the above characteristics can be guided by ecological theory as opposed to empiricism. Unfortunately, there are no simple principles that predict the success of BCAs any more than there are any ecological principles that forecast invasion of communities by exotic or indigenous colonists. Likewise, neither successful BCAs nor successful invaders share an inclusive group of characteristics. Thus, the challenge for theory is to be specific enough to be useful while remaining generalizable. For example, niche relationships, including preemptive colonization, density dependent regulation, and competitive dominance are generally important, yet frequently the decisive traits or mechanisms remain elusive or are counterintuitive. Ecological theory can be instructive, e.g. in decisions about what kinds of BCAs to look for and where, but specific information can only come from detailed studies in nature on a case by case basis.

BIOREMEDIATION POTENTIAL OF AN UNDESCRIBED SPECIES OF LEPTOGRAPHIUM. T. M. April, J. M. Foght, and R. S. Currah, Dept. of Biological Sciences, University of Alberta, Edmonton, Alberta T6G 2E9, Canada.

A sample of oily soil from a 30-year-old flare pit located in the foothills of west central Alberta was the source of a strain of an undescribed species in the genus Leptographium (Hyphomycetes) in 1994. The fungus is characterized by mono- and macronematous conidiophores, 160-225 μm in length, which give rise to slimy masses of bacilliform (9 x 2.5 μm) and pyriform (6 x 3 μm), single-celled conidia. Conidiogenous cells are annellate. Sensitivity to high concentrations (>100 ppm) of cycloheximide indicates an affinity with the genus Ceratocystis. This organism can grow on media in which 10W-30 motor oil or Prudhoe Bay Crude (PBC) is the sole carbon source. Gas chromatographic analyses indicate that the isolate can actively degrade both n-alkanes and polycyclic aromatic hydrocarbons. This is particularly interesting, as oil-degrading species generally tend to exhibit a substrate preference for either saturates or aromatics, but not both. Several additional isolates have been
obtained from flare pits in British Columbia and elsewhere in Alberta, indicating that it may be widespread and well-adapted to an unusual niche.

THE CYTOPLASMIC PROTON CONCENTRATION INFLUENCES HYPHAL TIP GROWTH AND CYTOSKELETON-RELATED ORGANIZATION. Catherine Bachewich and I. Brent Heath, Department of Biology, York University, 4700 Keele Street, North York, Ontario M3J 1P3, Canada.

We have investigated the potential of protons as regulatory effectors in tip growth by using membrane permeant weak acids to acidify the intracellular pH in hyphae of the oomycete Saprolegnia ferax. Acetic, propionic and isobutyric acids decreased the cytoplasmic pH and reduced hyphal growth in a dose dependent manner. Growth reductions were accompanied by changes in the positioning and morphology of mitochondria and nuclei, condensation of chromatin, and disruptions of peripheral actin. The alterations were reversible, with extreme cytoplasmic movements and apical vacuolizations taking place during recovery. Despite probable technical problems, measuring intracellular pH with ratio imaging of the pH-sensitive dye SNARF-1 indicated an overall decrease in pH with weak acid treatment, but little difference in proton concentrations along the lengths of individual growing hyphae. In the absence of a macroscopic proton gradient, transients or microenvironments of differing proton concentrations may be functional. These results suggest an important effector role for protons in regulation of tip growth, most prominently via the cytoskeleton.

BIOCONTROL APPROACHES FOR ENDOPHYTIC FUNGI OF GRASSES. C. W. Bacon, USDA, ARS, Russell Research Center, P.O. Box 5677, Athens, GA 30613.

Major forage and turf grasses have a wide number of heritable fungal symbionts (Neotyphodium, Epichloë, and Balansia species) that improve fitness and persistence of the host plants. Because of this characteristic, grass endophytes have the potential for becoming the most widely used biological control agents. Because this developed out of a series of studies designed to determine cattle toxicity, the more problematic aspect of these associations. These studies have developed into a large area of biocontrol where endophytes are being used for increased persistence, insect tolerance, and herbage yield. The potential benefits and failures of grasses endophytes will be discussed, as well as some research areas that should help in solving problems resulting from their uses.

A CLUSTER OF RELATED SPECIES AROUND PYTHIUM IRREGULARE BASED ON THE SS rRNA SPACER. M. Balcerzak, A.W.A.M. de Cock*, and G. R. Klassen, Dept. of Microbiology, University of Manitoba, Winnipeg, MB R3T 2N2; and *Centraalbureau voor Schimmelcultures, Julianalaan 67, 2628 BC, Delft, Netherlands.

Probing of genomic DNA from Pythium irregulare, P. paroecandrum, P. spinosum, P. mamillatum, P. kunmingense, and P. cylindrosporum with the SS rRNA spacer from any of these species results in a hybridization signal not observed from about 90 other species of Pythium. The SS spacers were partially sequenced and RFLP data was obtained from amplification products. The results, when compared with P. sylvaticum and other outgroup possibilities, confirm a close relationship.

DIFFERENCES BETWEEN ISOLATES OF LAETIPORUS SULPHUREUS IN THE INTERNAL TRANSCRIBED SPACER REGION OF THE NUCLEAR RIBOSOMAL DNA. M. T. Banik, H. H. Burdsall, Jr., and T. J. Volk, USDA Forest Products Laboratory, One Gifford Pinchot Dr., Madison, WI 53705.

Tissue isolates from more than 100 collections of Laetiporus sulphureus (Fr.) Murr. from throughout the United States were analyzed for variation in a region of the internal transcribed spacer (ITS) of the nuclear ribosomal DNA. The area was amplified using primers ITS 4 and ITS 5 in a polymerase chain reaction (PCR). The PCR products were of uniform size and were digested with six restriction endonucleases. Analysis of the resulting restriction fragment length polymorphisms (RFLPs) separated the isolates into six groups. The fruiting bodies associated with the isolates within each group shared many morphological and ecological characteristics. Yellow-pored northern collections from hardwoods, yellow-pored western collections from conifers, white-pored northern collections fruiting from roots and white-pored southern collections fruiting on trunks each yielded isolates that belonged to four, mutually exclusive RFLP groups. The remaining two groups are not as common and are less distinctive. The RFLP results may be indicative of reproductive isolation between L. sulphureus populations.

A MODIFIED VESICLE SUPPLY CENTER DESCRIBES THE GROWTH AND TAPERED SHAPE OF HYPHAL TIPS OF ACHLYA AND SAPROLEGNIAS. S. Barnicki-García, G. Gierz, and E. Lippman, Departments of Plant Pathology, and Mathematics, University of California, Riverside, CA 92521.

Video microscopy and image analysis were used to study hyphal tip morphology on the periphery of colonies of two fungi lacking Spitzenkörper (Spk): Saprolegnia monoica and Achlya bisexualis. In the Spk-bearing hyphae of higher fungi, shape follows closely that of the hyphoid equation y = x cot (x/VN). Accordingly, shape is generated by the release of wall-building vesicles from a linearly advancing Spk acting as a vesicle supply center (VSC). Although hyphae of saprolegniaceous fungi can display hyphoid shapes, their tips have generally a more conical shape--an indication of a more gradual decline in the gradient of apical growth, with a corresponding change in the pattern of discharge of wall-building vesicles. We have simulated the growth of these pointed hyphae by elongating their VSCs. The morphology of these conoid hyphae can be expressed mathematically by a generalized hyphoid equation that describes shapes produced from VSCs of different lengths. We propose that a key factor regulating hyphal shape of fungi is the state of the VSC: a highly condensed VSC would produce a hyphoid shape; elongation of the VSC would yield conoid hyphae with increasingly tapered tips.
PHYLOGENETIC DISTRIBUTION OF PATHOGENICITY.
M. L. Berbee, Department of Botany, Univ. of British Columbia, Vancouver, BC V6T 1Z4, Canada.

In this talk, I will review the taxonomic and phylogenetic distribution of plant and animal pathogenic fungi. Animal and plant pathogens occur in all three major groups of terrestrial fungi. Many of the significant human pathogens, such as the fungi causing athlete’s foot, aspergillosis and coccidiodomycosis, are ascomycetes and more specifically, plecomycetes. Numerous plant pathogens are also ascomycetes but the pathogens are concentrated in the pyrenomycetes or loculoascomycetes rather than in the plecomycetes. Obligate plant pathogens such as smuts and rusts are basidiomycetes. In some cases, closely related fungi attack both plants and humans. For example, the Dutch Elm Disease fungus that devastated North American elm trees and the fungus causing the human disease sporotrichosis are both phylogenetic members of the genus *Ophiostoma*. Phylogenetic trees from 18S rRNA gene sequences suggest that some plant pathogenic lineages originated earlier and lasted much longer than animal pathogenic lineages.


The filamentous fungus *Magnaporthe grisea* causes a devastating rice disease, rice blast. *M. grisea* grows biotrophically inside the plant, making up to 10% of the plant biomass within 72 h of infection. Rice blast disease is a model system to study host-pathogen interactions. An analysis of defense response genes induced in rice upon infection by *M. grisea* could elucidate some of the mechanisms underlying pathogenesis and host resistance. We have isolated several blast-induced transcripts (BITs) by subtractive hybridisation from a *M. grisea* infected rice leaf cDNA library. Sequence analysis of 15 of these BITs revealed homologues to known defense genes: pathogenesis related (PR) proteins, cysteine proteinases and cell wall structural proteins. Other BITs appear to have no homology to any known genes. We are currently studying the expression of two of the PR genes in compatible and incompatible host backgrounds. We are also looking at the effect of compounds such as jasmonic acid and salicylic acid on inducing resistance in rice against *M. grisea*.

CHARACTERIZATION OF FGL1 AND FGL2: TWO GALECTINS ISOLATED FROM THE BASIDIOMYCETE COPRINUS CINEREUS. Rob Boulianne, Stacy Charlton, and Benjamin Lu, Molecular Biology and Genetics, University of Guelph, Guelph N1G 2W1, Canada.

Two galactose binding lectins (galectins) isolated from the mushroom *C. cinereus* have been characterized. Elution of total protein extracts from a lactosyl sepharose column identified two galectins, Fgl1 and Fgl2 (Fungal galectins 1 and 2) of 15.3 and 16.8kDa respectively. The cDNAs of Fgl1 and Fgl2 each code for a 150 amino acid protein sharing 82.7% identity at the amino acid level, 92.7% with conservative changes. Comparisons between genomic and cDNA sequences indicate the presence of non-transcribed regions immediately 3’ from the termination codons of both genes, and a 5’ non-transcribed region upstream from the start codon of Fgl1. Fgl1 and Fgl2 are linked, separated by approximately 1.5kb. Sequence comparisons indicate that Fgl1 and Fgl2 are related to a family of mammalian galectins (L-14). Like the family of L-14 galectins, Fgl1 and Fgl2 are developmentally regulated. In *C. cinereus*, Northern and Western blotting indicate they are not expressed in the mycelium, but are only expressed during fruiting body development.


*Tilletia fusca* is a species complex infecting species of *Bromus, Festuca* and *Vulpia*. A *Tilletia* sp. (TA) that infects *Apera interrupta* in Washington is closely related to this group based on teliospore morphology and reproductive compatibility. However, *Apera* is not a known host for the *T. fusca* complex. *Tilletia separata*, a morphologically similar European species infecting *A. spica-venti*, has not been reported from North America or on *A. interrupta*. Teliospores of *T. separata* are paler brown than those of either *T. fusca* or TA. Four isolates of TA were compared to 16 isolates of the *T. fusca* complex using restriction fragment length polymorphism of the ITS region (RFLP-ITS) and random amplified polymorphic DNA (RAPD). Results of RFLP-ITS analysis showed a distinctive pattern for TA isolates. UPGMA analysis of RAPD data showed low levels of similarity between the TA isolates and fescue-infesting isolates (10%) and a slightly higher level of similarity with the brome-infesting isolates (30%) of *T. fusca*. Comparison of TA isolates and *T. separata* using SEM and RFLP-ITS analysis is underway to confirm the identity of the *Apera interrupta*-infecting bunt.

SPATIAL DISTRIBUTION OF ARMILLARIA GENETS IN THE WALKER BRANCH WATERSHED THROUGHFALL DISPLACEMENT EXPERIMENT, TENNESSEE, USA. J. N. Bruhn¹, J. A. Brenneman², J. J. Wetteroff Jr.¹, and T. D. Leininger³, ¹University of Missouri, Columbia, MO 65211; ²University of Evansville, Evansville, IN 47722; and ³USDA Forest Service, Southern Hardwoods Laboratory, Stoneville, MS 38776.

Armillaria genets were mapped on the Throughfall Displacement Experiment (TDE) using basidio and rhizomorph collections made in 1994 and 1995. Initiated in July 1993, the TDE consists of three contiguous 80 x 80 m plots. The ambient plot receives natural precipitation; the wet plot also receives 33% of throughfall from the dry plot. The dry plot also had lower treatment mean soil water content. Isolates from 36 rhizomorph collections and 48 basidio collections of *A. gallica* and 21 basidio collections of *A. mellea* represented 6 *A. gallica* genets and 17 *A. mellea* genets. Only 3 of the 84 *A. gallica* collections and 1 of the 21 *A. mellea* collections were obtained in the dry plot. The two largest *A. gallica* genets occupy most of the wet and ambient plots and overlap each other very little. Most of the 17 *A. mellea* genets were represented by single collections.

1996 MSA Abstracts, page 3
throughout the wet and ambient plots. At least 9 *A. mellea* genets occur within the boundaries of the two largest *A. gallica* genets. *Armillaria* spp. interactions with each other and with the TDE treatments are under study.

TRANSFORMATION OF MAGNAPORTHE POAE WITH THE GUS GENE AND HISTOLOGY OF INFECTION OF *POA PRATENSIS* ROOTS AT SEVERAL TEMPERATURES. T. E. Bunting and B. B. Clarke, Department of Plant Pathology, Rutgers University, Foran Hall, P.O. Box 0231, New Brunswick, NJ 08903-0231.

*Magnaporthe poae* causes summer patch disease of *Poa* spp. and some *Festuca* spp. during hot summer conditions (daytime temperatures >28°C). In addition the fungus grows most rapidly at temperatures above 28°C in vitro. It is unclear however, to what extent infection occurs at temperatures below 25°C. The infection process on *Poa pratensis* roots at 16°C, 20°C, 25°C, and 30°C is being examined histologically using *M. poae*. To aid in infection studies, *M. poae* was transformed with the GUS expression gene which will allow easy visualization of the fungus in the root.

ANALYSIS OF METALAXYL RESISTANCE IN PHYTOPHTHORA INFESTANS USING AN mRNA DIFFERENTIAL DISPLAY. Britt A. Bunyard, Paul W. Tooley, and Marie Carras, USDA-ARS, Bldg. 1301, Ft. Detrick, Frederick, MD 21702.

Late blight, the most economically-important disease of potato, is caused by the Oomycete *Phytophthora infestans*. Recently, increased genotypic variation (as a possible result of dissemination of the A2 mating type) worldwide, in addition to widespread use of metalaxyl, has led to increased resistance to this fungicide in populations of *P. infestans*. The goal of this work is to develop a rapid test for the detection, as well as the characterization of metalaxyl resistance isolates of *P. infestans*. In an effort to characterize the gene(s) conferring metalaxyl resistance, total RNA was isolated from isolates of *P. infestans* resistant (met-R) and sensitive (met-S) to metalaxyl. cDNA was synthesized by reverse transcription of isolated RNA. Differentially expressed cDNA subpopulations were identified by differential display PCR (ddPCR) amplification using custom made primers, followed by gel electrophoresis. Products of ddPCR were used as Southern hybridization probes to confirm their presence within the genome of met-R (but not met-S) *P. infestans*.

NEW LIGNICOLOUS PYRENOMYCETE RECORDS FROM HARDWOODS IN BRITISH COLUMBIA. B. E. Callan, Canadian Forest Service, Pacific Forestry Centre, 506 West Burnside Rd., Victoria, BC V8Z 1M5, Canada.

Recent provincial surveys for pathogenic fungi associated with poplars and other hardwoods have resulted in new and unusual host-fungus and distribution records. These records significantly extend the known range of some pyrenomycetes. Notable examples are *Hypoxylon novemexicanum*, which appears to be frequently encountered on decorticated aspen in northern and central BC, but has previously only been reported from South Africa and New Mexico. The first Canadian record of the rarely encountered *Biscogniauxia bartholomaei*, and the first provincial record of *B. mediterranea* are also included. In total, 19 new provincial host and distribution records are described.


*Paecilomyces fumosoroseus* is a pathogen of a variety of different insects found throughout the world. We used biochemical and molecular genetic markers to assess the diversity of 38 single spore isolates acquired from the ARS Collection of Entomopathogenic Fungi. Mutants deficient in nitrate utilization were obtained from cultures grown on minimal medium supplemented with potassium chloride. Complementary auxotrophs were then paired on nitrate-containing minimal medium to determine vegetative compatibility. Decamer primers were employed with RAPD-PCR to generate fingerprint profiles. Additionally, the PCR was used to amplify variable non-coding portions of the internal transcribed spacer and the intergenic spacer regions of rDNA genes. Enzymatic digests of these fragments were used to reveal RFLP's and intraspecific variation. The methods were compared for their ability to distinguish and group isolates. Findings will be incorporated into lab and field studies aimed at incorporating fungi into insect pest management programs.

MOLECULAR EVOLUTION IN CLONAL POPULATIONS OF THE PATHOGENIC FUNGUS, SCLEROTINIA SCLEROTIORUM ON WILD AND AGRICULTURAL PLANTS. Ignazio Carbone and Linda M. Kohn, Dept. of Botany, Univ. of Toronto, Erindale College, Mississauga, Ontario L5L 1C6, Canada.

We have identified intraspecific DNA sequence diversity in the intergenic spacer (IGS) of the rDNA repeat unit and two other single copy nuclear regions. Among the 3922 bases that make up the IGS in 6 strains in *S. sclerotiorum* we found 36 phylogenetically informative characters. We have analyzed the IGS to determine if there are any intra-strain differences in size and sequence among the repeated copies. Parsimony analysis of the 36 characters showed one most parsimonious tree with a consistency index of 1 and with all branches supported 100% by bootstrapping. Although this is very preliminary data for a small number of strains a few things are evident. First, some agricultural strains are identical at all 36 sites, while others are highly divergent from these. Second, strains of *S. sclerotiorum* from the wild populations sampled are highly divergent from all agricultural strains.
Nine isolates of a Colletotrichum sp. collected from yellow water lily (Nuphar luteum subsp. polysepalum) at five locations in the Pacific Northwest (PNW) and one isolate collected by R. D. Goos from Nymphaea odorata in Rhode Island (RI) were compared to three isolates of C. nymphaeae from Nymphaea spp. in Europe. Appressoria of the PNW and RI isolates were significantly (p = 0.01) wider than those of C. nymphaeae isolates. Colony morphology of the PNW and RI isolates were similar and differed from C. nymphaeae. Conidia of both the RI isolate and C. nymphaeae isolates. All isolates were compared using random amplified polymorphic DNA (RAPD) and restriction fragment length polymorphism of the ITS region (RFLP-ITS). The PNW and RI isolates produced similar RAPD patterns and identical RFLP-ITS patterns that were distinct from the patterns produced by the C. nymphaeae isolates. Based on morphological and molecular characterization the North American fungus is proposed as a new species of Colletotrichum.

DICOTYOSTELID CELLULAR SLIME MOLDS FROM THE AMAZON BASIN OF PERU. James C. Cavender, Department of Environmental and Plant Biology, Ohio University, Athens, OH 45701.

During February 1995 a total of 58 soil samples were collected from one site along the Rio Maranon and ten sites along its tributaries the Rio Nucuyar and the Rio Cambira about 200 miles upriver from Iquitos. The sites along the Rio Nucuyar and Rio Cambira had alluvial soils of generally high fertility and an average pH of 6.7. The one site along the Rio Maranon was not alluvial and had an average pH of 4.2. Most sites were beyond the zone of slash and burn although one site was so affected. Samples were processed for cellular slime molds immediately upon return to Ohio University using the standard isolation technique of Cavender and Raper (1965). Twenty species were isolated. There was an average of ten species/site and 333 clones/gm. Twelve of the species have been described in the literature. Five of the undescribed species appear to be similar to undescribed isolates from the Peten, Central America while three species were isolated for the first time. One of the latter belongs to the genus Acystostelium, one to the genus Polysphondylium and one to the genus Dictyostelium. A description of the Dictyostelium, which has a unique aggregation stage, is being prepared for publication.

CONSERVATION OF THE NITRATE ASSIMILATION GENES IN ASPERGILLI. P-K. Chang1, K. C. Ehrlich2, J. Yu2, J. E. Linz2, D. Bhatnagar2, T. E. Cleveland2, and J. W. Bennett1, 1Tulane University, New Orleans, LA 70118; 2SRRC, ARS, USDA, New Orleans, LA 70124; 3Michigan State University, East Lansing, MI 48824.

Nitrate assimilation in fungi is a highly regulated process. The nitrate reductase gene (niaD) and nitrite reductase gene (niaA) of Aspergillus parasiticus are clustered and divergently transcribed. The deduced A. parasiticus nitrate reductase sequence demonstrated a high degree of homology to those of other Aspergillus species, as well as to Leptosphaeria maculans, Fusarium oxysporum, Gibberella fujikuroi and Neurospora crassa. The characteristic GATA motifs for major regulatory proteins which mediate nitrogen metabolite repression and the target sites for the pathway-specific regulatory proteins of nitrate assimilation were abundant in the niaD-niaA intergenic region. Fusion proteins containing the A. parasiticus APN1, the major regulatory protein of nitrogen metabolism, and the A. nidulans counterpart are bound to segments of niaD-niaA encompassing the GATA motifs. These results suggest that the catalytic and regulatory mechanisms of nitrate assimilation are well conserved in Aspergillus.

ENTOMOPATHOGENIC FUNGI: TOWARDS MORE EFFICIENT MYCOINSECTICIDES. A. K. Charnley, School of Biology and Biochemistry, University of Bath, Claveron Down, Bath, Avon, BA2 7AY, United Kingdom.

Entomopathogenic fungi have considerable potential for pest control but of the major groups of disease causing organisms, fungi in particular have so far made little commercial impact. The major problems associated with mycoinsecticides are slow kill, constraints imposed by the environment (RH, temperature, UV, impact of synthetic pesticides), bulk production of the most stable, yet most virulent propagules and formulation (particularly to provide a long shelf life). This paper will focus on recent research which addresses some of these problem areas. In particular insights into the mechanisms of fungal pathogenesis could eventually provide a vehicle for a programme of strain improvement, with a view to producing more virulent, faster killing strains.

PHYLOGENETIC RELATIONSHIPS AMONG FRESHWATER PYRENOMYCETES WITH SIGMOID ASCOSPORES. W. Chen1, C. A. Shearer2, and J. L. Crane1, 1Illinois Natural History Survey, 607 E. Peabody Drive, Champaign, IL 61820; and 2Department of Plant Biology, University of Illinois, Urbana, IL 61801.

In connection with a latitudinal survey of freshwater ascomycetes, numerous pyrenomycetes which have sigmoidal ascospores and are similar in varying degrees to the genus Ophioceras were encountered. Collections could be partitioned into six morphological groups, with one of the groups representing the type species, O. dolichostomum. Restriction banding patterns of the rDNA were consistent with the morphological groupings. Given the strong possibility of convergent evolution in ascospore morphology in the freshwater environment, molecular data were obtained and used to elucidate phylogenetic relationships among the species groups as well as
with species of Lulworthia, a marine pyrenomycete with sigmoidal ascospores, and representatives of the Sordariales, Ophiostomatales, and Halosphaeriales. Morphology of each species group and phylogeny based on rDNA sequences will be presented.

TWO VARIANTS OF A GROUP I INTRON IN THE NUCLEAR SMALL SUBUNIT rDNA OF PSEUDOHALONECTRIA LIGNICOLA. W. Chen¹, C. A. Shearer², and J. L. Crane¹, Illinois Natural History Survey, 607 E. Peabody Drive, Champaign, IL 61820; and ²Department of Plant Biology, University of Illinois, Urbana, IL 61801.

During a survey of the evolution of freshwater and marine ascomycetes, we observed a group I intron in the nuclear small subunit rDNA (SrDNA) of Pseudohalonectria lignicola. The intron is located in a highly conserved region. Except for the presence of the intron, the intron+ and intron- isolates have identical sequences in the exons. Two variants (A and B) of the intron were observed among four isolates. Variant A is 865 bp long, whereas variant B has almost identical sequence as variant A, but with an additional 639 bp insertion. Both intron sequences have all the characteristics of a group I intron including four conserved sequence elements (P, Q, R, and S), the presence of characteristic U and G bases at the splice sites, a putative internal guiding sequence, and fitting a secondary structure model for group I introns.

COMPARISON OF THE GENETIC LIFE-HISTORIES OF CULTIVATED MUSHROOMS, LENTINULA EDODES AND VOLVARIELLA VOLVACEA. S. W. Chiu and D. Moore, Department of Biology, The Chinese University of Hong Kong; School of Biological Sciences, University of Manchester, Manchester M13 9PT, United Kingdom.

Lentinula edodes is the most popular dried mushroom, and Volvariella volvacea is the most popular fresh mushroom in Hong Kong. They have also gained worldwide popularity, being among the top five most cultivated mushrooms. However, molecular studies in these two mushrooms are comparatively rare, and this is especially true for V. volvacea, the straw mushroom. We have initiated a molecular study on these mushrooms using the polymerase chain reaction to generate natural markers for tracing the inheritance pattern. These two mushrooms were fruited in vitro. DNA fingerprints of the F1 progenies were detected. Together with cytological results, it was found that L. edodes shows a typical 'textbook' haploid monokaryotic/dikaryotic life cycle while V. volvacea shows a haploid homokaryotic life cycle with the transient diploid state limited to the basidial initial.

MYXOMYCETE REPRODUCTIVE SYSTEMS: STEMONITIS SPECIES. J. Clark, School of Biological Sciences, University of Kentucky, Lexington, KY 40506.

While the basic sexual system in the Myxomycetes is one-locus multiple allele heterothallism, there are many clonal strains (presumptive apomicts) in most of the morphologically defined species. There can also be a number of reproductively and geographically isolated sibling species within each of the morphospecies. These variations often produce species complexes which are difficult to sort out into recognizable groups. Also since most studies have dealt with Physarales species, there is little information on the reproductive systems of species in the other orders of Myxomycetes. This work, therefore, investigated isolates of two Stemonitales species, Stemonitis fusca Roth (Ut 1) and S. herbatica Peck (Ind 1) which were heterothallic and clonal respectively.

GENOTYPE-SPECIFIC EFFECTS OF ATKINSONELLA HYPOXYLON (CLAVICIPITACEAE) INFECTING DANTHONIA GRASSES. Keith Clay, Department of Biology, Indiana University, Bloomington, IN 47405.

The importance of fungal genotype for host fitness was investigated through inoculations of Danthonia compressa seedlings which were then followed demographically in the field for three years. Three isolates of Atkinsonella hypoxylon were used: one from the same population as the seedlings, one from another population of the same host, and a third from the conger D. sericea. There was a highly significant effect of isolate on all measures of plant performance: survival, growth, reproduction and biomass production. Plants infected with the native isolate outperformed all other plants, including uninoculated controls, indicating a high degree of coadaptation. Plants infected with the isolate from D. sericea lost the infection and produced aberrant, partially aborted inflorescences at a high rate. The results indicate that the relative mutational vs. pathogenic effects on host plants varies with fungal genotype.

SHUTTLE STREAMING IN PHYSARUM POLYCEPHALUM: CYTOPLASM AT THE EDGE OF CHAOS. Steven J. Coggin¹ and James L. Pazun², Department of Biology, Catawba College, Salisbury, NC 28144; ²Department of Chemistry, Pfeiffer College, Misenheimer, NC 28110.

The plasmodium of the myxomycete Physarum polycephalum exhibits rapid cytoplasmic streaming that reverses direction at intervals of about one minute. The nature of the oscillator producing the rhythm of shuttle streaming in Physarum is unknown. To examine this phenomenon, the time between reversal of streaming direction was determined over several hours in an intact plasmid. Time series data were used to analyze the three aspects of shuttle streaming dynamics. Shuttle streaming time series data have a 1/f power spectrum as determined by the Fast Fourier Transform. The phase space diagram produced from the time series shows shuttle streaming is described a strange attractor. Shuttle streaming dynamics have a dominant Lyapunov exponent of approximately zero, indicating a system at the edge of chaos. Systems at the edge of chaos show self-organized criticality, which produces complex behavior in many physical and biological systems. We propose that complex dynamics in Physarum shuttle streaming is an example of self-organized criticality in cytoplasm. The complex behavior of Physarum is an emergent phenomenon that probably results from the interaction of actin filaments, myosin, ATP, and other components involved in cell motility.

1996 MSA Abstracts, page 6
Mycorrhizal members of the Cortinariaceae are an important component of the mycoflora of aspen stands in Montana. Species of Inocybe, a poorly known genus in North America, were particularly prevalent in aspen stands near Butte, where the soil has been impacted by copper smelters. Twelve of the 16 species of Inocybe which occurred with aspen on Montana study sites have smooth spores, thick-walled pleurocystidia, and a cortina. Several of the species have previously been reported with aspen in Europe. A majority of the 16 species were linked for the first time with aspen in North America. This is the first report of I. flavella, I. longispora, I. pseudodestricta, and I. squamata from North America.

Species of Mycosphaerella and their anamorphs occurring on Eucalyptus leaves. P. W. Crous, Department of Plant Pathology, University of Stellenbosch, Stellenbosch 7600, South Africa.

The genus Mycosphaerella is one of the largest ascomycete genera, with more than 1800 species published in Mycosphaerella or Sphaerella. Mycosphaerella leaf blights is a serious disease of Eucalyptus spp. worldwide, and presently more than 20 species have been described from this host. Species with known anamorphs have been linked to form genera such as Sonderhenia, Siagonospora, Colletogloeum (Colomycetes), Pseudocercosporella and Sienella (Hyphomycetes). In the present study, several species of Mycosphaerella are newly described, while their anamorphs and additional collections of cercosporidoid fungi are placed in Cercospora, Passalora, Phaeoramularia, Pseudocercosporella, Pseudocercosporella and Stigmina. Furthermore, two new form genera are proposed, key provided to the cercosporidoid anamorphs occurring on eucalypts, and the known ascospore germination patterns of Mycosphaerella spp. on eucalypts discussed.

Two undescribed Calonectria States for Cylindrocladium gracile and C. naviculatum. P. W. Crous1, G. R. A. Mchau1, M. J. Wingfield2, and W. H. van Zy1, 1, 2Departments of Plant Pathology and Microbiology, University of Stellenbosch, Stellenbosch 7600; and 2Department of Microbiology and Biochemistry, University of the Free State, Bloemfontein 9300, South Africa.

Cylindrocladium clavatum is an important root and leaf pathogen of many hosts worldwide. Based on nuclear DNA (nDNA) polymorphisms and general morphology, this fungus was recently reduced to synonymy with the earlier described C. gracile. Recently, a homothallic fungus, morphologically similar to C. gracile, was isolated from soil in Colombia using an alfalfa baiting technique. The nDNA of C. gracile, C. clavatum, C. pteridis and the Colombian fungus were digested with EcoRI, HindIII and XhoI, and Southern analyses performed using a 6.3-kb ribosomal DNA repeat unit of Neurospora crassa as probe. The banding patterns of C. clavatum, C. gracile and the Colombian fungus were similar to each other, but distinct from C. pteridis. Using the same baiting technique, isolates of C. naviculatum were obtained from soil in Venezuela. Mating studies of these isolates with the original ex type strains induced a previously unknown Calonectria teleomorph for C. naviculatum in culture. The two new Calonectria states are described and contrasted with other in the genus.

A New genus of hyphomycetes to accommodate Phialophora parasitica. P. W. Crous1, W. Gams2, M. J. Wingfield3, and P. S. Van Wyk4, 1Department of Plant Pathology, University of Stellenbosch, Stellenbosch 7600; 2CBS, P.O. Box 273, 3740 AG Baarn, The Netherlands; 3Department of Microbiology and Biochemistry, University of the Free State, Bloemfontein 9300; and 4Grain Crops Institute, ARC, P. Bag X1251, Potchefstroom 2520, South Africa.

The genera Acremonium and Phialophora are generally known to be heterogeneous. The morphological structures used to separate these species in these complexes are poorly differentiated and, therefore, of limited taxonomic value. For this reason, and due to a general lack of viable cultures of many of the species, there has been a tendency to assign intermediate strains to either one or the other of these generic aggregates. As more isolates of P. parasitica and similar fungi have been collected, it has become obvious that they form a cluster of related species which cannot adequately be accommodated in Phialophora. A new hyphomycete genus with five new species and the type species P. parasitica, is therefore proposed. Morphologically, the genus is intermediate between Acremonium and Phialophora. It is distinguished from Phialophora by its tapering conidigenous cells and inconspicuous cellaretes, and from Acremonium by its dematiaceous conidiophores.

Infection of Rose leaves by Pestalotiella guepinii. V. Dhevan and J. Taylor, Dept. of Biology, Stephen F. Austin State University, Nacogdoches, TX 75962.

Pestalotiella guepinii was isolated from infected leaflets of rose obtained from a local garden. The fungus was cultured on potato dextrose agar and inoculated onto healthy leaflets of Rosa hybrida, cv. La Reine. Investigation of the structure and mode of penetration of the fungus was conducted with both scanning and transmission electron microscopy. Fungal germ tubes terminated in penetration structures called appressoria. TEM was used to observe the growth of hyphae and ultrastructural changes in host cells. Plants maintained in the greenhouse developed lesions within 7-10 days post-inoculation.


Asparagus decline is a disease complex involving biotic and abiotic factors. The main pathogens associated with asparagus decline in the U.S. are Fusarium oxysporum and F. proliferatum. Plant and soil samples were collected from 7...
declining and 9 non-declining asparagus fields in Washington and Oregon in 1994 and 1995. Root, crown and stem tissue pieces, and soil samples were plated on Komada’s medium to isolate *Fusarium* species. Fifty-five percent of the tissue samples yielded *F. oxysporum*, and 39% *F. proliferatum*. All *F. oxysporum* isolates tested were pathogenic to asparagus seedlings. *F. oxysporum* was isolated from 99% of the soil samples and *F. proliferatum* from 1% of the samples. Isolates putatively described as *F. proliferatum* were paired with tester isolates from six mating populations in Section Liselo. Fifty-nine percent of the isolates tested were pathogenic to asparagus seedlings. No consistent differences in *F. proliferatum* and *F. oxysporum* populations were noted between declining and non-declining fields.

**NUTRITION AND GROWTH OF A CALCIFUGE PLANT IN A MODEL CALCAROUS SYSTEM: EFFECTS OF MYCORRHIZATION AND RHIZOSPHERE OXALIC ACID.**

Gregory K. Eaton and Orson K. Miller, Jr., Dartmouth College, Hanover, NH 03755; and Virginia Tech, Blacksburg, VA 24061.

Rhizosphere production of oxalic acid may enhance localized nutrient cycling and drive soil chemical reactions that markedly change the environment experienced by plants. We evaluated the influence of oxalic acid produced in ectomycorrhizal symbiosis on rhizosphere nutrients and on the nutrition and growth of a calcifuge plant grown in calcareous soil. *Eucalyptus diversicolor* seedlings were grown with or without the ectomycorrhizal fungus symbiont *Hebeloma westraliense* in calcareous and non-calcareous media in synthesis tubes in a growth chamber. The calcareous system had increased solution pH and Ca and decreased solution P. Seedlings without mycorrhizae had increased shoot P, reduced height and mass and macroscopic symptoms of severe nutrient deficiency. The effects of mycorrhization on calcareous solution included increased pH, decreased Ca and P and substantially increased rhizosphere oxalates. Mycorrhizal seedlings had increased Ca and P in shoots, greater height and mass and no symptoms of nutrient deficiency. Oxalate binds Ca in calcareous soil to form Ca oxalate crystals. This allows increased P in the rhizosphere solution from the dissolution of Ca phosphates, and increased plant uptake of this nutrient. Oxalic acid production in mycorrhizal symbiosis may ameliorate the intolerance of *Eucalyptus* spp. to calcareous soil.

**PYRENOPHORA TYPHAECOLA (PLEOSPORALES), REVISITED.**

Payam M. Fallah and C. A. Shearer, Department of Plant Biology, University of Illinois, 505 South Goodwin Avenue, Urbana, IL 61801.

*Pyrenophora typhaecola* (Cke.) Müller was collected from submerged stems of *Typha latifolia* L. from fresh water. Two collections from northern Wisconsin and one from Illinois were compared to the type specimen described by Cooke in 1876. Ascomata embedded in low viscosity resin were sectioned to illustrate anatomical details and centrum structure. This species is characterized by tomentose, membranous, small-celled ascomata, fissitunicate asci with a thick-walled apex and claw-like base and eight biseriate ascospores, and light brown, 3-septate ascospores bisected by a single vertical septum. A gelatinous sheath surrounding the ascospores was present in all fresh collections but was not found in the type material.

**USING GAMMA RADIATION TO KILL WOOD INHABITING FUNGI.**

C. M. Freitag and J. J. Morrell, Department of Forest Products, Oregon State University, Corvallis, OR 97331.

The increasingly global trade in wood and wood products carries with it the threat of a trade in forest pests and pathogens. Importing nations seek to protect their natural resources by requiring assurance that wood poses a minimal risk to native forests. Many methods of mitigation are available, including heat, chemical treatment and irradiation. Irradiation is effective against many insects at less than 100 krad, but the lethal dose for fungi is reported to be 2.5 Mrad. To confirm this level, Ponderosa pine wafers were inoculated with one of 5 test fungi (*Postia placenta, Phlebia subserialis, Ophiostoma picea, Aspergillus niger* or an unidentified fungus isolated from irradiated wood) or left uninoculated. The wafers were exposed to 100 krad to 15 Mrad of γ radiation. Survival was assessed by culturing on malt agar. Preliminary results suggest all of the test fungi were killed by exposure to 0.5 - 1.0 Mrad.

**PULLING THE PLUG ON THE SIMPLE SEPTUM.**


Ultrastructural aspects of the septal pore apparatus appear to be evolutionarily conserved and have been widely used in the assessment of natural relationships within the basidiomycetes. An 18S rRNA gene sequence phylogeny and the simple septal pore ultrastructure of some heterobasidiomycetes, especially *Jola javensis*, will be used to critique the explicit, phylogenetically distinct, categories of simple septa that appear in the literature. Molecular analyses are clarifying natural relationships among the simple septate taxa. However, a more complete analysis of septal development in a range of taxa is required to determine the evolutionary significance of variation in septum morphology.

**HYPOVIRULENCE IN NORTH AMERICA.**

D. W. Fulbright, Michigan State University, East Lansing, MI 48824-1312.

Chestnut blight, caused by *Cryphonectria parasitica*, is such a devastating disease of the American chestnut (*Castanea dentata*) in North America that any American chestnut trees showing obvious infections, attaining a relatively large size and surviving to maturity are rare and worthy of study. When studied, these trees have often been associated with a hypovirulent pathogen population where the hypovirulent phenotype is cytoplasmically transmissible to virulent strains. Where transmissible hypovirulence can be found throughout the chestnut growing areas of Europe, hypovirulence in North America appears to be limited to specific localized sites. In North America, studies on naturally occurring hypovirulence have provided variable results in our understanding of important genetic and ecological criteria needed for establishing hypovirulence where it has not been found. Discussion will focus on these variables including the...
different cytoplasmic agents responsible for the hypovirulence phenotype, the correlation between hypovirulent strains and healing chestnut trees and the role of vegetative compatibility in limiting the dissemination of hypovirulence.

MOLECULAR SYSTEMATICS OF RHABDOCLINE AND ITS RELATIVES. D. S. Germant and J. K. Stone, Dept. of Botany and Plant Pathology, Oregon State University, Corvallis OR 97331.

The genus *Rhabdocline* is comprised of six taxa parasitic on Douglas-fir, together with *Meria laricis*, an autonomous anamorph parasitic on larch. *Rhabdocline* and many inoperculate discomycetes are foliar fungi that appear to have coevolved with their coniferous hosts, but the relationships among these fungi are poorly understood. *Rhabdocline* has alternately been placed in the Hemiphacidiaceae (Leotiales) and the Rhytismataceae (Rhytismatales). We have used nuclear ribosomal DNA sequence data (small subunit and internal transcribed spacer region) to identify closely-related outgroups to *Rhabdocline* and investigate evolutionary relationships among selected genera in the Leotiales and Rhytismatales.

EFFECTS OF TEMPERATURE AND SALINITY ON THE GROWTH OF THE MARINE FUNGI, COROLLOSPORA MARITIMA AND DENDRYPHIELLA SALINA. R. V. Gessner and Y. Kang, Department of Biological Sciences, Western Illinois University, Macomb, IL 61455.

Fungi that grow on detritus that accumulates on beaches in marine habitats are exposed to high temperatures and salt concentrations. To study these interactions, as well as the influence of hyper saline conditions, cultures of *C. maritima* and *D. salina* were grown on GPY agar and broth prepared with deionized water and Rila artificial seawater salts. Dry weight, ash-free dry weight and radial growth were measured after 10 days. Both species grew from 5-35°C and exhibited a broad tolerance to salinity. The optimal temperature for both species was 30°C. *Corollospora maritima* produced the greatest dry weight and ash-free dry weight at a salinity of 51 ppt and the most radial growth at 34 ppt. *Dendryphiella salina* produced the most dry weight at 17-85 ppt and the highest radial growth was at 34-51 ppt. The optimum salinity for radial growth increased with temperature for each species, while for dry weight, *C. maritima* grew optimally at 51 ppt at all temperatures and *D. salina* did not exhibit a clear pattern.

**NEOTYPHIDIUM, A NEW GENUS FOR THE ASEXUAL GRASS ENDOPHYTES.** A. E. Glenn and C. W. Bacon, Dept. of Plant Pathology, Univ. of Georgia and USDA, ARS, Russell Res. Center, Athens, GA 30613.

*Acremonium* is a form genus for anamorphic fungi producing single celled conidia from mostly simple orthophialidic conidiogenous cells. The possibility of multiple independent origins of *Acremonium* anamorphs and the systematics of some of the sections and species have been reassessed based upon phylogenetic analyses of nuclear rDNA sequences. The analyses indicated that *Acremonium* is indeed a polyphylectic genus. *Acremonium alternatum*, the type species, appears to be derived from within the Hypocreaceae. The genus *Acremonium* is therefore suggested to be restricted to orthophialidic anamorphs of the Hypocreaceae. The grass endophytes of sect. *Albolanosa* show a close relationship to *Epichloë* of the Clavicipitaceae. To eliminate some of the heterogeneity within *Acremonium* while also emphasizing the unique biological and ecological characteristics of the grass endophytes, the reclassification of the asexual endophytes into the new genus *Neotyphodium* has been proposed.

CHARACTERIZATION OF FUNGAL SPORES OF PHIALOPHORA GREGATA BY FLOW CYTOMETRY. C. Gourmet¹, L. E. Gray², and A. L. Rayburn¹, ¹Department of Crop Sciences, ²USDA/ARS, 320 ERML, 1201 W. Gregory Ave., Urbana, IL 61801.

Flow cytometry was used to characterize isolates of *Phialophora gregata* using the fluorescence intensity of propidium iodide-stained conidia. Isolates differed in their mean fluorescence intensity, ranging from 89.4 to 116.0. When the number of fluorescent events was plotted against intensity of fluorescence, a single peak was observed. Fluorescent patterns of *Phialophora*-like fungi isolated from soybean vascular tissue were compared to isolates of *P. gregata*. Their mean fluorescence intensity ranged from 51.5 to 66.8. Multiple peak histograms were observed corresponding to multiple spore sizes as well as single and double nucleated conidia. Using flow cytometry, we were able to distinguish *P. gregata* isolates from *Phialophora*-like fungi isolated from soybean vascular tissue, based on mean fluorescence intensity and/or the presence of multiple peaks.

COPPER-ZINC SUPEROXIDE DISMUTASE FROM CANDIDA ALBICANS. Portia Groening, Ruipeng Yang, and M. Gunasekaran, Department of Biology, Fisk University, Nashville, TN 37208.

Superoxide dismutase (SOD; EC 1.15.1.1) plays an important role in protecting cells from the oxidative damage of superoxide radicals. *Candida albicans*, an opportunistic yeast which causes candidiasis in immunosuppressed patients was grown in Lee synthetic medium as a shake culture in yeast form at 25°C. Cells were harvested by centrifugation and cell free extracts were prepared by grinding the cells in liquid nitrogen. Culture filtrates concentrated by ultrafiltration, and cell-free extracts were used to measure the intracellular and extracellular SOD activities, respectively. SOD activity was determined spectrophotometrically at 560 nm by measuring the superoxide generated by xanthine-xanthine oxidase reaction and the rate of reduction by nitro blue tetrazolium (NBT). Maximum SOD activity was found after 72 hrs of growth. The optimum pH and temperature for the SOD activity were 7 and 40°C, respectively. The enzyme was stimulated to varying degrees by cholic acid, procaine and tocopherol. The enzyme was completely inhibited by cyanide and partially inhibited by peroxide and azide. The major SOD activity was found in the cytosol fraction and the level of extracellular SOD was very low.
ERICOID MYCORRHIZAL FUNGI FROM THREE DISTINCT HABITATS IN ALBERTA. S. Hambleton and R. S. Currah, Dept. of Biological Sciences, University of Alberta, Edmonton, Alberta, Canada.

The importance of *Hymenoscyphus ericae* as an ericoid mycorrhizal fungus in natural habitats of North America is largely unknown, though it is widely associated with the Ericales in N. Europe and Australia. There is one report of the occurrence of the anamorph state, *Scylidiaum vaccinii*, as well as evidence that species of *Oidiodendron* are also mycorrhizal partners. Fungal endophytes were isolated from the roots of 19 species of ericaceous plants. *S. vaccinii* was isolated from all species and *O. maius* (or *O. griseum*) from all but three. Both were frequently isolated from the same root system indicating that both mycorrhizal partners might be operational in the same segment of root. The morphology of these two fungi in the host cells is similar and there is no simple way to determine whether both are present in a particular sample. Cultural conditions are important for the formation of arthroconidia and subsequent identification of *S. vaccinii*. The majority of *Oidiodendron* strains are *O. maius*; fewer are *O. griseum*; a certain percentage are intermediate. The rare formation of sterile ascomata typical of *Mycotrichum* strengthens the presumed relationship to the *Mycotrichaceae*.


Cytokinesis in *Aspergillus nidulans* is an actin-dependent process coordinated with mitosis. T- mutations in *A. nidulans* *sepA* result in defects in cytokinesis and polarized growth. At restrictive temperature, *sepA* mutants form multi-nucleate hyphae, which fail to undergo cell division and exhibit abnormal branching patterns. Temperature shift experiments suggest that the *sepA* gene product acts late during cell division. *sepA* has been cloned, and shown to encompass the previously described *figA* gene; thus *figA* is a truncated allele of *sepA*. Sequence analysis reveals that *sepA* is a member of a conserved family of genes, whose products appear to function in actin-independent processes. In particular, *sepA* shares significant blocks of homology with genes involved in cytokinesis: *S. cerevisiae BNII*, *S. pombe CDC12*, and *D. melanogaster diaphanous*. Our results suggest that *sepA* may play a role in mediating actin-polymerization, such as at the division site.

**UREDINIA DEVELOPMENT AND HOST-PARASITE RELATIONSHIPS IN SLOW-RUSTING OF BEAN.** M. W. Harding, J. R. Stutz, and R. W. Roberson, Department of Botany, Box 871601, Arizona State University, Tempe, AZ 85287-1601.

Slow-rusting has been shown to be a susceptible infection type, but is characterized by slower disease development, smaller uredinium size and reduced sporogenesis. Little information is available on the characteristics and mechanisms associated with slow-rusting of bean. Therefore, we present this study of uredinia development and ultrastructural aspects of the host-parasite interface in three cultivars of French bean (*Phaseolus vulgaris*) infected with the bean rust fungus (*Uromyces appendiculatus*). Initial observations indicate that uredinia in cultivar Pinto 111 developed faster and were larger compared to those observed on slow-rusting cultivars (Early Gallatin and 814). Variation in uredinium size between cultivars was confirmed by microscopic observations and computer-aided measurement of pustule surface area. Infected leaf tissues from all cultivars were prepared for electron microscopy using traditional fixation methods or high-pressure cryofixation/freeze substitution protocols. These ultrastructural data will be compared and discussed with regard to host-parasite relationships and disease development.

**FUNGAL ANTAGONISTS AND MYCOPARASITES.** G. E. Harman, Departments of Horticultural Sciences and of Plant Pathology, Cornell University, Geneva, NY 14456.

Fungi, including those in the genera *Trichoderma* and *Gliocladium*, have long been known for their ability to reduce plant diseases caused by other fungi. They do this by a variety of methods, but they can only function if they occupy the infection site and are actively growing. In order for this to occur, the delivery system must be manipulated in order for the environment to be favorable to the biocontrol fungi and to be unfavorable to competitive or pathogenic fungi. Successful use of biocontrol fungi demands an understanding of both the physiology of the biocontrol agent and the ecosystem in which it will be employed. Such data can be used to devise uses that are likely to be successful and to avoid ones in which poor results are likely. Delivery systems that are based on sound physiological and ecological knowledge, and that take advantage of the most effective uses of the particular strain, are likely to provide reliable and consistent results.

**PRELIMINARY IDENTIFICATION OF SELECTED SPECIES OF ARBUSCULAR MYCORRHIZAL FUNGI USING PCR AMPLIFIED rDNA.** S. K. Hammar, F. S. Edwards, and M. F. Allen, Biology Department, San Diego State University, San Diego, CA 92182.

The obligately symbiotic group of fungi, the arbuscular mycorrhizal (AM) fungi, possess several characteristics (e.g. inability to be grown in pure culture) which make identification, and therefore ecological field studies, difficult. Traditional methods of identifying this group rely on the isolation of asexual spores from the soil. These spores, which are resting structures, do not necessarily reflect what species are actively colonizing the plant root. We have recently utilized molecular methods to develop a protocol for identifying AM fungi. Field collected spores were identified using traditional microscopy, and DNA was extracted for amplification. DNA was extracted using crude lysate, which eliminates the need for a large amount of tissue, and produces a DNA template suitable for PCR amplification. Results indicate that size polymorphisms in the ITS region of rDNA can distinguish among genera, and can be used to screen species. Amplification products of field collected *Artemisia californica* roots showed that these fungal endophytes may be identified to species based on size polymorphisms.

1996 MSA Abstracts, page 10

The Sarcoscyphineae include two families of the Pezizales with distinctly thickened ascwall, discrete opercula and multinucleate ascospores. Phylogenetic relationships within this suborder of twenty-four genera were inferred from the nucleotide sequences of the nuclear 18S ribosomal RNA gene. In a preliminary analysis, the sequences from six isolates were determined. Additional sequences for other discomycete taxa (e.g. Leotia, Morchella and Glaziella) and the outgroup taxon Taphrina deformans were either directly sequenced or acquired from Genbank. Parsimony analyses of these sequences resulted in a well-resolved phylogeny that support monophyletic Helotialean and Pezizalean clades. Within the Pezizales, neither the Sarcoscyphineae nor the Pezizinae are monophyletic. Within the Sarcoscyphineae, the Sarcoscyphaceae are monophyletic but the Sarcosomataceae are paraphyletic with respect to some members of the Pezizinae.

DOES VARIATION IN RESOURCE USE INFLUENCE MOLD COMMUNITIES? L. K. Hawkins, Dept. of Biology, The Pennsylvania State University, Mont Alto, PA 17237.

The mold community associated with a granivorous desert rodent differs substantially from the mold community of the surrounding soil. One factor which may help maintain the differences is differential use of resources available in this habitat. I experimentally assessed nine taxa for their ability to grow and sporulate on seeds, chitin, keratin, and cellulose. All species sporulated best on whole seed agar and also sporulated on seed extract agar and chitin agar. Growth and sporulation was slow on hair. Some species never grew on cellulose; others did. Molds varied in levels of sporulation achieved on a particular resource. Patterns of resource use, abiotic tolerances, and competitive abilities all influence the composition of these mold communities.

EVIDENCE AGAINST THE UNIVERSALITY OF THE VSC MODEL FOR HYPHAL TIP GROWTH. I. Brent Heath and E. J. Janse van Rensburg, Biology and Mathematics & Statistics Departments, York University, 4700 Keele St., North York, Toronto, Ontario M3J 1P3, Canada.

The morphogenesis of hyphae has been postulated (Bartnicki-Garcé et al. 1989, Protoplasma 153, 46-57) to involve a vesicle supply centre (VSC) which directs the distribution of surface expansion "units" (=vesicles). The VSC is capable of generating diverse fungal structures by appropriate movements and is coincident with the Spitzenkörper. However, we show (Mycoscience, 37, 1-10) that morphogenesis can be explained by equations describing gradients of vesicle fusions, independently of their distribution mechanisms. Furthermore, the organization and behaviour of apical cytoplasm in growing hyphae of Saprolegnia ferax are inconsistent with the existence and predicted behaviour of a VSC. For example, substantially different patterns of organelle arrangements in the predicted region of the VSC occur in hyphae showing similar growth behaviour and rapid movements of organelles through the hypothesized position of the VSC are without effect on growth. Together, these observations indicate that, at best, the VSC is not a universal model applicable to all tip-growing cells.

EVIDENCE FOR A Ca2+-REGULATED MEMBRANE SKELETON IN HYPHAL TIP GROWTH OF THE OOMYCETE SAPROLEGNIA FERAX. I. Brent Heath and Gagan Gupta, Biology Department, York University, 4700 Keele St., North York, Toronto, Ontario M3J 1P3, Canada.

Morphogenesis of hyphal tips may be via an actin-containing part of the cytoskeleton attached to the plasma membrane, the membrane skeleton (MS) (Heath, 1995, Can. J. Bot. 73, suppl.1, S131-S139). The MS is postulated to resist positive turgor pressure and generate tip protrusion with "zero" turgor. Disruption of the membrane skeleton with the anti-actin drug, latrunculin B, caused transient acceleration of growth with normal turgor and deceleration with "zero" turgor, as predicted by the model. The postulated regulation of this skeleton by an observed tip-high gradient of cytoplasmic Ca2+ necessitates an intracellular Ca2+ sequestering system. The endoplasmic reticulum is a prime candidate for this role, in which case thapsigargin, an inhibitor of the Ca2+ sequestering pump of the sarcoplasmic reticulum (SR), is predicted to influence tip growth, which it does in a dose dependent manner. In contrast, ryanodine, which blocks the Ca2+ release channels of the SR, is without effect, indicating evolutionary conservation of only parts of the regulatory system.

UREDO VETUS SP. NOV., THE OLDEST LIVING RUST SPECIES? J. F. Hennen, Botanical Research Institute of Texas, 509 Pecan St., Ft. Worth, TX 76102-4060.

A species of Uredinales was found on plants of Selaginella sp. (Lycophyta), intercepted by plant quarantine officials in San Francisco, CA, 10 Sept.1993. The dried, dead plants were used as packing in a shipment from the Peoples' Republic of China. The source is unknown. Selaginella specimens at MO yielded another specimen from Lantau Isl. Hong Kong. Sori are 0.1-0.2 mm across; spores 26-31 x 18-20 µ, broadly ellipsoid; walls evenly 0.5 (-1) µ thick, echinulate; pores obscure; paraphyses 30-35 x 4.5-6.5 µ, cylindrical with apical wall often thickened 4-6 µ. This rust is of exceptional interest because the host represents the most primitive group of vascular plants on which a rust fungus has ever been found.

HERBARIA FOR PLANT PARASITIC FUNGI. J. F. Hennen, Botanical Research Institute of Texas, 509 Pecan St., Ft. Worth, TX 76102-4060.

Many kinds of research with plant parasitic fungi require herbarium specimens of very high quality. New knowledge can come from very old specimens via new technologies such as SEM and DNA analyses, but few older specimens meet the standards now needed. Unimagined technologies in the future can yield even more new knowledge from old specimens. New
 specimens, however, should be prepared by obtaining generous amounts of fungal material in the field, by using techniques similar to those for vascular plant specimens, and by including good host voucher material. Methods of preparation of information rich specimens are illustrated on the poster.

CUE ASSESSMENT OF MICROBIALLY INFECTED FOOD BY TWO RODENT SPECIES. Jose Herrera, Mark W. McDonald, and Charles L. Kramer, Division of Biology, Kansas State University, Manhattan, KS 66506.

Two cafeteria-style feeding trials were used to determine the cues used by 2 species of food-caching rodents (adult and juvenile eastern wood rats and adult banner-tailed kangaroo rats) faced with information rich specimens are illustrated on the poster.

FOSSIL MUSHROOMS IN AMBER. D. S. Hibbett and M. J. Donoghue, Harvard University Herbaria, 22 Divinity Avenue, Cambridge, MA 02138.

The paucity of fossil mushrooms limits understanding of homobasidiomycete evolution. In this talk, we will describe two fossil mushrooms from Cretaceous and Oligocene amber that are strikingly similar to certain Tricholomataceae. These fossils have the potential to provide insight into the minimum ages of certain homobasidiomycete lineages, the evolution of ecological strategies, biogeographic relationships, and the pace and mode of morphological evolution in homobasidiomycetes. The utility of the fossils is limited, however, by two factors: 1) the lack of certainty about the phylogenetic placement of the fossils; and, 2) the poor phylogenetic resolution for the homobasidiomycetes.

FUNGICIDAL ACTIVITY AND PROPERTIES OF AN INHIBITOR FROM AN ENDOPHYTIC BACTERIUM. D. M. Hinton and C. W. Bacon, USDA/ARS, Russell Research Center, Athens, GA 30604.

The endophytic bacterium Enterobacter cloacae, RRC101, exhibits strong antagonism to isolates of Fusarium moniliforme Sheld. The compound(s) restricted the growth of hyphae and conidia when grown on nutrient agar and in contact with the fungicidal compound(s). The bacterium and a supernatant prepared from its growth medium were studied to determine their effects on colony growth and ultrastructure of F. moniliforme. Ultrastructural examinations showed that the compound(s) caused an enlarging of hyphae and conidia, degradation of cytoplasmic organelles and matrix, and cell wall structure. These results provided a bioassay for determining some physical and chemical properties of the inhibitory substance(s).

TWO HARPOSPORIUM SPECIES WITH HIRSUTELLA SYNANAMORPHS. K. T. Hodge¹, N. M. Viene¹, and W. Gams², ¹Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853; ²Centraalbureau voor Schimmelcultures, P.O. Box 273, 3740 AG Baarn, The Netherlands.

Each of two species of Harposporium isolated from infected nematodes developed a novel synanamorph attributable to Hirsutella in culture. One also developed an arthroconidial synanamorph. In infection studies of nematodes, conidia typical of Harposporium were capable of killing bacterial feeding nematodes (Rhabditis spp.) when ingested. Neither Hirsutella nor Harposporium conidia were observed to be infective to the stylet-bearing nematodes Aphelenchus sp. (fungus-feeding) or Meloidogyne hapla (plant parasitic). Details of infection and a discussion of the implications of the various spore states in the ecology of Harposporium species will be presented.

BIOLOGY OF CURZATE® ACTION AGAINST PLASMOPARA VITICOLA INFECTION OF VITIS. R. J. Howard¹, M. A. Ferrari¹, T. M. Bourret¹, M. D. Sidham², C. Shillingford², R. J. Power², and R. A. Hamlen², DuPont Company, ¹Central Research & Development, and ²Agricultural Products, Wilmington, DE 19880-0402.

We have conducted a qualitative and quantitative cytological analysis using light and cryo scanning electron microscopy of the interaction between the downy mildew pathogen, Plasmopara viticola, and leaf tissue of Vitis that was treated with Curzate® 50 WP (a.i. cyoxanil). Treatments of 40ppm (a.i.) were applied either lh before or 18h after inoculation. Preventive treatments of Curzate® abated spread of the pathogen beyond the initial site of infection by inhibiting formation of intercellular hyphae. Curative (post-infection) treatments caused the collapse and death of haustoria, hyphae and infection vesicles. Both post-infection applications of Curzate® inhibited sporulation by Plasmopara and caused infected host cells to turn a brown color and collapse, which characterized an induced, hypersensitive-type host cell response. Curzate® effects on zoospore release were tested in vitro and in situ and were found inhibitory in a dose-dependent manner.

ANALYSIS OF THE cox2-cox1 INTERGENIC REGION OF OOMYCETE MITOCHONDRIAL DNA. D. S. S. Hudspeth, D. M. Stevenson, and M. E. S. Hudspeth, Northern Illinois University, DeKalb, IL.

By DNA transfer hybridization we confirmed the tight linkage of cytochrome c oxidase subunit 2 and 1 loci in a variety of 1996 MSA Abstracts, page 12
oomycete mtDNAs. The intergenic regions were subsequently either cloned directly, or indirectly from PCR products generated from the use of highly conserved \textit{cox2} and \textit{cox1} primers. In representative genera from the Pythiales, Rhipidiales, and Leptomitales DNA sequence analysis identified a short open reading frame encoding 32-34 (orf32/34) amino acids. Although the amino acid sequence is highly variable within these orders the hydrophobicity profiles are similar and suggestive of an integral membrane protein. Comparison with similar profiles from non-oomycete \textit{atp8} deduced protein sequences suggests a possible function for this \textit{orf}. An orf32/34 equivalent was notably absent in the same intergenic region of several genera of the Saprolegniaceae.

**AN OOMYCOTA PHYLOGENY BASED ON CYTOCHROME c OXIDASE SUBUNIT 2 SEQUENCE DATA.** D. S. S. Hudspeth, S. A. Nadler, and M. E. S. Hudspeth, Northern Illinois University, DeKalb, IL.

We have used \textit{cox2} nucleotide sequence data to develop a mitochondrially based molecular phylogeny for the Oomycota. Restriction fragments containing all of the \textit{cox2} coding region, or PCR fragments of an internal region of \textit{cox2}, were cloned from 15 oomycete genera representing four major orders. A similar region from the hyphochytriomycete \textit{Hyphochytrium catenoides} was also cloned for use as an outgroup. At the amino acid level a tripeptide sequence was absent from all Saprolegniaceae representatives, but present in all examined representatives of the Pythiales, Leptomitales, and Rhipidiales as well as \textit{H. catenoides}. Preliminary parsimony analyses of the deduced amino acid sequence data suggest a closer affinity of the Leptomitales with the Saprolegniaceae rather than the Rhipidiales. Similarly, the Rhipidiales are more closely associated with the Pythiales. A cladistic analysis of a common 629 nucleotide region will be presented.

**SPATIAL AND TEMPORAL PATTERNS AND HOST SPECIFICITY AMONG SOME WOOD-INHABITING ASCOMYCETES AT EL VERDE RESEARCH AREA, PUERTO RICO.** S. M. Huhndorf and D. J. Lodge, USDA Forest Service, Forest Products Laboratory, One Gifford Pinchot Dr., Madison WI 53705-2398; and P.O. Box 1377, Luquillo, PR 00773-1377.

Wood-inhabiting ascomycetes were collected at the El Verde sixteen hectare grid research site in Puerto Rico during four trips made between April 1995 and February 1996. Ascomycetes were collected from wood and bark of decaying logs of 33 tree species located throughout the grid. Different logs were sampled on each of the four trips. Branches and twigs were collected from fifty 0.5 m$^2$ semicircular plots located at 10 m intervals along a 500 m transect. The plots were sampled in April and again in September. Additionally, 16 randomly spaced plots were sampled in June and January. A total of 1004 collections were made. The specimens were distributed among 125 genera in 47 families. Species in four families were most frequently encountered: 21% of the fungi collected were in the Lasiosphaeriaceae, 10% in the Xylariaceae, 6% in the Hypocreaceae, and 5% in the Tubeufiaceae. Spatial and temporal patterns are compared for the fungi found in the plots and the results are discussed. No evidence of host specificity was found for the ascomycetes encountered on the decaying logs, except for one collection that supported the reported specificity of a fungus for its host family. There is evidence of selectivity by the fungi for the size and decay class of the wood.

**PATTERNS OF ISOZYME VARIATION AMONG POPULATIONS OF THE PUFFBALL SPECIES \textit{LYCOPERDON PYRIFORME.}** Martin J. Huss, Department of Biological Sciences, Arkansas State University, State University, AR 72467-0599.

Basidiocarps of the puffball species \textit{Lycoperdon pyriforme} Schaeff.: Pers. were collected from seven populations located in central Arkansas, northeastern Kansas and northwestern Missouri. Cultures isolated from immature glebal tissue were subjected to starch gel electrophoresis to study patterns of isozyme variation. Forty-nine unique electrophoretic types or isozyme phenotypes were identified. Of the eleven putative loci examined in this study, nine were polymorphic, with a mean of 3.6 alleles/locus. Mean heterozygosity for populations varied from 0.200 to 0.345, suggesting that outcrossing occurs in this species. Unweighted pair group method cluster analyses displayed marginal grouping of populations based on geographic proximity. Genetic diversity statistics of isozyme data suggest that genetic differentiation in populations is low (\textit{GST} = 0.122). Patterns of variation observed in this species suggest that the effects of gene flow have acted as a homogenizing force in this species (e.g., outcrossing, long-range dispersal) within the region sampled.

**THE PRESENCE AND ANTIFEEDANT FUNCTION OF TOXIN-PRODUCING SECRETORY CELLS ON HYPHAE OF SOME LAWN-INHABITING AGARICS.** Leonard J. Hutchison and G. L. Barron, Department of Environmental Biology, University of Guelph, Guelph, Ontario N1G 2W1, Canada.

On water agar, \textit{Conocybe lactea} and \textit{Panaeolina foenisecii} produce droplets of toxin on conspicuous secretory cells. Fungus-feeding nematodes (\textit{Aphelegenoides sp.}) are immobilized when they contact the toxin droplets. Prolonged or repeated exposure to the toxin results in death of the nematodes. Droplets produced by \textit{P. foenisecii} are less toxic to nematodes than are those of \textit{C. lactea}. No differences were observed in nematode response between dikaryotic and monokaryotic cultures of \textit{C. lactea}. Unlike \textit{Pleurotus ostreatus}, the hyphae of \textit{C. lactea} and \textit{P. foenisecii} do not locate and colonize nematodes and consume them as a nutrient source. It is considered that the toxin droplets are for protection of the hyphal system and function as antifeedants to repel or kill fungus-feeding nematodes and possibly other fungus-feeding soil microfauna.

1996 MSA Abstracts, page 13
STUDIES ON THE DEVELOPMENT OF THE EPISPORIUM AND THE ENDOSPORIUM OF *NEUROSPORA ASCOSPORES*. Monde Imoh and L. Frederick, Department of Biology, Howard University, Washington, DC 20059.

Walls of Neurospora ascospores consist of three main layers, viz., the perisporium, the episporium, and the endosporium. Reports have been published on the ontogeny of the perisporium. The ontogeny of the other layers has not been investigated. Results of our ultrastructural studies on the ontogeny of the episporium and the endosporium are presented in this report. Two homothallic species, viz., *N. dodgei* and *N. lineolata*, were used in this study. *N. lineolata* is reported to lack the inner wall layers. The episporium forms immediately after deposition of the rib-vein layer is completed. A narrow electron dense layer binds the episporium to the perisporium. The episporium is unstratified, dense, and melanized. Fracture lines develop in it when sectioned. Vesicles appear to be electron dense layer binds the endosporium and the episporium. Mature ascospores in both homothallic species are developmentally and structurally similar.

**VIBRISSEA PFISTERI**, A NEW SPECIES WITH AN UNUSUAL ECOLOGY. Teresa Iturriaga, Plant Pathology Herbarium, Cornell University, Ithaca, NY 14853.

Vibrissa is generally considered an aero-aquatic genus of discomycetes, since apothecia are typically found growing on substrates immersed in water, or at least on substrates that are splashed by water or are water-soaked. A new species, *V. pfisteri*, described here, was found in a forest that had been dry during the entire summer of 1995, with no water source in the area. Such an ecological niche is completely new for the genus. Placement in one of the three sections of *Vibrissa* proved difficult, and redefinitions of *V. sect. Apostemium* and *V. sect. Microstemonium* are provided.

**FUNGAL ECOLOGY AND BIODIVERSITY IN ARID WESTERN NAMIBIA.** K. M. Jacobson, Dept. of Biology, Virginia Tech, Blacksburg, VA 24061.

The ecology and biodiversity of mycorrhizal and decomposer fungi were examined in the Namib Desert over a three year period. Fungal activity was closely associated with the duration of "wet" periods resulting from rainfall amounts as low as 11 mm. While fungal biodiversity is lower than in more mesic habitats, a number of desert-adapted fungal species are common; grow rapidly when moisture is available; are effective decomposers or common mycorrhizal symbionts; and produce spores and sporocarps in response to the drying cycle. Prior to this study, fungi were thought to be less integral to decomposition processes in deserts than in more mesic habitats. Because of the aridity, decomposition of buried plant material was primarily attributed to dry season activity of detritivores. In the Namib Desert, however, buried cellulose substrates, sequentially removed over two 10 month periods, revealed that most decomposition occurs during the brief wet season. My studies show that fungal decomposers and VA-mycorrhizal fungi in arid western Namibia are well adapted to small, infrequent rains and may therefore be as integral to below-ground ecosystem processes in deserts as fungi in more mesic habitats.

**THE FUNGUS-PARASITIZED NEMATODE: RELEVANCE TO FUNGAL LIFE HISTORY AND NEMATODE BIOLOGICAL CONTROL.** B. A. Jaffee, Department of Nematology, University of California, Davis, CA 95616-8668.

The fungus-parasitized nematode is an essential stage in the life history of at least some nematophagous fungi. For example, the Hyphomycete *Hirsutella rhossiliensis* is a poor competitive saprophyte and depends on nematodes: In natural epidemics, all infective propagules (adhesive conidia) are produced from parasitized nematodes. Such nematodes are readily extracted from soil and produce many conidia when added back to soil. The *H. rhossiliensis*-parasitized nematode therefore is an effective although impractical 'formulation' for biological control of nematodes via inoculative or inundative release. In contrast, nematodes parasitized by trapping fungi, such as *Monacrosporium cionopagum*, are not readily extracted from soil, and their ecological significance in fungal life history is unclear. Nevertheless, when added to soil, *M. cionopagum*-parasitized nematodes produce many traps (adhesive branches) and substantially suppress nematode invasion of roots. As a substitute for the parasitized nematode, we have formulated both fungi as assimilative hyphae in alginate pellets. Pelletized *M. cionopagum* has suppressed nematodes in field plots.

**PRELIMINARY ESTIMATES OF PHYLOGENETIC RELATIONSHIPS WITHIN THE GENUS XEROMPHALINA KÜHNER & MAIRE (AGARICALES, XERULACEAE).** J. E. Johnson, R. H. Petersen, and K. W. Hughes, Botany Department, The University of Tennessee, Knoxville, TN 37996-1100.

*Xeromphalina* comprises 13 commonly recognized species in the North Temperate Zone, with several additional species described from the Southern Hemisphere. Sequences of the internal transcribed spacers (ITS1 and ITS2) along with the 5.8s ribosomal RNA gene were obtained for 12 species of *Xeromphalina*, including the South American taxon, *X. austroandina* Singer, and the outgroup taxon, *Baeospora myosura* (Fr.) Singer. Phylogenies were reconstructed using parsimony, neighbor-joining, and maximum-likelihood. In addition, the effects of different gap weights in alignment, weights of transitions vs. transversions, and weights of insertions/deletions (indels) were investigated. Initial results indicate good support for the major taxonomic subdivisions of the genus. Additional correlations between published taxonomies, morphological observations, and initial mating data are discussed.

1996 MSA Abstracts, page 14
PHYLOGENETIC RELATIONSHIPS WITHIN LEPIOTA (SENSU LATO) INFERRED FROM NUCLEAR AND MITOCHONDRIAL RIBOSOMAL DNA SEQUENCES.
Jacqui Johnson and Rytas Vilgalys, Dept. of Botany, Duke University, Durham, NC 27708.

Do segregate genera within Lepiota s. l. represent monophyletic groups? Exemplar DNA sequences from two genes (nuclear large subunit rDNA and mitochondrial small subunit rDNA) were sampled from several segregate taxa. Gene phylogenies from both data sets support the division of Lepiota s. l. into several commonly recognized groups, including Leucocoprinus, Lepiota s. str., and Macroplepiota. However, phylogenetic analysis also demonstrates that Lepiota s. l. may be paraphyletic, since several dark-spored agaric lineages including Coprinus comatus, Coprinus sterquilinus, Montagnea arenaria, and Podaxis pisillaris are nested within Lepiota s. l. Two lineages of fungi cultivated by attine ants (Chapela, et al. 1994) were also found to be closely related with two distinct clades of lepiotoid agarics (G1 group with Lepiota s. str. and G3 group with Leucoagaricus species). Problems with taxonomic circumscription based on phylogenetic criteria will be discussed.

INTRAGENOMIC VARIATION IN 18S rDNA SEQUENCES FROM PYXIDIOPHORA ARVENSENSE DUE TO THE VARIABLE PRESENCE OF A TYPE I INTRON. K. G. Jones and M. Blackwell, Louisiana State University, Baton Rouge, LA 70803.

Polymerase chain reaction amplification of 18S rDNA sequences from the mycoparasitic ascomycete fungus Pyxidiophora arvensense yields two products in approximately equal amounts which differ in size by 400 bp. Sequencing of the two fragments revealed that the intragenomic length variation is due to the variable presence of a type I intron inserted towards the 3' ends of the longer 18S rDNA copies. The intron in P. arvensense shares features of secondary structure with a mitochondrial type I intron in Podospora anserina. A survey of 18S rDNA products from an additional 12 isolates of Pyxidiophora failed to detect introns in other members of the genus. These data are discussed in relation to the distribution of type I introns and molecular drive in fungi.

FIFTY FIVE MILLION YEAR OLD FUNGI FROM THE ICEBERG BAY FORMATION, AXEL HEIBERG ISLAND, NORTHWEST TERRITORIES, CANADA. R. M. Kalugutkar, Geological Survey of Canada, Calgary, Alberta, Canada.

Well preserved remains of fungal spores and fructifications were encountered during the palynological study of the Iceberg Bay Formation at Kanguk Peninsula, Axel Heiberg Island, Arctic Canada. Controlled oxidation yielded good recoveries of fungi from 12 of 35 samples from Section RAK-83-27. A total of 36 genera and 74 species of dispersed fungi including 7 genera of microthyriaceous ascosporas and 29 genera of spores were investigated. Nineteen new species are illustrated. The flora is characterized by the presence of distinctive spores such as Cercosporites salmonii sp. nov., Ctenosporites eskerensis, Heliciumites goosii, Helicosporiates pirozyinskii, Pesavis tagluensis, and species of microthyriaceous genera namely Callimothallus, Euthythyrites, Microthyrites, Paramicrothallites, Phragmothyrites, Plochmopeltinites and Trichothyrites. Some species are restricted to only one sample and others to just a few samples in their stratigraphic distribution. An age of Late Paleocene to Early Eocene (between 60 to 50 million years old) and a mesothermal humid climate can be inferred from the total fungal assemblage. The possible affinities of some genera and species to modern taxa are suggested.


Fungal septation, a type of secondary wall growth, is analogous to cytokinesis in most organisms. In Aspergillus it is correlated with the mitotic cycle, cell growth, and hyphal features, segmenting multinucleate hyphae into compartments each with 2-3 nuclei. Details of Aspergillus septation are being identified by analyzing aspB actuate mutants and septin homologs. Mutants defective only in temporal/spatial septation controls are expected to have abnormally spaced or precocious septa. Five such strains were identified in a morphological screen of ts-mutants, and were shown by standard methods to be nonlethal, recessive defects in single independent genes (hypA-E for hypercellular). Here, we describe the hypA phenotype. At restrictive temperature, ≥37°C, hypA strains grow slowly, producing short, wide germlings with >wildtype numbers of nuclei and septa per hyphal length, and delayed conidiation. Shifting hypA germlings from 28°C to 42°C inhibited tip extension and induced growth in basal regions. Thus, it appears that hypA regulates both tip and secondary growth.

ECOLOGICAL AND LIFE HISTORY OBSERVATIONS OF A RARE ASCOMYCETE, CHORIOACTIS GEASTER, THE DEVIL'S CIGAR. H. W. Keller, Univ. of North Texas Health Science Center, Fort Worth, TX 76107; and K. C. Rudy, River Legacy Foundation, Box 150392, Arlington, TX 76015.

Chorioactis geaster was first described as new by Charles Peck in 1893. The type locality was designated as Austin, Texas. Since then it has been collected from several localities in Texas and two sites in Japan. This unusual fungus has earned the name "Devil's Cigar" for two good reasons: first, the three-inch apothecium is a dark brown, tough, spindled-shaped tube that somewhat resembles a short cigar; second, as it matures, splitting open from its apex to form a sizable earth star, it audibly releases a smokelike cloud of spores. In 1991 it was first discovered growing on decaying cedar elm stumps in River Legacy Parks, Arlington (Tarrant County), Texas. It is now known from over 50 different sites in the park. Its growth habit, development, seasonality patterns and geographical distribution will be discussed. This bizarre, cigarlike, exploding fungus has been adopted as a totem for River Legacy Parks and its new Living Science Center. It has been featured in The Mycophile and The Mycophile, used as a fund raiser for the new building through the sale of t-shirts bearing colored fruiting bodies, and has created public awareness and interest in the ecology of the park.

1996 MSA Abstracts, page 15
ORCHID RUST FUNGI (UREDINALES) OF THE WORLD. M. Kenney, Pathologist, USDA, APHIS, PPQ - JFKIA, Bldg #77, Jamaica, NY 11430.

The Orchid family (Orchidaceae) is large and economically important and many are imported into the U.S. for propagation and as cut flowers. About 30 species of rusts in 9 genera are known and many are of plant quarantine interest. Rust fungi have been recorded on orchids worldwide. The largest number of species have been described from Latin America. Morphologically distinctive species are: Uredo phajii and U. behnickiana with super stomatal sori, Puccinia anhewiana with amphisporic urediospores, and P. humationis with indehiscent, deep-seated telia. Rusts are often found on orchids inspected at U.S. ports of entry; five species have been described as a result of interceptions by USDA Plant Protection and Quarantine officers.

STUDIES ON EMERICELLA ISOLATES AT THE E. NIDULANS - E. RUGULOSA INTERFACE. M. A. Klich1, J. W. Bennett2, and M. C. Mendoza2, 1USDA, ARS Southern Regional Research Center, P.O. Box 19687, New Orleans LA 70179; and 2Dept. Cell & Molecular Biology, Tulane University, New Orleans, LA 70118.

A number of Emericella isolates were observed to have some macroscopic characteristics of E. rugulosa, but the smooth ascospore walls characteristic of E. nidulans. The morphological characteristics of the interface (E. nidlrug) isolates were more similar to those of E. rugulosa than those of E. nidulans. All of the E. nidlrug and E. rugulosa isolates produced the mycotoxin sterigmatocystin on Shift and YES media, whereas the E. nidulans isolates observed did not. Thin layer chromatography of mycelial/substrate extracts yielded identical metabolic patterns for E. nidlrug and E. rugulosa isolates on YES medium, and the patterns for E. nidlrug were more similar to those of E. rugulosa than to E. nidulans for extracts made from three other media. Southern blots of genomic DNA probed with the sterigmatocystin pathway gene ver-1 yielded identical patterns for E. nidlrug and E. rugulosa which were distinct from those for E. nidulans. We conclude that E. nidlrug is probably a non-rugulose variety of E. rugulosa.

PHYLOGENETIC ANALYSIS OF TRICHAPTM SPECIES SHOWED THAT STRAINS OF EACH SPECIES FORMED A SEPARATE GROUP, BUT EACH OF TWO T. ABIEITUM STRAINS FORMED ANOTHER INDEPENDENT GROUP. IT MAY BE INFERRABLE THAT EACH TRICHAPTM SPECIES IS PHYLOGENETICALLY DISTINCT AND, IN CASE OF T. ABIEITUM, IT SEEMS TO BE UNDER WAY TO DIVERSION. PRESENT RESULTS SUGGEST SIMILAR PROJECTIONS FOR BOTH 18S rRNA GENE AND ITS1-5.8S-ITS2 REGION ANALYSES. AND EXAMINATION OF BASE SUBSTITUTIONS OF 18S rRNA GENE REVEALS THAT THE C-T TRANSITION IS MOST PRONUNCED AND THAT THERE IS A STRONGER TRANSITION BIAS TOWARD BETWEEN CLOSELY RELATED ORGANISMS RATHER THAN BETWEEN DISTANTLY RELATED ONES.

RANDOM ASSOCIATION AMONG LOCI IN CLONAL POPULATIONS SCLEROTINIA SCLEROTIORUM ON CANOLA. Y. Kohli and L. M. Kohn, Dept. of Botany, Univ. of Toronto, Mississauga, Ontario L5L 1C6, Canada.

Multiple loci identified in DNA fingerprints were used to test for panmixia in populations of S. sclerotiorum on canola. Two indirect methods were employed to test for random association among 53 loci in a sample of 2747 isolates and in a sample of 594 unique genotypes, censored to include only one representative of each genotype. Multilocus association analysis, based on the distribution of allelic mismatches between pairs of isolates over all loci, showed a significant non-random association among loci. Linkage disequilibrium (LD) analysis among the pairs of fingerprint fragments, ranging in frequency from 0.1 to 0.9, indicated random association among 62% of pairs of fragments. Significant clonality was observed in tests of LD on the entire sample but not on the censored sample. Our data suggest that although the agricultural populations of S. sclerotiorum have a significant clonal component, the total genome is not tightly linked and that genetic exchange and recombination among some loci may result in the origin of new genotypes. Once originated, such genotypes probably amplify and propagate by clonal means.


A number of macrofungi with distributions restricted to eastern North America and eastern Asia have been reported in the literature. However, these putative disjunct distributions have not been rigorously tested. We are examining morphological and genetic divergence between selected putative disjuncts to test the validity of these reports. Micromorphological characters from North American, Chinese and Japanese samples of Amanita flavoconia, Boletus griseus, Lactarius gerardii, Leccinum eximium, Suillus picipus, and Xeromphalina kauffmanii were collected and analyzed using cluster analysis and PCA. Results from rDNA sequencing of the ITS region of DNA from North American and Costa Rican populations of Amanita flavoconia, with A. flavorecens as an outgroup, indicate that the ITS is too conserved to resolve population level relationships in Amanita.
The host range of *Syzygites megalocarpus* Ehrenb.:Fr., a presumptive necrotrophic mycoparasite, is poorly documented. This study, updated from our report in 1995, has now documented a total of 48 new (previously unreported) host genera, 85 new host species, and 11 new host families of fungi for *Syzygites*. *Syzygites megalocarpus* occurs on at least 98 host species in 65 genera from 22 different families of Basidiomycetes. Herbarium specimens and growth on *Morchella esculenta* (L.) Pers. in the laboratory show that *Syzygites* can also occur on at least four Ascomycetes. Potential hosts for *Syzygites* occur throughout the United States; yet, with the exception of Texas, we did not locate any evidence of collections in the Western half of the country. Further attention should be given to the geographic and host range of this fungus—particularly in the western half of the United States.

**REALIZED VERSUS OBSERVED SUCCESS OF VERTICAL AND HORIZONTAL TRANSMISSION OF A PLANT PATHOGEN.** Paula X. Kover and Keith Clay, Indiana University, 47401, Bloomington, IN.

*Atkinsonella hypoxylon* commonly infects the grass *Danthonia spicata*, castrating the host arial inflorescence and greatly reducing the host’s fitness. Such parasitic interaction is not expected to be maintained by high vertical transmission. However, 90% of the basal seeds produced by infected plants carry fungal hyphae, and horizontal transmission is seldom observed in the field. Horizontal transmission of *A. hypoxylon* is associated with sexual reproduction, while vertical transmission occurs through vegetative growth of hyphae into the host’s seeds. In the 3 populations investigated with RAPD markers, genotypic diversity was not significantly different from their expected values under the assumption of panmixia. Only one of the populations shows weak evidence of linkage disequilibria when allele associations in loci pairwise comparisons were carried and multilocus measures of loci association were estimated. We conclude that most of the established genotypes of *A. hypoxylon* in natural populations are derived from sexual reproduction and therefore horizontal transmission.

**EVOLUTIONARY ORIGINS OF EPICHLOÊ SPECIES AND COEVOLUTION WITH HOST GRASSES.** Gretchen A. Kulda, Kuang-Ren Chung, Malcolm R. Siegel, and Christopher L. Scharl, Dept. of Plant Pathology, Univ. of Kentucky, Lexington, KY 40546-0091.

EpichloÊ species and the asexual *Acremonium* relatives are endophytes of cool season grasses and classified in the Clavicipitaceae. Molecular phylogenetic analyses of large subunit rDNA sequences of EpichloÊ species and other genera in Clavicipitaceae show these endophytes form a distinct clade. Within this family, plant-associated genera group together separately from animal- or fungal-associated genera. EpichloÊ symbioses span the continuum from mutualism to antagonism. Many symbioses exhibit both types of interactions on the same plant and are termed pleiotropic. Using molecular phylogenetic methods we examined the question of whether any EpichloÊ species have evolved by common descent with their hosts. Evidence for common descent was strongest for the five pleiotropic EpichloÊ species. These observations suggest that the coevolution of symbioses in which costs and benefits are finely balanced are the most likely to involve common descent.

**ECOLOGICAL STUDIES OF YEASTS AND THE WINE INDUSTRY.** R. E. Kunkee, University of California, Davis, CA 95616.

For almost 100 years after Pasteur’s spectacular discoveries, there was little further investigation on the fermentative activities of wine microbes. Some starters were employed for a short time in France and some investigations of wine lactic acid bacteria were made in Germany. Instead, active ecological investigations were made, providing important information on the indigenous yeast on grapes: especially, *Hansenia, Hanseniaspora, Kloekera, Candida* and *Meichnikowia*. These genera were found to be responsible for the initiation of natural fermentations—which were then completed by wine strains of *Saccharomyces*. Modern winemakers are extending Pasteur’s work to define the best conditions for various *Saccharomyces* strains—which now, at last, can be precisely identified. However, it is only now being realized that the latter strains are rarely present on grapes, even though the major portion of global wine production is made without deliberate inoculation. Some conflicts have developed—what are the origins of the indigenous strains and what are their effects? There is lots of anecdotal evidence for the importance of favorite strains, but little else.

**INTRON PHYLOGENY SUPPORTS rDNA PHYLOGENY IN TWO GROUPS OF RAMALINA LICHENS.** Scott LaGreca and Rytas Vilgalys, Department of Botany, Duke University, Durham, NC 27708.

Do intron and exon sequences share a common evolutionary history? The current study examines this question using ribosomal DNA (rDNA) genes in the lichen genus *Ramalina*. While sequencing the rDNA internal transcribed spacer (ITS) regions for a phylogenetic study of *Ramalina*, a 240 bp Group I intron was identified at base position 1516 in the 18S gene of four species, including multiple representatives of the *R. americana* species complex. In addition, a 310 bp Group I intron was discovered at position 1506 of this gene in five different species, including four from the SE US coastal plain. A phylogenetic analysis was performed on both groups of intron sequences, and in both cases, the intron-derived phylogeny agrees with the ITS-derived phylogeny at low taxonomic levels. These results support the idea (DePriest, 1995) that rDNA introns evolve in situ within groups of recently diverged taxa.
IN SPECIFIC RAPD MARKERS FOR COLOR PRODUCTION IN MONASCUS SPP. K. Lakrod, C. Chaisrisook, and B. Yongsmit, Department of Microbiology, Faculty of Science, Kasetsart University, Bangkok 10900, Thailand.

Polymorphisms in total DNAs of 25 isolates of Monascus spp. isolated from red rice (an-kak) or red fermented tofu curds from Thailand, China and Japan were investigated. Red, yellow, and albino color mutants generated from Thai wild-type (KB11304) were included as controls. Random decamer sequences of DNA were used as primers to reveal RAPD patterns. Optimal conditions for the RAPD assay with Monascus were investigated. One of 25 decamers provided a DNA fragment tentatively associated with the color marker. Several additional RAPD markers loosely associated with color variants are being examined. We anticipate using fragments associated with the color markers as DNA probes to detect and locate color-producing gene(s) on chromosomes of Monascus revealed by molecular karyotyping.

OSMOTIC TOLERANCE AND ION CHANNELS IN PROTOPLASTS OF ENTOMOPHAGA AULICAE. M. Lamb, P. Moody-Corbett, and F. Murrin, Dept. of Biology and Faculty of Medicine, Memorial University, St. John's, NF A1B 3X9, Canada.

Fungi of the genus Entomophaga are potential biocontrol agents against economically important insect pests. The fungus proliferates in the insect hemolymph as cell-free protoplasts. These cells are used as inoculum for mass fermentation production. We studied the osmotic stability of the protoplasts. Protoplasts of E. aulicae were capable of surviving in solutions ranging from 0 to 550 mOsm with the optimal range from 350 to 550 mOsm. Whole cell and single channel recordings indicated the presence of voltage-gated ion channels. Outward rectifying channels were triggered by membrane depolarization. These ion channels may be involved in osmoregulation in entomophthoralean protoplasts.

EFFECTS OF CALCIUM AND MANGANESE ON EDIBLE MUSHROOM PLEUROTUS PULMONARIUS. S. C. Law and S. W. Chiu, Department of Biology, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong.

Effects of three calcium salts and three manganese salts on various developmental stages of oyster mushroom, Pleurotus pulmonarius, were examined. Two mushroom strains which have been characterized by arbitrarily-primed polymerase chain reaction were used. It was found that these two strains responded differently to some metal treatments. Basidiospore germination required the presence of exogenous metals but was inhibited at metal concentrations tolerant by vegetative mycelia. In contrast to the nonlethal doses of the calcium salts with tested concentrations up to 100 mM, the minimum inhibitory concentrations of the manganese compounds fell at 20 mM for both strains. The more the metal was added to the medium, the more the metal translocated to the vegetative mycelium. Addition of the sublethal concentrations of manganese decreased the fruiting initiation in vitro and crop yield in straw-based compost whereas the calcium salts had a beneficial effect, enhancing fruit-body initiation and yield. The metal content in fruit-body could be increased by the higher concentrations in substrate. Together with the amino acid profile, addition of calcium can improve the nutritional values of the mushroom crop.

AN EOCENE TAR SPOT FROM A SUBTROPICAL TERRESTRIAL PALEOECOSYSTEM AND ITS FUNGAL HYPERPARASITE. B. A. LePage, R. S. Currah, and R. A. Stockey, Dept. of Biological Sciences, University of Alberta, Edmonton, Alberta T6G 2E9, Canada.

Exquisitely preserved, permineralized fungal remains are abundant in the Middle Eocene Princeton chert deposit of southern British Columbia. Some of these fossils represent the fructifications of a Phyllachora-like fungus on both the upper and lower surfaces of leaves of an extinct coryphoid palm, Ulhia allenbyensis. Robust erumpent stromata are approximately 1 mm thick, up to 13 mm across and are composed of a thick layer of distinctive columnar cells and an external layer of isodiametric cells. Locules are approximately 500 μm across, form a single layer through the stromata and are mostly empty, although some contain large, clavate, multicelled Brachysporiella-like conidia up to 30 μm long and 12 μm wide. Others contain globose ascospores, some of which display asci and rows of bicelled ascospores. These intralocular structures resemble the modern genus Didymosphaeria, species of which are known parasites on living species of Phyllachora. These fossils are the first report of mycoparasitism from a subtropical terrestrial paleoecosystem.

HERMAPHRODITE FREQUENCY AND THE FREQUENCY OF SEXUAL REPRODUCTION IN FUNGAL POPULATIONS. John F. Leslie and Keith K. Klein, Dept. of Plant Pathology, Kansas State University, Manhattan, KS; Dept. of Biological Sciences, Mankato State University, Mankato, MN.

The relative number of hermaphrodites and female-sterile (fs) strains can be used to estimate the number of asexual generations per sexual generation. The fs mutants are at a selective disadvantage every time sexual reproduction occurs. To overcome this disadvantage, the fs strains must have a selective advantage during asexual growth. When a significant frequency of fs strains is observed in a field population it indicates that asexual reproduction is a significant component of the fungus's life cycle. Depending on the mutation rate to female sterility and the selective advantage of the fs strains during asexual growth, the ratio of sexual:asexual generations can range from 1:15 to 1:2300 for some species in the Gibberella fujikuroi species complex. The relative rarity of sexual reproduction may permit the accumulation of fs strains to such a level that some populations could completely lose sexuality, permitting the evolution of asexual (imperfect) species.

1996 MSA Abstracts, page 18
ULTRASTRUCTURAL STUDIES OF PICOA CARTHUSIANA (HYPOGEOUS PEZIZALES). Li-Tzu Li, Plant Pathology Department, P.O. Box 110680, University of Florida, Gainesville, FL 32611.

Ascospores and septal structures of both vegetative and reproductive hyphae of Picoa carthusiana were studied ultrastructurally. The apiculate ascospore contains a couple of large gutules and multiple nuclei (more than four). Early spore wall development is similar to that of most epigeous and hypogeous Pezizales studied. The mature spore wall has a very thick primary wall with a brick-like arrangement of wall fibers and a three-layered epispor. Septal structures of vegetative hyphae are constructed of laminate pore plugs and globose, hexagonal, and cylindrical Woronin bodies which are found typically in the Pezizales. In reproductive hyphae, septal pore plugs are dome-shaped with central laminations. Cylindrical Woronin bodies are found around the septal pore in ascus bases. Based upon ultrastructural data, P. carthusiana is closely related to the Morchellaceae and Helvellaceae. However, the placement of P. carthusiana in either family is not certain.

ENTOLOMA ABORTIVUM AS A PARASITE OF ARMILLARIA. Daniel L. Lindner, Thomas J. Volk, and Harold H. Burdsall, Jr., Center for Forest Mycology Research, Forest Products Lab, One Gifford Pinchot Dr., Madison, WI 53705.

Careful field observations indicate that carpophoroids traditionally attributed to Entoloma abortivum (Aborted Entolomas) represent malformed basidiomata of Armillaria species permeated by E. abortivum hyphae. This contrasts the generally accepted hypothesis that carpophoroids are E. abortivum basidiomata that have failed to develop due to colonization by Armillaria. Our work with field-collected material (1) confirmed the presence of active Armillaria and E. abortivum hyphae in carpophoroids (2) verified that carpophoroids often form Armillaria-like basidia and spores and (3) indicated that carpophoroids reportedly formed by A. mellea s.l. are most likely the same structures as the carpophoroids attributed to E. abortivum. Our field observations led to laboratory studies in which we inoculated pure cultures of fruiting A. tabescens with E. abortivum, which is not known to fruit under cultural conditions. E. abortivum grew well on A. tabescens fruiting structures and, in one instance, a structure resembling an immature carpophoroid was formed. This is further evidence that the fruiting mechanisms of Armillaria are involved in carpophoroid formation and may indicate that carpophoroids can be formed when a flowering Armillaria mycelium and a vegetative E. abortivum mycelium interact. Verification of this scenario would suggest that E. abortivum is a parasite of Armillaria. Such a finding could be a significant step toward developing a biological control of Armillaria species.

PHYSIOLOGIC ORIGINS OF THE ASEXUAL MYCORRHIZAL SYMBIONT CENOCOCCUM GEOPHILUM FR. AND OTHER MYCORRHIZAL FUNGI AMONG THE ASCOMYCETES. K. F. LoBuglio and John W. Taylor, University of California, Berkeley, CA 94720.

Recently, DNA sequencing has been undertaken for a number of protein-encoding nuclear genes of fungi in order to extend phylogenetic studies to this major sector of the genome. RP2, the gene for the second-largest subunit of nuclear RNA polymerase II, is attractive for such studies because it is ubiquitous, highly conserved (in part) and present in one copy per cell. To efficiently recover and sequence RP2 genes from many different fungi, we have designed several degenerate primers based upon RP2 sequences conserved in yeasts, animals and plants. With these, we have been able to sequence the RP2 genes from seven different ascomycetes. Because different regions of the sequence have diverged at quite disparate rates, they can prove useful for exploring phylogenetic relationships at different levels. We shall discuss applications of this principle, as well as the prospects for developing specific (i.e. non-degenerate in sequence) RP2 primers for selected groups of fungi.

1996 MSA Abstracts, page 19
A fungus associated with decline and mortality of big-leaved mahogany trees in Puerto Rico appears to be *Beenachia fuliginosa*, a species described from Zambia and previously known only from the type locality. It was originally placed in its own genus, *Psathyrodon*. The basidiomes are spongy, monomitic, and turn from white to pale yellow and gray. The teeth are soft, rounded, and ca. 1 cm long. Basidiospores are colorless, verruculose, and 6-8 x 3.8-4.8 μm. Basidiospores germinate readily to produce yellow cottony cultures that turn gray and produce highly ornamented, golden chlamydospores. A monokaryon was isolated from the disease front of a declining mahogany, and these cultures match those of dikaryons from basidiomes and basidiospores. Cottony yellow rhizomorphs are associated with dead and dying medium to large roots of the mahogany trees. Inoculation trials are currently underway.

**CYTOSKELETON INVOLVEMENT IN THE ESTABLISHMENT AND MAINTENANCE OF NUCLEAR POSITIONS IN ZOOSPORANGIA OF ALLOMYCETES MACROGYNUS.** D. S. Lowry and R. W. Roberson, Department of Botany, Arizona State University, Tempe, AZ 85287-1601.

The involvement of microtubules and actin microfilaments in the establishment of uniform nuclear spacing in the multinucleate zoosporangia (ZS) of *Allomyces macrogyrus* was assessed using cytoskeleton disrupting treatments and documented with light and electron microscopy. The inhibitory treatments were also used with centrifugation of ZS to determine the role of the cytoskeleton in maintaining nuclear positions once uniform spacing has been established. The results suggest that both the tubulin and actin cytoskeletons are involved in establishing uniform nuclear spacing. Centrifugation tests indicate the microtubule cytoskeleton is primarily responsible for anchoring nuclei in position following the establishment of uniform spacing.

**ASCOMYCETE ISOLATION FROM WHITE SPRUCE NURSE LOGS USING AGAR SUPPLEMENTED WITH CYCLOHEXIMIDE.** T. C. Lumley and R. S. Currah, Department of Biological Sciences, University of Alberta, Edmonton, Alberta T6G 2E9, Canada.

Nurse logs are prostrate tree stems that provide a habitat for the growth of gymnosperms, ericas, and orchids in the boreal forest. These logs represent a transition in microfungus communities, from one of primarily wood decay to one that more closely resembles those that occur in soil. During the summer of 1995, a log of *Picea glauca* (white spruce) harboring white spruce seedlings was sampled for microfungi. Many common soil fungi were isolated using malt extract agar and tapwater agar, including species of *Trichoderma*, *Paecilomyces*, *Penicillium*, and *Oidiodendron*, as well as zygomycetes, such as *Mortierella* spp. and *Mucor* spp. However, isolation using Mycobiotic agar (containing cycloheximide) yielded rarely-isolated ascomycetes from the Onygenales. *Uncinocarpus uncinatus*, which is keratinolytic, and *Gymnascella liitoralis*, which is hitherto known only from marine invertebrates, and members of the anamorphic genera *Chrysosporium* and *Geomyces* were isolated. The role these fungi play in nurse log microfungus communities is unclear.

**SELFING AND HETEROOTHALLISM IN CRYPTONECTRIA PARASITICA.** R. E. Marra and M. G. Milgroom, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853.

It has been shown that natural populations of *C. parasitica* in the eastern US have selfing rates of approximately 25%. However, in the laboratory selfing is rare, and crosses reveal a robust bipolar heterothallic mating system. We have recently been able to obtain self-fertilizations from several genotypes. Two subsequent clonal generations from one of these (WV43-1-3) have a similar propensity for selfing. Interestingly, the clonal ascospore progeny from any one of these selfed perithecia segregate for mating type, and a small fraction are able to cross with both mating types. Single conidia from one of these ascospores (A17-5) were similarly self-fertile, and interfertile with both mating types. A conserved mating type domain (HMG), which is found in one of the two mating types of all heterothallic ascomycetes studied so far, has been cloned from a *Mat-1* strain of *C. parasitica*, and has been shown to hybridize specifically to all other *Mat-1* strains, and not to *Mat-2* strains. Segregation for this mating-type specific marker has been observed in all clonal ascospore sets probed so far, confirming laboratory crossing data, and providing strong evidence that a possibly unique genetic mechanism allows a single haploid genotype to self-fertilize and transmit to its clonal progeny segregating mating-type alleles.


Smith and Hesler (1968) defined the *Pholiota alnicola* complex as being comprised of 3 species, two with varietal forms. Utilizing 69 collections and cultures of members from this complex from North America and Europe a study to resolve the systematics of this complex has been conducted. Methods used include: (1) phenetic analysis of morphological data from basidiomata; (2) examination of type specimens; (3) phenetic analysis of the culture morphology; (4) elucidation of mating systems; (5) determination of interbreeding compatibility; and (6) comparison of enzyme profiles. Results from these data sets show this to be a highly variable complex that does not separate according to Smith & Hesler's morphospecies concepts.

The Pholiota spumosa complex as defined by Smith & Hesler (1968) comprises 9 morphospecies. Using 50 collections and cultures (mono- and dikaryons) of members of this complex from North America and Europe, the following study was conducted to resolve the systematics of this complex: (1) phenetic analysis of morphological data obtained from basidiomata; (2) examination of type specimens; (3) phenetic analysis of the culture morphology; (4) elucidation of mating systems; (5) determination of intra- and intercontinental interbreeding compatibility; and (6) comparison of extra- and intracellular enzyme profiles. Examination and correlation of these various data sets will be discussed and contraction of the number of acceptable names proposed by Smith & Hesler is recommended.

CHARACTERIZATION OF VESICLE MOTION IN HYPHAL CELLS OF ALLOMYCES MACROGYNUS. D. P. McDaniel and R. W. Roberson, Department of Botany, Box 871601, Arizona State University, Tempe, AZ 85287-1601.

Directed vesicle motion was observed and characterized in apical and subapical regions of hyphal cells of Allomyces macrognus. Motion data were obtained and studied using video-enhanced light microscopy and computer analysis. The vesicles, believed to represent multivesicular bodies, were approximately 0.5 - 1.0 μm in diameter and exhibited both orthograde and retrograde motility. Vesicles showed variability in their rates of travel, with orthograde movement generally being faster than retrograde (average 4.0 μm/s versus 2.2 μm/s). Some vesicles displayed short bursts of motion, traveling only a few micrometers before halting, while others displayed continuous motion for over 40 μm. Vesicles moved along discrete paths, with several often following the same path within a short period of time. Paths of vesicular motion were often coincident with mitochondrial position. The effects of cytoskeleton inhibiting drugs on vesicle behavior will be presented and discussed.

SEVERAL NEW SPECIES IN THE GENUS PHIALOPHORA. J. M. McKemy1, K. F. LoBuglio2, Z. H. Yan3, and C. J. K. Wang1, 1SUNY College of Environmental Science and Forestry, Syracuse, NY 13210; 2University of California, Berkeley, CA 94720; 3National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709.

During the last several years, isolates belonging to the form-genus Phialophora have been obtained in pure culture from soil and decaying creosote-treated utility poles. Critical examination of these isolates has revealed that they differ from the more than 40 described species in Phialophora. Therefore, we propose that these isolates represent hitherto undescribed species and are describing them as new.

CHESTNUT BLIGHT FUNGUS POPULATION BIOLOGY. M. G. Milgroom, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

The diversity of multilocus genotypes, such as vegetative compatibility (vc) types, is correlated to the reproductive mode of Cryphonectria parasitica. Populations in the Appalachian region of the US are sexually-reproducing and have high diversity of vc types. Clonal populations in Italy and Michigan have few vc types and deviate significantly from random mating. In Italy, only 20 vc types have been observed although there is potential for 64 vc types (6 polymorphic vic loci). Although perithecia are common in most Italian populations, recombinant genotypes are not prevalent. The proportions of selfed perithecia in Italian populations are similar to proportions found in the US. The causes of clonal population structure in Italy is not understood but may be related to environmental conditions necessary for survival or infection.

SPECIES OF HEBELOMA IN ALASKAN ARCTIC TUNDRA. Orson K. Miller, Jr., Dept. Biology, Virginia Tech., Blacksburg, VA 24061.

Hebeloma (Agaricales, Cortinariaceae) are ectomycorrhizal fungi associated with families of Angiosperms and Gymnosperms. In Arctic and subalpine tundra the principal host plants are species of Salix, Betula, and Dryas. Ectomycorrhizal plants are preferentially found on dryer sites such as high center polygons, high river banks, and low hills created by the frost and thaw cycle in tundra. In Arctic tundra H. kühneri and H. pusillum are associated with Salix and H. alpinum with Salix and possibly Dryas. A nunatak in the Kaskawulsh Glacier, Donjak Mts., Yukon Territory has H. pusillum associated with Salix species in the initial stage of recolonization of newly released land. The systematics, distributions, and host relationships of additional taxa in Hebeloma, as yet unnamed, are discussed in light of the known species which have circumpolar distributions in both Arctic and subalpine tundra.

THE ROLE OF FUNGI IN SOIL BIOTECHNOLOGY. R. Michael Miller, Environmental Research Division, Argonne National Laboratory, Argonne, IL 60439.

The importance of the aggregated state in soil comes not only from its role in controlling soil erosion, but also because aggregates facilitate the creation of a soil's nutrient reserve. Without the physical protection afforded within stable aggregates, organic matter may be rapidly lost through both mineralization and erosion. The stabilization of higher hierarchical orders of soil particles into stable aggregated units appears to depend upon soil particles being enmeshed in roots and the hyphae of mycorrhizal fungi. Moreover, the stability of soil aggregates is maintained not only by physical entanglement of the soil particles by roots and hyphae, but also from the stabilizing properties of plant and microbially derived polysaccharides and mucigel. Recent studies also indicate that fungal hyphae also exude a hydrophobin-like substance, glomulin, that acts as a hydrophobic glue with the amount of glomulin directly related to the soil's structural stability and the amount and kinds of arbuscular fungi present. I will discuss how...
the mycorrhizal fungus can be used as an integrator for understanding the restoration of degraded soil systems by using examples from our experiences with agroecosystem and prairie restorations.

ULTRASTRUCTURE OF CONIDIA AND CONIDIUM GERMINATION IN THE PLANT PATHOGENIC FUNGUS *ALTERNARIA CASSIAE*. C. W. Mims1, M. A. Rogers2, and C. G. Van Dyke3, 1Dept. of Plant Pathology, Univ. of Georgia, Athens, GA 30601; 2Dept. of Biology, Campbellsville College, Campbellsville, KY 42718; and 3Dept. of Botany, North Carolina State Univ., Raleigh, NC 27695.

Hydrated conidia of *A. cassiae* were incubated for 1-3 h on pieces of dialysis membrane and then prepared for study with TEM using freeze substitution. Each large, darkly pigmented conidium was surrounded by a thick, two-layered wall and divided by transverse and longitudinal septa into multiple cells, each containing a typical complement of organelles including multiple nuclei. Germ tube development was visible by 2 h post-incubation and well-developed germ tubes were present by 3 h. Two modes of germ tube development were observed. Less commonly, germ tubes developed inside conidia and grew internally through one or more adjacent cells. Invaded cells appeared necrotic. More typically, germ tubes developed directly from the conidium surface. Multiple germ tubes arose from a single conidium. Those that contacted the underlying dialysis membrane grew along its surface. Extracellular material was produced in association with developing germ tubes.

COMMUNITY STRUCTURE OF PROTOSTELIDS. D. L. Moore and F. W. Spiegel, University of Arkansas, Department of Biological Sciences, Fayetteville, AR 72701.

A standardized technique using sterile wheat straw has been used to study protostelid communities in leaf litter and aerial microhabitats of forest and grassland habitats in Northwest Arkansas. Preliminary qualitative results suggested that certain species showed a preference for one microhabitat over the other. However, there appears to be little difference between protostelid communities in grasslands versus forests. Statistical analyses support these results. Drought events also appear to play a role in determining community structure in some habitats.

MORPHOLOGY, rDNA, AND CLADISTICS OF THE GANODERMATACEAE. Jean-Marc Moncalvo, Department of Botany, Duke University, Durham, NC 27708.

Morphological characters traditionally used for the systematics of Ganodermataceae Donk were mapped on a phylogenetic tree produced by rDNA sequences of about 60 taxa. The distribution of these characters was critically examined to evaluate their utility in assessing natural groups. A cladistic analysis using selected characters with taxa representing different combinations of these characters and/or belonging to the major taxonomic groups proposed to date (*Ganoderma, Elvewingia, Amauroderma, Haddowia, Humphreya, Magodera, Tomophagus, Characoderna, Phaeonema,...*) was performed. Preliminary results suggest that some taxonomic groups should be abandoned and others redefined on the basis of monophyly; however, new combinations are not proposed. Instead, previously overlooked taxa which may represent distinct evolutionary lineages are discussed.

CONFIRMATION OF A LINK BETWEEN FUNGAL PIGMENTATION, TURGOR PRESSURE, AND PATHOGENICITY. Nicholas P. Money and Richard J. Howard*, Department of Botany, Miami University, Oxford, OH 45056; *DuPont Experimental Station, P. O. Box 80402, Wilmington, DE 19880-0402.

A requirement for melanin synthesis has been identified in a number of dark-pigmented fungi that cause disease in plants and animals. Previous work on the rice blast fungus *Magnaporthe grisea* is consistent with the idea that pigment deposition within the appressorial wall may be key to the generation of high turgor pressures that are required for host penetration. Using a novel technique, we have compared the pressures produced by appressoria of wild-type and melanin-deficient mutants of *M. grisea*. The method employs a cold stage to measure the melting point of ice within individual cells; turgor is then calculated from these data. The results of this study strengthen the hypothesis that melanin confers pathogenicity by facilitating the development of high pressures within appressoria. The new technique is suitable for work with cells that are too small for direct measurements of turgor with a pressure probe.

PROTOSTELIDS FROM TROPICAL FORESTS OF COSTA RICA AND PUERTO RICO. Donna L. Moore1, Steven L. Stephenson2, and Frederick W. Spiegel1, 1Dept. of Biological Sciences, University of Arkansas, Fayetteville, AR 72701; 2Dept. of Biology, Fairmont State College, Fairmont, WV 26554.

Protostelids are a group of simple mycetozoans which produce microscopic fruiting bodies that usually bear a single spore at the tip of a delicate stalk. Although these organisms are thought to be ubiquitous members of terrestrial decomposer communities, little is known about their distribution and ecology in nature. In the present study, samples of aerial (dead but still attached plant parts) and forest floor litter were collected from three study sites in Costa Rica and two study sites in Puerto Rico. Seven species of protostelids were recovered from samples collected in Puerto Rico, and samples collected in Costa Rica yielded 15 species, including one undescribed species. Species recorded from at least two study sites and/or litter types (i.e., aerial or forest floor) were *Nematosphelium gracile*, *N. ovatum*, *Protostelium arachisporum*, *P. mycophaga*, *Schizoplasmidiopsis pseudoendospora*, and *Schizoplasmmodium cavositoioides*. It is interesting to note that species of *Nematosphelium* that are almost exclusively found on forest floor litter in temperate habitats appear to be common on both aerial and forest floor litter in tropical habitats.
CHARACTERIZATION AND CLONING OF sepH, A GENE REQUIRED FOR SEPTATION IN ASPERGILLUS NIDULANS. Jennifer L. Morrell and John E. Hamer, Department of Biological Sciences, Purdue University, West Lafayette, IN 47907-1392.

We are investigating septation in the filamentous fungus Aspergillus nidulans. The hypha of A. nidulans are divided into multinucleated compartments by the formation of septa. We have previously shown that this process is coordinated with nuclear division and requires actin. Eight temperature-sensitive mutants that are defective in the process of septum formation (sep mutants) have been identified and phenotypically characterized (Harris et al., 1994. Genetics 136:517-532). Cloning and characterization of the sepH gene will be presented.

PHOTOTROPISM IN PENICILLIUM SERIES DUCLAUXII. J. J. Muchovej, Ornamental Horticulture, 306 Perry-Paige Building, Florida A&M University, Tallahassee, FL 32307.

The effects of various colors of light on the production and orientation of synnemata of Penicillium claviforme, P. clavigerum, P. duclauxii and P. isariiforme as well as on sporulation was determined. Penicillium claviforme and P. duclauxii produced synnemata independent of light and no orientation was observed, while P. clavigerum and P. isariiforme oriented synnemata in the direction of filters which allowed the passage of light in the blue spectral range. Spore production was usually higher in isolates when orientation was not produced.

KARYOTYPE MAPPING OF FOUR ASPERGILLUS NIGER ACID PHOSPHATASE GENES. E. Mullaney, C. B. Daly, K. Ehrlich, and B. Montalban, Southern Regional Research Center, USDA, ARS, New Orleans, LA.

Four Aspergillus niger extracellular acid phosphatase genes have recently been cloned, (aphA, phoA, phyA and phyB). When A. niger is grown under limited phosphate conditions, each of these acid phosphatases is secreted at high levels. Also all four genes are phosphate-repressible. Several of these enzymes are economically important because they can degrade phytic acid or they are thermally stable. In this study we employed CHEF gel electrophoresis and Southern analysis to determine the chromosome location of each gene. For some of the genes, it was necessary to use a series of A. niger tester strains with introduced chromosomal size variations to verify their chromosome assignment.

THERMOSTABLE PHYTASE IN ASPERGILLUS SPECIES. E. J. Mullaney, A. H. J. Ullah, and C. B. Daly, Southern Regional Research Center, ARS, USDA, New Orleans, LA.

The animal feed industry is seeking a thermostable phytase for use as a feed additive. Phytase makes the phytin phosphorus in soybean meal available and this reduces phosphorus contamination of groundwater from animal waste. A thermostable enzyme would survive the brief period of elevated temperature during pelleting in animal feed production. Aspergillus spp. isolates have now been identified that secrete an extracellular phytase with a much higher thermostability than found in the previously reported A. niger (ficuum) phytase. We hope to determine the molecular basis of this heat stability, i.e., primary structure, metal binding sites, disulfide bonds, etc., in order to enhance the thermostability of A. niger phytase.


Effects of DC fields applied parallel to growing hyphae until the Spitzenkörper retracted 1-2 μm from the apical pole were recorded by video-microscopy. Fields were then turned off, and the cells recovered. When a +30 V/cm field (anode distal) was applied, the Spitzenkörper retracted within 14 sec, and visible cytoplasmic contractions preceded Spitzenkörper retraction. Hyphal elongation rate quickly dropped to less than 25% of the pre-field rate, often approaching 0. When the field was discontinued, hyphal elongation resumed, reaching 25% of the pre-field rate in 2.5 minutes, 50% in less than 4 minutes, and 75% in 5.3 min. Spitzenkörper retraction with -30 V/cm fields (cathode distal) was 5x slower than with +30 V/cm fields. Hyphal elongation rate dropped to 50% of the pre-field rate when the field was applied, and no visible cytoplasmic contractions preceded Spitzenkörper retraction. Tip growth rate recovered to 75% of pre-field rates 2.5x faster than recovery from +30 V/cm fields. These responses to controlled electrical fields are reproducible and vary with polarity of the field. Electric field perturbation promises to be a valuable tool in the effort to help elucidate cytoplasmic dynamics involved in hyphal tip morphogenesis.

HIGHER FUNGI OF THE CHICAGO REGION IN THE TWENTIETH CENTURY. J. F. Murphy and G. M. Mueller, Department of Botany, The Field Museum, Chicago, IL 60605-2496.

In 1909, Dr. W. S. Moffatt published *The Higher Fungi of the Chicago Region*, a collaborative effort begun in 1898. Since that publication, fungal taxonomy and our understanding of systematics have changed considerably. So has the lay of the land, since much of the prairie-oak savanna ecotype sampled by Moffatt and collaborators has been destroyed by urban and suburban development. We have updated Moffatt's species list of Agaricales, Boletales, and Cantharellaceae, according to modern monographs and rules of nomenclature, and have checked some of Moffatt's identifications by direct examination of vouchers. We have listed all Field Museum accessions in these taxonomic groups from the Chicago region since 1909, and initiated an intensive local collecting campaign involving both mycologists and non-mycologists. The purposes of this work include establishing baseline data, developing reference lists for local fungal monitoring projects, and contributing to an understanding of species frequency and diversity and community structure in the Midwestern Oak Savanna ecotype.

1996 MSA Abstracts, page 23
**PHANEROCHAETE FLAVA - A CONSPICUOUS WOOD-INHABITING FUNGUS IN THE FORESTS OF PUERTO RICO.** K. K. Nakasone, D. J. Lodge, and H. H. Burdsall, Jr., Center for Forest Mycology Research, One Gifford Pinchot Drive, Madison, WI.

*Phanerochaete flava* (Burt) comb. nov., in ed. is a bright yellow, resupinate, wood-inhabiting basidiomycete commonly encountered on the forest floor in Puerto Rico and other tropical countries such as Jamaica and Brazil. It is characterized by fragile basidiocarps with abundant rhizomorphs. At the microscopic level, numerous crystals are found on the hyphae and cystidia. Chemical analyses of the crystals indicate that high levels of calcium (probably calcium oxalate) are present. Recent data show *P. flava* and other litter fungi with rhizomorphs may play an important role in nutrient recycling in forests and may be involved in competition with trees for limiting nutrients following disturbances that leave woody debris on the forest floor, such as hurricanes and logging.

**RELATIONSHIPS WITHIN THE PLEUROTUS DJAMOR SPECIES COMPLEX.** D. B. G. Nicholl and R. H. Petersen, Botany Dept., University of Tennessee, Knoxville, TN 37996.

*Pleurotus djamor* is a widespread tropical to subtropical species complex. This complex has been given many names based primarily on the color of the pileus and geographic origin of the collection. Three distinct basidiome morphologies have been described: 1) off-white, tan to pallid olive; 2) pink; 3) gray, fibrillose. Isolates representing these forms fruiting in the laboratory, indicate that these forms overlap even within a single collection. Intercollection crosses were performed to determine sexual compatibility (=dikaryotization) between collections. Initial results indicate universal compatibility between all morphotypes. Fruiting of these dikaryons is being attempted to ascertain possible interfertility among these forms and from diverse geographic locations. Macro- and micro-morphological characters will be examined to create a phenetic tree of relationships within this group.

**THE AGARIC GENUS PHAEOCOLLYBIA IN WESTERN NORTH AMERICA: NEW SPECIES.** L. L. Norvell and J. F. Ammirati, Department of Botany, Box 355325, University of Washington, Seattle, WA 98195.

Phenetic analyses of molecular, morphological, and ecological data sets support the existence of several new *Phaeocollybia* species in British Columbia, Washington, Oregon, and California. Co-migrating fragments produced by digesting PCR-amplified DNA from 160 representative basidiomes with 9 enzymes comprised a RFLP-based character set. Macro- and microcharacters--drawn from both recent collections and published descriptions of 62 known species--and environmental characters based on recent field observations were scored, coded, and respectively grouped into morphological and ecological sets. The 3 subset trees were then compared and pruned. Results from cluster and multivariate analyses of a combined character set support the existence of 25-30 PNW species. Types for 8 new species have been selected from cluster-centers, and circumscriptions of all PNW taxa have been expanded to represent a full intraspecific continuum. Morphologically distinct new species have continued to be discovered with each new field season, implying that the scope of this distinctive, once "small" genus will continue to expand.

**EUROPEAN HYPOVIRULENCE AND CONSTRUCTION OF TRANSGENIC FUNGAL STRAINS FOR BIOLOGICAL CONTROL OF CHESTNUT BLIGHT.** Donald L. Nuss, Center for Agricultural Biotechnology, University of Maryland Biotechnology Institute, College Park, MD 20742-3351.

Hypovirus-containing hypovirulent strains of the chestnut blight fungus Cryptococcus parasitica, while reported to effectively control chestnut blight in European chestnut tree orchards and forest ecosystems, have been less effective for biocontrol in North America. We recently described the cloning of a full-length cDNA copy of the prototypic hypovirus, CHV1713, derived from a European hypovirulent *C. parasitica* isolate. This development has led to the construction of transgenic "engineered" hypovirulent fungal strains with enhanced biocontrol potential for use in North America due to novel modes of hypovirus transmission. It has also been possible to modify hypovirus genetic information in the context of the infectious viral cDNA to generate hypovirulent strains altered in specific phenotypic traits that should increase ecological fitness and to establish infection of pathogenic fungi other than the natural host.

**COMPARISON OF CATION CONCENTRATIONS IN DECAYING RED SPRUCE SAPWOOD AND HEARTWOOD.** Andrea Ostrofsky and Jody Jellison, Dept. of Plant Biology and Pathology, Univ. of Maine, Orono, ME 04469-5722.

The ability of fungi to translocate cations is potentially relevant to the wood biodegradation process. Concentrations of cations in red spruce sapwood and heartwood blocks inoculated with one of 7 basidiomycetes were compared. Wood blocks were incubated in ASTM soil block jars for 8 months with one of the following: *Postia placenta*, Gloeophyllum trabeum, *Trametes versicolor*, *Phanerochaete chrysosporium*, Resinicium bicolor, *Scytinostroma galactinum*, Armillaria sp., or sterile agar serving as a control. Concentrations of Ca, Mg, K, Mn, Fe, and Al were determined with inductively coupled plasma emission spectroscopy and corrected for percent weight loss. As in previous studies, concentrations of Ca and Mg increased in decayed wood. Mn concentrations did not increase. Changes in resultant wood cation concentrations varied among the decay fungi. Similar decay-induced changes in cation concentration were observed in both sapwood and heartwood.

**ENRICHMENT OF VERTICILLIUM DAHLIAE RACE 2 SEQUENCES BY GENOMIC SUBTRACTION.** N. A. Patterson and K. F. Dobinson, Agriculture and Agri-Food Canada, 1391 Sandford St., London, Ontario N5V 4T3, Canada.

The method of genomic subtraction was used to enrich sequences from a race 2 isolate of *Verticillium dahliae*, the fungal pathogen that causes vascular wilt diseases on many plant species. Enrichment was achieved by removing the sequences in the race...
2 DNA that are homologous to sequences of DNA obtained from a race 1 or a nonpathogenic isolate of tomato. Southern blot analysis with radiolabeled amplified subtraction products showed polymorphisms amongst the different isolates. The PCR products were cloned into a plasmid vector and 15 recombinant colonies selected were found to contain inserts ranging in size from 200 to 500 bp. Individual sequences have been used in Southern hybridizations, the results of which will be presented and discussed.

PATTERNS OF INTERCONTINENTAL SEXUAL COMPATIBILITY IN OMPhALOTUS (AGARICALES). Ronald H. Petersen, Botany Department, University of Tennessee, Knoxville, TN 37996.

Using basidiomata and monokaryon cultures from collections of O. olearius (southern Europe), O. illudens (eastern North America), O. subilludens (Florida), O. olivascens (California), and O. nidiformis (southen Australia), individual mating systems were identified. Intercontinental and inter-regional mating studies revealed that O. nidiformis is genetically isolated from all Northern Hemisphere taxa. Omphalotus olearius is completely intercompatible with O. subilludens: they can be considered conspecific. Omphalotus illudens and O. olearius are virtually totally incompatible, while O. illudens and O. subilludens are partially compatible. An A-B-C relationship is postulated.

MOLECULAR PHYLOGENY OF NORTH AMERICAN BIOLOGICAL SPECIES OF ARMILLARIA. Michele D. Piercey-Normore, Memorial University of Newfoundland, St. John's, NF A1B 3X9, Canada; Keith N. Egger, University of Northern British Columbia, Prince George, BC V2N 4Z9, Canada; and Jean A Bérubé, Natural Resources, Newfoundland and Labrador Region, P. O. Box 6028, St. John's, NF A1C 5X8, Canada.

Armillaria: (Fr.:Fr.) Staude is a genus of root infecting basidiomycetes, which includes nine North American Biological Species (NABS). Independent nucleotide sequences obtained from four different 10bp primer pairs, using SWAPP (Sequencing With Arbitrary Primer Pairs), were combined to produce a more extensive data set. Phylogenetic analysis of the combined data set provided strong support for intraspecies clustering. Isolates of NABS I retained a single cluster despite large distances between collection sites. Isolates of NABS III and VII clustered together. Similarly, isolates of NABS V, IX and X also clustered together. A. tabescens was selected as outgroup as suggested by its morphology and sequence alignment. NABS VI was the first to diverge outside the group.

POPULATION DYNAMICS OF TELLETIA CONTROVERSA AND TELLETIA FUSCA COMPLEX BASED ON MOLECULAR MARKERS. G. Pimentel and L. M. Carris, Dept. Plant Pathology, Washington State University, Pullman WA 99164-6430.

Identification of Tilletia controversa (TcK), the causal agent of dwarf bunt of wheat, is based on morphological and physiological characteristics which are variable and overlap among closely related species. Previous studies showed that TcK can hybridize with wild grass bunts T fusca vars. bromitectorum (Tb) and guyotiana (Tg). Our objective was to determine the population dynamics of these fungi and how it affected speciation. Thirty samples from natural populations of TcK, Tb and Tg were collected from four sites in the Pacific Northwest. Molecular markers were obtained from genomic DNA from teliospores using twelve RAPD primers. Among the 52 and 55 RAPD markers identified within populations of Tb and TcK, respectively, 8 were monomorphic between species. Four TcK markers were present in 23-43% of individuals in Tb populations, suggesting that introgression may have occurred. Chi square analysis was used to determine the segregation of RAPD markers among progeny of a TcK x Tb cross. Twenty-four TcK markers and 20 Tb markers were identified among the F1 progeny. Sixty-eight percent of these markers segregated in a 1:1 pattern.

MOLECULAR PHYLOGENY OF THE CANTHARELLOID AND CLAVAROID FUNGI. Elizabeth Pine and David Hibbett, Harvard University Herbaria, 22 Divinity Avenue, Cambridge, MA 02138.

The cantharelloid and clavarioid fungi are fleshy basidiomycetes that include the coral, club, and trumpet fungi. Their evolutionary history and relationships to the Agaricales and Aphylloroparales are highly controversial; neither monophyly of currently accepted families nor relationships among genera have been rigorously tested. Sequence data from the mitochondrial and nuclear rDNA were used to generate a phylogeny including representatives of the Cantharellaceae, Gomphaceae, Clavariaceae, Agaricales, and Aphylloroparales. Although incongruences between the mitochondrial and nuclear "gene trees" were observed, certain clades were strongly supported by both data sets. Analyses using both maximum parsimony and maximum likelihood optimality criteria indicate that none of these families, as traditionadly defined, are monophyletic. Results support widespread homoplasy of basidioide macro morphology, notably multiple derivation of the gilled agaric fruiting body.

MORPHOLOGICAL AND GENETIC DIVERSITY IN CHALARA ELEGANS (THIELAVIOPSIS BASICOLA). Z. K. Punja and L. J. Sun, Department of Biological Sciences, Simon Fraser University, Burnaby, BC V5A 1S6, Canada.

Colony morphology, chlamydospore size and septation, and RAPD patterns generated using six primers, were determined for 50 isolates of C. elegans from 12 different regions. Morphological and cladistic groups were established to represent the various isolates. The greatest diversity in morphology was observed among isolates from British Columbia and California obtained from a broad range of hosts. Isolates from similar geographic regions, e.g. Arkansas or North Carolina, and one host, e.g. tobacco, tended to group together based on both morphology and cluster analysis. There was a high overall level of genetic variation within C. elegans and 75 out of 105 bands scored were polymorphic. The similarity index among all 50 isolates studied was 87%; for an outgroup species (C.
thielaviodes), the value was 40%. In many isolates, the RAPD banding patterns produced unique fingerprints. Two aberrant morphological types (albino, mycelial) that developed in culture from the dark-pigmented wild type colony showed 1-2 novel polymorphic bands.

A STUDY OF DISTRIBUTION AND rDNA ITS VARIABILITY OF EPICHLÖE-RELATED ENDOPHYTES IN SOME GRASSES FROM PATAGONIA AND TIERRA DEL FUEGO. P. V. Reddy¹, D. Cabral², M. D. Richardson¹, and J. F. White, Jr.¹, ¹Center for Turfgrass Science, Foran Hall, Cook College, Rutgers University, New Brunswick, NJ 08903; ²Departamento de Ciencias Biológicas, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina.

Grasses from Patagonia and Tierra Del Fuego were screened microscopically for the presence of endophytic mycelium in leaf sheaths and culms in a herbarium survey and field study. In a screening of genera Festuca and Poa in the Instituto de Botanica Darwinin in San Isidro, Argentina, endophytes were encountered in 10-20% of the specimens examined, including species Festuca argentina, F. distitiflora, F. erecta, F. fimbrriata, F. hieronymi, F. subantarctica, Poa alopecurus, P. gymnantha, P. ibari, P. magellanica and P. pardoana. Living plants were also screened for endophytes in Tierra Del Fuego. These were detected in Festuca magellanica, Poa poecila, P. rigidifolia, and Phleum commutatum. Endophytes were isolated and examined in culture. Colonies are white, slow growing, with morphology typical of the Epichlöe-related endophytes. DNA was extracted and rDNA ITS regions amplified and sequenced. Sequences are compared to those of North American and European endophytes.

MYCOBIONT DIVERSITY IN 'LOWER' FUNGUS-GROWING ANTS (TRIBE ATTINI): EVIDENCE FOR INDEPENDENT ACQUISITION, HORIZONTAL AND VERTICAL TRANSMISSION OF FUNGAL SYMBIONTS. Stephen A. Rehner and Ulrich Mueller, Smithsonian Tropical Research Institute, Panama, Naos Marine Laboratory, Unit 0948, APO AA 34002-0948 USA.

Incongruence between phylogenies of 'lower' attine ants and their lepiotaceous symbionts suggests a facultative mode of mycobiont replacement by these obligate fungus-growing ants. Genetic analyses of mycobionts from three sympatric species of lower attine ants from Trinidad revealed a surprising degree of genetic heterogeneity at several hierarchical levels as indicated by AFLP multilocus fingerprints, RFLP's of ribosomal intergenic spacers and ITS and 28S rDNA sequence phylogenies. The distribution of mycobiont genotypes demonstrates that individual ant species utilize more than one phylogenetic species of Leucocoprinus and that mycobionts are recruited from free-living populations or transmitted vertically within ant lineages. Moreover, the data indicate the three ant species tap common, partially overlapping pools of mycobionts and also may exchange clones via horizontal transmission. The plasticity of associations between lower attine ants and their fungal symbionts has several implications for understanding symbiotic evolution at the local and geographic levels.

ANALYSIS OF THE ROLE OF THE SPITZENKÖRPER IN FUNGAL MORPHOGENESIS BY COMPUTER SIMULATION OF APICAL BRANCHING IN ASPERGILLUS NIGER. C. G. Reynaga-Peña¹, G. Gierz², and S. Bartnicki-García¹, Departments of Plant Pathology¹ and Mathematics², University of California, Riverside, CA 92521.

The morphogenetic process observed during apical branching in Aspergillus niger was duplicated with the Fungus Simulator program. This process involved a series of profound changes in cell shape and Spitzengärper behavior: Spitzengärper retraction, its disappearance for 3.5 min, and the reappearance of two new Spitzengärper. We divided the sequence into 3 parts: normal growth, branching prelude and branch development. Simulation of this complex sequence gave us a unique opportunity to test our mathematical model of fungal growth and morphogenesis. We simulated the entire apical branching process by correlating position and movement of the Spitzengärper in the cell with those of the VSC in the model. The predictive power of the model was used to determine which pattern of vesicle traffic operates when a Spitzengärper is not detectable. The best approximation was obtained by positioning a motionless VSC in the center of the apex. The onset of polarized growth prior to branch development was best simulated by assuming the presence of incipient VSCs at likely positions before the new Spitzengärper were clearly visible. Our results support the idea that the Spitzengärper acts as a VSC, and is therefore directly responsible for the elaborate sequence of morphogenetic events during apical branching.
CYTOPLASMIC CONTRACTIONS IN FUNGAL HYphaE AND THEIR MORPHOGENETIC CONSEQUENCES. C. G. Reynaga-Peña¹, R. López-Franco², and S. Bartnicki-García¹, ¹Department of Plant Pathology, University of California, Riverside, CA 92521; and ²Centro de Biotecnología, ITESM, Suc. de Correcos "J," Monterrey, N.L., 64849, México.

Video microscopy of the apical growing region of hyphae of several fungi revealed the existence of momentary synchronized motions of subcellular organelles. These seemingly spontaneous "cytoplasmic contractions" were detected in hyphae of *Rhizoctonia solani*, *Neurospora crassa* and *Trichoderma harzianum* but could be induced to occur at greater frequency in a temperature-sensitive morphological mutant (ramosa-I) of *Aspergillus niger*. Most cytoplasmic contractions lasted less than 1 s. Often, within 10 s, the Spitzenkörner became dislodged from its polar position. This dislocation was accompanied by a reduction or cessation of growth and marked morphological changes: 1) In the ramosa-I mutant of *A. niger* and occasionally in *N. crassa*, two apical branches were produced. 2) In *R. solani* and *N. crassa* a bulbous tip was formed, which became a bulge in the hyphal profile after normal elongation resumed. 3) In *T. harzianum*, subapical and lateral branches were formed. Our evidence points to a cytoskeletal connection between Spitzenkörner and cytoplasmic organelles. Although the cause of the cytoplasmic contractions is unknown, the fact that most organelles move in unison indicates that they are tied together in a contractile network.


*Echinodothis tuberiformis* Atk. is an epibiotic symbiont of bamboo (*Arundinaria tecta* L.). Stromata of this fungus may be commonly encountered on stems of bamboo in North America. Stromata contain fluorescent compounds. Examination of whole stromata with long-wave UV reveals a bright orange fluorescence. It is hypothesized that fluorescent compounds may play a role in defending stromata of *E. tuberiformis* from herbivory and parasitism by mycoparasitic fungi. Bioassay directed fractionation techniques will be employed to screen stromata and cultures for defensive compounds. Fractions with bioactivity will be further examined using HPLC, UV absorption, and Mass Spectroscopic Analysis.

VIDEO-MICROSCOPY ANALYSIS OF *NEUROSPORA CRASSA* GROWTH: WHAT DETERMINES GROWTH DIRECTION IN FUNGAL HYPHAE? M. Riquelme¹, C. G. Reynaga-Peña, G. Gierz², and S. Bartnicki-García¹, Departments of Plant Pathology¹ and Mathematics², University of California, Riverside, CA 92521-0122.

Earlier observations had suggested that the position of the Spitzenkörner determines the direction of hyphal growth. We studied directional growth and Spitzenkörner behavior in video-taped sequences of growing hyphae of *N. crassa*. Hyphae of *N. crassa* have a pronounced tendency to undulate. Despite meandering, the overall direction of *N. crassa* hyphal growth is essentially a straight line. The Spitzenkörner moves forward along the cell longitudinal axis as the hyphal apex advances, but it does so with frequent short transverse oscillations. Growth directionality was correlated with Spitzenkörner behavior. Hyphae grow in a fixed direction when the Spitzenkörner maintains an overall straight path. A change in growth direction is preceded by a sustained shift of the Spitzenkörner trajectory away from the existing longitudinal axis, and as a consequence, a new longitudinal axis is established. The morphogenesis of a meandering hyphae of *N. crassa* was simulated with our mathematical model validating our prediction that the Spitzenkörner functions as a vesicle supply center (VSC). We propose the existence of an intrinsic mechanism that maintains a rather fixed overall direction of hyphal extension while allowing the Spitzenkörner to depart repeatedly but briefly from its original trajectory.

ELECTRICAL CHARACTERIZATIONS OF A BIO-HYBRID INTEGRATED SYSTEM: THE UNION OF MYCOLOGY AND MICROELECTRONICS. R. W. Roberson¹, M. N. Kozicki², S. E. Kersey³, and H. McNally³, Departments of Botany¹, Electrical Engineering², and the Center for Solid State Electronics Research³, Arizona State University, Tempe, AZ 85285.

The union of cell biology, biochemistry, and microelectronics has led to the development and study of functional combinations between integrated circuits and organic and/or biological materials. Data are reported from experiments designed to judge the potential of *Uromyces appendiculatus* germings, grown on custom-designed integrated test circuits, i.e., a biohybrid integrated system, to conduct an electrical current of sufficient strength and reliability to create functional bioelectronic devices. Direct current measurements were made on chemically stabilized and living cells. Currents were measured for 5 minutes at voltages ranging from 1V/-1V to 20V/-20V. Chemically stabilized germings conducted currents that varied from 11 pico amps (pA) to 182 pA at 20V. Preliminary data indicated that vacuolate regions of germ tubes produced higher currents than cytoplasm-filled regions. Measurements of living cells have thus far shown no obvious trends of conductivity at 10V/-10V.

FUNGAL ENDOPHYTES OF *SPONDIAS MOMBIN*: A PRELIMINARY STUDY. K. F. Rodrigues¹ and G. J. Samuels², ¹Dpto. de Micología-IOC, Fundação Oswaldo Cruz, Av. Brazil 4365, 21045-900, RJ, RJ, Brazil; and ²United States Dept. of Agriculture, Systematic Botany and Mycology Lab., Rm. 304, Bldg. 011A, BARC-West, Beltsville, MD 20705.

The aim of this study was to determine colonization frequencies, plant organ specificity and geographical location effects on the fungal assemblages. Isolations were made from healthy leaves and twigs taken from four mature trees of *Spondias mombin* located at one site each in the states of Para (Amazon forest) and Rio de Janeiro (Atlantic forest), Brazil. Ten leaves and 9 twig pieces were taken from each tree. Leaves and twigs were surface sterilized. The fungi isolated were: *Colletotrichum gloeosporioides*, *Colletotrichum sp.*, *Drechslera sp.*, and *Guignardia..."
sp., Mycelia Sterilia 1, Mycelia Sterilia 2, Phomopsis sp., Physalospora sp., Trichoderma viride, and Wiesneriomycetes cf. javanicus. Guignardia sp. was the dominant species at the two sites. Although leaves and twigs shared several species, colonization frequencies of some species in each of the two plant organs varied.


*Xyleborus affinis* infests a wide variety of woody hosts in its temperate to tropical world-wide distribution. The beetle first bores a gallery into the inner bark region and later extends its gallery system into the sapwood. Low nitrogen concentrations in the wood is considered to be a critical and limiting factor for success of ambrosia beetles and their mutualistic fungi. Growth studies on the two primary symbiont fungi, an undescribed *Raffaelea* species and a *Fusarium* species, indicate they grow successfully at the levels of nitrogen present in the inner bark, but not at the lower nitrogen levels present in the sapwood. Similarly, *in vitro* culture of the beetle-fungal complex also is successful at nitrogen levels of the inner bark but less so at the nitrogen levels found in sapwood. Fungal recycling of beetle excretory uric acid is suggested as a possible mechanism by which the beetle invades the sapwood to raise its progeny.


Mycoherbicide effectiveness can be influenced both positively and negatively by the microbial interactions that occur on the phylloplane of weedy plants prior to and during the infection process. Direct interactions with negative impact include toxic metabolite production by phylloplane colonists and prior niche possession. Direct interactions with positive implications to weed disease severity include enhancement of mycoherbicide spore germination and appressorium formation. Similarly, indirect microbial interactions can be deleterious (induction of plant resistance) or advantageous (predisposition of the weed to disease or suppression of host defense systems) to the success of a mycoherbicide. "Microbial facilitators" of weedy plant disease offer opportunities to increase disease over that achieved by the mycoherbicide used alone. Additional research to identify the mode of action of these organisms may permit disease enhancement in the absence of microbial facilitators. As management of the phylloplane environment becomes feasible through the application of basic research results, further success in developing and deploying mycoherbicides will be realized.

**DIVERSITY AND ABUNDANCE OF MACROMYCETES IN COWLES BOG, INDIANA DUNES.** J. P. Schmit, J. F. Murphy, and G. M. Mueller, Department of Botany, The Field Museum of Natural History, Chicago, IL 60605-2496.

Two tenth hectare permanent plots were established in Cowles Bog, an oak dominated forest in Indiana Dunes National Lakeshore, one in 1994 and the other in 1995. The plots were visited weekly during the fruiting season, and all sporocarps of macrofungi were collected. Sporocarps were identified to species, and abundance was measured for each species. Over 80 different species were recovered from the plots. Wood decay fungi were the most speciose. There was little variation between plots and years with regard to species diversity, with most species being present in both years and plots. There were striking differences, however, in the abundance of some species between the two years. The abundance data was used to estimate the total number of species which occur on the plots.

**EFFECTS OF NITROGEN DENSITY ON COMPETITION BETWEEN FUNGAL DECOMPOSERS.** John Paul Schmit, The Committee on Evolutionary Biology, University of Chicago, Culver Hall 402, 1025 E. 57th, Chicago, IL 60637, and The Department of Botany, The Field Museum of Natural History, Lakeshore Dr. at Roosevelt Rd., Chicago, IL 60605.

The effects of nutrient density on growth and competition of fungal decomposers was explored using mushrooms of the genus *Coprinus* as a model system. Species of *Coprinus* were grown in a series petri plates containing a yeast extract agar with differing concentrations of nutrients. Individuals grown in plates with increased nutrient concentration had slower growth rates, took longer to fruit, and had larger fruiting bodies compared to those grown in low nutrient density plates. Two species of *Coprinus* were then grown together in a series of petri plates with differing nutrient concentrations. Nutrient density changed the ability of species to coexist, i.e. successfully produce fruiting bodies, by affecting the size of the territory a species was able to capture and the concentration of resources in that territory.

**PHENETIC VARIATION AND PATTERNS OF TAXONOMIC CORRELATION AMONG CHARACTERS IN CORTINARIUS SUBGENUS MYXACIUM (BASIDIOMYCOTINA, AGARICALES).** M. T. Seidl and J. F. Ammirati, Department of Botany, University of Washington, Seattle, WA 98195.

*Cortinarius* Fr. is a large, ectomycorrhizal genus divided into seven subgenera. The subgenus *Myxacium* is characterized by a gelatinous universal veil. Several studies indicate the subgenus is polyphyletic. This study focuses on two sections, *Myxacium* and *Defibulati*, that have similar morphologies and equally diverse ecologies, but have traditionally been separated by the presence or absence of clamp connections, respectively. Phenetic variation and validity of taxonomic characters delimiting sections are assessed using cluster strategies and ordination techniques of NTSYS software. The utility of taxonomic characters will be analyzed utilizing morphological, ecological, and RFLP data sets. The ITS1-5.8S-ITS2 region of nuclear ribosomal DNA was extracted and amplified from 11 putative taxa using up to 7 primer sets. The amplified DNA is sequenced and the sequences used to infer phylogenetic relationships among taxa.
replicates for each taxon. The PCR products (800-900 bp range) were subjected to restriction digests using four enzymes. The resultant patterns are used for initial groupings and analysis in combination with other data sets. Representative species found in western North America were used in this study. The molecular screening used NIH Image and SYSTAT software for data analysis.

rDNA GENE SEQUENCES AND GENERIC CONCEPTS IN SOME HYPHOMYCETES. K. A. Seifert and G. Louis-Seize, Eastern Cereals and Oilseed Research Centre, Agriculture and Agri-Food Canada, Ottawa, Ontario K1A 0C6, Canada.

Phylogenetic relationships of five hyphomycetes were explored by including partial sequences of 18S and 28S rDNA with data from related Ascomycetes from GenBank. Cultural similarities suggest a close relationship between Spicellum roseum and Trichothecium roseum. PAUP analysis supports the concept that the two species are a monophyletic group, but differences in conidium ontogeny favour maintenance in separate genera. A close relationship between a sporodochial fungus with slimy green conidia and Myrothecium inundatum is also confirmed. Conidium ontogeny is also different in these fungi, but a conservative approach to their classification suggests they be included in the same genus. These examples demonstrate the awkwardness of interpreting gene sequences in taxonomic studies that are not intended as full-scale revisions. A concrete conclusion on the generic placement of Stilbella thermophila should be possible because sufficient 18S and 28S data is available to determine whether it forms an in-group or sister-group to Ophiostoma.

HOST-PATHOGEN INTERACTIONS BETWEEN CASTANEA SPP. AND THE CHESTNUT BLIGHT FUNGUS. L. Shain, Department of Plant Pathology, University of Kentucky, Lexington, KY 40546.

Studies on host-pathogen interactions during chestnut blight have focused on putative factors responsible for virulence of Cryphonectria parasitica against American chestnut and factors responsible for resistance of Chinese chestnut. Insights to pathogen virulence were obtained from comparisons of metabolites produced by virulent (V) and isogenic hypovirulent (H) or gene-disrupted strains. V strains were reported to produce greater amounts of oxalic acid, polygalacturonase, cellulase, laccase, cutinase, G-protein, pheromone, and cryparin than H or disrupted strains. Chinese chestnut bark was reported to contain greater amounts of constitutive polygalacturonase inhibitor protein as well as induced chitinase, β-1,3-glucanase, and peroxidase than American chestnut bark. Isoform differences in these enzymes were noted between the two species. A previous report that bark tannin conferred resistance to Chinese chestnut was not substantiated.

MITOCHONDRIAL DNA INHERITANCE WITHIN THE A1 MATING SERIES OF DIDYMUM IRIDIS. Margaret E. Silliker and Jason A. Monroe, Depaul University, Department of Biological Sciences, Chicago, IL 60614.

During mating in the acellular slime mold Didymium iridis isogametes completely fuse to form a zygote which develops into a coenocytic diploid plasmodium. In earlier studies, a uniparental mitochondrial (mt) inheritance pattern was observed in replicate matings between the Hon1-2 strain and the Pan2-16 strain. Remarkably, even though individuals had only one mt type, both parental types were transmitted at equal frequency. We are now analyzing crosses with these strains and other members of the A1 mating series. Individual plasmodia are isolated from cross plates as soon as they are detected (<0.5 mm) and separated from unmated amoebae. Total DNA is isolated and probed with cloned mtDNA fragments from the Pan2-16 strain to highlight polymorphisms. When Pan2-16 was mated with CR2-26 (representing a third mating type) 15/17 progeny inherited only the CR2-26 mt type but 2/17 inherited only the Pan2-16 mt type. Our results confirm the uniparental inheritance pattern observed earlier, though some combinations bias mt transmission in favor of one parental mt type. Our current methodology also indicates mt homogeneity is established very early in plasmodial development.

EVIDENCE FOR THE POLYPHYLY OF PHYLLACHORALES (ASCOMYCOTINA) SUGGESTED BY 18S rDNA. Denise M. W. Silva and Richard T. Hanlin, Dept. of Plant Pathology, The University of Georgia, Athens, GA 30602-7274.

The order Phyllachorales is represented mostly by foliar parasites which produce perithecia under a clypeus, inside a stroma, or do not produce any stromatic tissue. A major taxonomic problem with this order is the lack of reliable morphological characters that clearly delimit the group. In order to evaluate the monophyly of the Phyllachorales from a molecular standpoint and elucidate its phylogenetic relationships with other orders, a segment of the 18S rRNA gene was sequenced (~1000 bp) from several representatives of the Phyllachorales, including species of Glomerella, Phyllachora, Coccodiella (=Coccoctroma), Sphaerodothis, and Ophiodothella. Maximum parsimony analysis revealed that the Phyllachorales is a polyphyletic assemblage of taxa. Species of Glomerella, a non stromatic genus, formed a monophyletic clade, which appears to be a sister group to the Microascales and Hypocreales. None of the other members of the Phyllachorales, which produce either a clypeus or stroma, clustered with Glomerella. Of the taxa examined, Coccodiella is the closest relative of Phyllachora. These two genera form a sister group to the Sordariales, which together are a sister group to the Diaporthales. Additionally, new sequences of species of Beria, Magnaportha, Pachyrype, and Pestsalosphaeria, all with uncertain taxonomic affinity, have been obtained and their taxonomic position is indicated.
ENZYMATIC CONVERSIONS OF PLANT BIOMASS. Robert L. Sinsabaugh, Biology Dept., University of Toledo, Toledo, OH 43606.

Plant fiber is a renewable resource. The bioconversion of lignocellulose to fuel, feed, or precursors for commercial syntheses may reduce consumption of fossil fuels and reduce waste streams. However, except for limited applications of fungal pectinases and xylanases, the conversion of lignocellulose into marketable products using enzyme technology remains a long term goal rather than a practical reality. The proximate limitations are economic, but these economic constraints largely reflect our still fragmentary understanding of the biochemistry of plant fiber decomposition and the ecology of the decomposers. To develop a practical delignification process, at the biochemical level, a mechanistic understanding of the apparently diverse ligninolytic systems of fungi and bacteria may be a prerequisite to the development of a practical delignification process. At the ecological level, the exploration of microbial diversity, especially in extreme environments, may yield new strains with commercial potential. As additional biochemical and ecological information accumulates, the possibilities for reduced costs through the engineering of transgenic strains expand.

USTILAGO MAYDIS MATING HYPHAE ORIENT GROWTH TOWARD PHEROMONE SOURCES. Karen Snetselaar1, Michael Belker2, Regine Kahmann2, 1St. Joseph's University, Philadelphia, PA 19131; 2University of Munich, Munich, Germany.

When drops of U. maydis sporidia were placed 0.1 mm apart on agar surfaces and covered with paraffin oil, sporidia from one drop formed thin hyphae that grew toward the other drop if it contained sporidia making the appropriate pheromone. For example, a2b2 hyphae grew toward a1b1 and a1b2 hyphae, and the mating hyphae eventually fused at their tips. Time-lapse photography showed that mating hyphae could rapidly change orientation. Sporidia without functional pheromone genes formed mating hyphae when exposed to pheromone but induced no response, and sporidia without pheromone receptors induced formation of mating hyphae although they formed no mating hyphae. The mating hyphae formed in these interactions did not precisely locate each other and fuse as wild-type cells did. When exposed to pheromone produced by cells in an adjacent drop, haploid sporidia with the a2 allele always began elongating before sporidia with the a1 allele. Diploid sporidia heterozygous at b but not at a formed straight, rigid, aerial filaments when exposed to pheromone produced by appropriate haploid sporidia, and the a2a2b2b2 strain formed filaments more quickly than the a1a1b1b2 strain. Additional results indicating that a2 pheromone diffuses slower or breaks down faster than a1 pheromone will also be discussed.

DEVELOPMENT OF AN IN SITU HYBRIDIZATION PROTOCOL TO LOCALIZE MITOCHONDRIAL DNA IN THE SLIME MOLD DIDYMUM IRIDIS. Devry A. Spreitzer and Margaret E. Silliker, DePaul University, Department of Biological Sciences, Chicago, IL 60614.

Aspects of in situ hybridization protocols have been optimized in order to use this technique to visualize the spatial arrangement of mitochondrial DNA within freshly fixed myxamoebal cells of the slime mold Didymium iridis. Mitochondrial DNA was labeled with digoxigenin using the random primed method. The probe was detected with an anti-digoxigenin antibody conjugated to fluorescein and visualized by fluorescence microscopy. Several steps were identified as key to optimizing in situ hybridization and detection. Probe permeability to fixed cells was maximized by adjusting protease enzyme concentration and incubation times. Target and probe DNA were quickly and thoroughly heat denatured, then combined and cooled before incubating at the annealing temperature. Probes with high specific activity with the antibody were obtained by adjusting the concentration of components in the labeling reaction and the incubation time. Short probes (100-500bp) were optimal for in situ hybridization, however, longer fragments were more efficiently labeled. Therefore, longer fragments were labeled and then digested to 100-500bp before hybridization.

A COMPARISON OF ISOLATES IN THE CERATOCYSTIS COERULESCENS COMPLEX USING DNA SEQUENCE DATA. R. C. Strydom1, B. D. Wingfield1, M. J. Wingfield1, and T. C. Harrington2, 1Tree Pathology Co-operative Programme, Department of Microbiology and Biochemistry, PO Box 339, U.O.F.S., Bloemfontein, 9300, South Africa; 2Department of Plant Pathology, Iowa State University, Ames, IA 50011.

Ceratocystis sensu stricto includes numerous species of insect-vectorized, wood-staining and plant pathogenic fungi. Ceratocystis coerulescens is the cause of blue-stain in spruce and pine. Previous investigations, using morphological characteristics and
isozyme comparisons, have shown that *C. coerulescens* encompasses at least five morphological types. The aim of this study was thus to compare isolates of *C. coerulescens sensu lato* and morphologically similar species, including *C. laricola*, *C. polonica* and *C. virescens*. Using the polymerase chain reaction (PCR), a 600 base pair fragment within the ribosomal DNA operon was amplified. The amplification was performed directly from living fungal tissue without the extraction of DNA. The amplified fragments included part of the large sub-unit rRNA genes, the 5.8S rRNA gene and the internal transcribed spacers (ITS) 1 and 2. Both strands of the PCR products were sequenced. Phylogenetic relationships were determined using Phylogenetic Analysis Using Parsimony (PAUP). The five morphological types in the *C. coerulescens* complex had unique ITS sequences and appear to represent distinct taxa. *C. laricola* and *C. polonica* have similar ITS sequences and may be synonymous.

**PYCNOTHYRIUM ULTRASTRUCTURE IN TUBAKIA DRYINA.** J. Taylor, Dept. of Biology, Stephen F. Austin State University, Nacogdoches, TX 75962.

*Tubakia dryina*, a fungal leaf parasite of numerous forest trees, produced fruiting bodies called pycnothryia on infected sweet gum leaves. These structures were excised and prepared for transmission electron microscopy using standard chemical fixation techniques. The pycnothryia was umbrella-like in appearance. Its surface layer, the scutellum, was composed of thick walled prosenchymatous hyphae. It was attached to the leaf by a multistalked collarette, the conidiospores associated with the under surface of the scutellum. The spore producing cells were phialidic, with a prominent collarette present at their apex.


*Magnaporthe grisea*, the causal agent of the rice blast disease, is an amenable model system for studying the interactions between an economically important crop and a damaging fungal pathogen. *M. grisea* species related to pathogenesis have been cloned by screening of genes highly expressed in planta, among them *MPGI*. The *MPGI* gene product, *MPGIp*, is a hydrophobin, a class of hydrophobic fungal proteins which are highly expressed during several developmental processes. A model for the role of the *MPGIp* suggests this protein can act as a structural component of the appressorium and/or as an adhesion protein. It has been implicated in the transduction of signals required for appressorium formation. To test this model we are attempting to locate *MPGIp* in conidia and during appressorium formation by tagging the protein with an epitope from the human influenza hemagglutinin protein. Implications for the role of the protein will be discussed.

**TRENDS IN FUNGAL ANALYSIS.** M. Thibaut, Paris.

The electron probe X-ray microanalyzer has been successfully applied for micro detection of elements in fungal tissues. We used this method with pathogenic fungi for humans. The electron beam in a scanning microscope ionizes the sample. X-rays are generated within the excited volume and chemical elements in Mendeleev's classification are detected by spectrographic analysis. Three diffractive spectrometers were each positioned to the specimen plane. Two methods of excitation are possible: direct bombardment of the specimen with an electron beam, or irradiation with X-rays of energy sufficient to cause fluorescence. Then using this approach it may be possible to utilize an established histochemical technique.

**EVOLUTIONARY RELATIONSHIPS AMONG NEW WORLD AND AUSTRALASIAN MEMBERS OF THE GENUS LENTINULA.** M. R. Thon and D. J. Royse, The Pennsylvania State University, Department of Plant Pathology, University Park, PA 16802.

Recent studies have investigated the phylogenetic relationships among members of the genus *Lentinula* (Tricholomataceae) with particular attention to the relationships among the Australasian species. One rare species, *L. guarapiensis* (Speg.) Pegler had not been included in these studies. *Lentinula guarapiensis* is only represented to the mycological community as an herbarium collection from 1879. To investigate the evolutionary relationship of this specimen to closely related species, regions of the rDNA repeat spanning the internal transcribed spacers and the 5.8S gene were amplified, cloned and sequenced. Comparisons were made to published sequences of species of *Lentinula* as well as to closely related genera. Phylogenetic analysis using the neighbor-joining method suggests that *L. guarapiensis* is more closely related to the Australasian species than was previously indicated based on morphology. Investigations are underway to include South American representatives of *L. boryana* as well as closely related outgroup genera.

**A RE-EVALUATION OF THE GENUS CERATOCYSTIOPSIS.** C. D. Viljoen, B. D. Wingfield, and M. J. Wingfield, Tree Pathology Co-operative Programme, Department of Microbiology and Biochemistry, University of the Free State, P.O. Box 339, Bloemfontein, South Africa.

The genus *Ceratocystiopsis* was established to distinguish species of *Ceratocystis sensu lato* with falcate ascospores. Species with this ascospore type were segregated from *Ceratocystis* and *Ophiostoma* while other groups of species with different, but distinct ascospore forms, were not treated equally. The aim of this study was to determine whether *Ceratocystiopsis* forms a coherent group amongst species of *Ceratocystis s.l.* To achieve this, the ribosomal RNA operon was characterized in species of *Ceratocystiopsis* as well as *Ceratocystis fimbriata* and *Ophiostoma piliferum*, the type species of *Ceratocystis* and *Ophiostoma*, respectively. A filter DNA:DNA hybridisation method, DNA:DNA Probe hybridisation (DDP hybridisation) was used to assess the relationships of the relevant species based on total genomic DNA. These data were compared with results obtained by RFLP analysis. Our results confirm that species in *Ceratocystiopsis* do not form a monophyletic group and are best.
accommodated in what is currently recognised as *Ophiostoma sensu lato*. This is with the exception of *Cop. proteae* and *Cop. falcata* that cannot be placed at this stage.

**ECOLOGICAL GUIDES TO THE CULTIVATION OF EDIBLE MUSHROOMS.** Thomas J. Volk¹, Joseph Krawczyk², and Mary Ellen Kozak², ¹Center for Forest Mycology Research, Forest Products Lab, One Gifford Pinchot Dr., Madison, WI 53705; ²Field & Forest Products, Inc., N3296 Kozuszek Rd., Peshtigo, WI 54157.

Fungal ecologists have a great deal to contribute to the science and art of mushroom cultivation. A grower must have a thorough understanding of the life history, substrate utilization, and the ecological niches and microclimates occupied by the fungus. A deeper understanding of the influence of microclimate and the interaction of these fungi with other organisms, including both their hosts and their pests, is also indispensable. Since many mushroom growers look at mushroom cultivation from an agricultural point of view, much of the methodology for commercial mushroom cultivation are adapted from agriculture rather than from ecological considerations. It is tempting to try to adapt methods directly from crops already being produced (e.g., *Agaricus bisporus*), even though most specialty mushrooms have completely different life histories and occupy vastly different niches. Most successful cultivators of “exotic” mushrooms have a strong background in wild mushroom hunting and are able to extrapolate from the ecological conditions in the wild to indoor cultivation conditions. Examples of the development and refinement of cultivation methods for specific fungi based on an ecological framework will be discussed.

**AECIOSPORE FORMATION IN AXenic CULTURES OF PERIDERMIUM HARKNESSII.** J. A. Walla, North Dakota State Univ., Fargo, ND 58105.

Axenic culture of *Peridermium harknessii* (PH) could be useful in studies of host/pathogen interactions. Host infection has been accomplished with axenic cultures of other pine rusts, but not of PH. The orange callus-like cultural form of the fungus (1994, Lundquist et al, Can. J. For. Res. 24) contains cells similar in dimension and pigmentation to aeciospores. Those cells, however, normally lack surface ornamentation and do not germinate like aeciospores. When PH was grown on a medium slightly modified from that described by Yamazaki and Katsuya (1987, Phytopath. Soc. Jpn. 53), ornamented aeciospore-like cells developed in highly friable colonies after 30 days. Cell ornamentation appeared identical under light microscopy to that on aeciospores from galls, indicating equivalency with aeciospores. Development of highly friable colonies was favored by crushing colony explants of the most vigorous portion of orange callus-like colonies during monthly transfer. The ornamented cells did not germinate. Further manipulation is underway to obtain functional aeciospores in axenic culture.

**CHARACTERIZATION OF THE ASPERGILLUS FLAVUS POPULATION WITHIN AN ILLINOIS CORN FIELD.** D. T. Wicklow, C. E. McAlpin, and C. E. Pliatis, National Center for Agricultural Utilization Research, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

An evaluation was made of the genetic diversity (DNA fingerprinting) of 265 *A. flavus* strains isolated from grain samples at harvest (91 genotypes/124 strains), field soil (26 genotypes/31 strains), corn insects (49 genotypes/52 strains) and air-spora (56 genotypes/58 strains), from a corn field near Kilbourne, Illinois. Several genotypes were isolated from grain samples collected in different years. Genotype #36, isolated from three corn samples, matched the DNA fingerprint of a K. E. Papa strain from Georgia, NRRL 19979. Nineteen five percent of the *A. flavus* genotypes produced sclerotia but only 52% of the genotypes produced aflatoxin. Contrasts of DNA fingerprints revealed two (2) matches involving subpopulations from grain and soil, one (1) match for grain and corn insects, and no matches for corn and air-spora. The high genotypic diversity recorded for each subpopulation, in addition to a limited sample size, precluded any assessment of the importance of these subpopulations as sources of *A. flavus* infective inoculum. *Aspergillus parasiticus* was also routinely isolated from soil samples.

**SEARCH FOR GENETIC MARKERS AMONG CLOSELY RELATED FUNGAL ISOLATES.** K. Wikler, M. Neff, T. Pinto, R. Mullin, and T. R. Gordon, Division of Microbial Ecology, Univ. of California-Berkeley, Berkeley, CA 94708.

*Fusarium subglutinans* fsp. *pini*, the causal agent of pine pitch canker disease, appears to be a recently introduced pathogen in California (CA). Understanding the relationships among CA isolates and those found world-wide, requires polymorphic genetic markers. However, the methods conventionally used to detect intraspecific polymorphisms have not revealed genetic differences among isolates of *F. pini* from either CA or the SE USA: mtDNA RFLPs, RAPDs, PCR-amplified IGS RFLPs, and Southern blotting with anonymous genomic clones (with the exception of a few polymorphisms distinguishing VCG C3 from all other CA VCGs). However, each of these methods show clear genetic differences between *F. pini* and *F. subglutinans* isolated from hosts other than pine, suggesting that *F. pini* isolates form a tight and distinct phylogenetic group. Thus, we are currently experimenting with RFLP subtraction (Rosenberg et al. 1994, PNAS 91: 6113) as a more sensitive method to detect polymorphisms among such closely related genomes. Preliminary results indicate that subtractive hybridization between size-fractionated restriction digests followed by amplification of non-hybridized fragments yields DNA fragments unique to one of the two isolates.

**ECOLOGICAL GUIDES IN DRUG AND PESTICIDE DISCOVERY.** H. G. Wildman, AMRAD Natural Products Pty. Ltd., 571 Swan Street, Richmond, Victoria 3121, Australia.

After the great therapeutic advances of the 1950's, it has become noticeably more difficult to discover new medicines. In 1961,
over 90 new medicines were launched, but less than 50 were launched in 1980, and just over 40 in each of the past few years. It can take up to 10 years and $150-200M to develop a new medicine from a natural product. The application of sound ecological ideas to the search for novel natural products to be developed as new medicines may reduce both the time and costs involved in this process. A number of ecological ideas will be discussed along with the approaches that these suggest for the isolation of fungi and the manipulation of secondary metabolite production. These include the effects of habitat on the production of secondary metabolites, the growth of fungi in mixed culture, use of specific metabolic uncouplers and enzyme inhibitors, and fruit-body production and the use of solid state fermentation techniques.

GRASS-ENDOPHYTE INTERACTIONS: INSECT FEEDING TRIALS, GROWTH, AND NITROGEN FERTILIZATION OF AGRICULTURAL AND NATIVE PLANTS. Dennis Wilson and Stanley H. Faeth, Department of Zoology, Arizona State University, Tempe, AZ 85287.

Grasshopper feeding trials and growth experiments with and without nitrogen fertilization were conducted on uninfected, Acremonium, p-endophyte, and Acremonium and p-infected Festuca arundinacea plants to test if the rarity of the p-endophyte in grass populations is a result of a detrimental impact of "p" on the grass host. Grasshopper feeding trials on F. arizonica (Acremonium infected and uninfected) were compared to those with F. arundinacea to compare an artificially selected species with a native. F. arizonica plants (infected and uninfected) were grown with and without nitrogen fertilizer to test if endophyte enhanced protection of plants to herbivory would be reduced under N limitation, as N based alkaloids may not be produced. P-infected F. arundinacea plants were preferred more by grasshoppers, supported the best insect growth, and were the smallest plants. Endophyte infection of F. arizonica plants had a negative impact on insect performance, especially in unfertilized treatments.

A NOVEL ALTERNATIVE TO DNA:DNA HYBRIDISATION. B. D. Wingfield, C. D. Viljoen, J. L. F. Kock, and M. J. Wingfield, Department of Microbiology and Biochemistry, University of the Free State, P.O. Box 339, Bloemfontein, South Africa.

Despite the availability of new techniques, PCR (polymerase chain reaction) and rapid sequencing, DNA:DNA hybridisation remains a useful approach to evaluating relatedness of organisms. This is because of the large numbers of characters that can be studied simultaneously. The major disadvantages of this technique are the necessity to isolate large amounts of DNA for pairwise reactions and the specialised spectrophotometric equipment that is required. Filter hybridisations with DNA have not found application in this field because quantification of DNA and labelled DNA is essential but difficult. In this study we describe a new technique, DDP (DNA:DNA Probe) hybridisation that makes use of quantified filter hybridisations. In order to verify this technique, we have compared results of DDP hybridisations with published data from DNA:DNA reassociation studies and have obtained excellent correlations. DDP hybridisation offers a useful and simple alternative to DNA:DNA reassociation that can be applied in studies of relationships, not only amongst fungi but also in the case of other organisms.

GENETIC VARIABILITY IN PHAEOCRYPTOPUS. L. M. Winton and E. M. Hansen, Botany and Plant Path., Oregon State Univ., Corvallis, OR 97331.

The five species of Phaeocryptopus (Pleosporales) are widely distributed saprophytes and parasites on the needles of conifers. P. nudus is a common saprophyte of Abies. P. pinaster occurs on dead needles of Pinus rigida. P. araucariae and P. australis occur as weak parasites on Araucaria araucana and Fitzroya cupressoides respectively. P. gaeumannii, causing Swiss Needle Cast of Pseudotsuga menziesii, was originally described as a devastating plantation pathogen in Europe. It is now found wherever P. menziesii is planted and is a serious pathogen of Christmas trees in several areas of North America. The fungus is endemic and seldom associated with disease in native P. menziesii forests of western North America. Recently, a severe outbreak has been observed in production plantations in the Tillamook area of Oregon. Molecular methods are being developed to assess the population structure of aggressive strains and further elucidate the systematics of the genus.

NUCLEAR POSITIONING AND CELL SIZE CONTROL SEPTUM FORMATION IN ASPERGILLUS NIDULANS. Tom Wolkow and Steven D. Harris* and John E. Hamer, Department of Biological Sciences, Purdue University, West Lafayette, IN 47906; and *Department of Microbiology, University of Connecticut Health Center, Farmington, CT.

The completion of the first cell cycle in A. nidulans involves the formation of a septum that assymmetrically partitions a multinucleate cell. The placement of septa is precise and requires the assembly of an actin ring and the completion of mitosis. We employed thermosensitive alleles in genes required for mitosis and nuclear distribution (nud) to investigate the role of mitotic nuclei in regulating septum formation. Our results show that the positioning of mitotic nuclei dictate the site of septation and that separation requires the attainment of a critical threshold size.

STUDIES ON THE BIODIVERSITIES OF INOPERCULATE DISCOMCETES IN FUSHAN BOTANICAL GARDEN OF TAIWAN. M. L. Wu, No.1, Ai-Kuo West Road, Taipei, Taiwan, Republic of China.

Fushan botanical garden is located in northern Taiwan with elevations between 400-1400 meters. The weather is hot and humid in summer, cold and wet in winter. The minimum, maximum, and average temperatures in this area were respectively 2.9°C, 35.3°C and 19.1°C in 1994, -1°C, 33.2°C and 17.5°C in 1995. The relative humidity were respectively 89.6 - 100 % in 1994 and 84.3 - 95.8 % in 1995 but the precipitation were 4235 mm/year in 1994 and 2836 mm/year in 1995. In such a special environment, many species of Lachnum, Coccomyces, Trichobelonium, Sorokina, Hymenoscyphus, Dicephalospora and Baemomyces were collected and studied in the past two years. However, there are lots of inoperculate
The communities of aquatic hyphomycetes on submerged deciduous tree leaves and the aquatic hyphomycete conidial pool in water in a freshwater stream in Illinois were sampled by random leaf sampling and water filtration, respectively, for three 12 month seasonal cycles. Frequency of occurrence of aquatic hyphomycetes on discs cut from leaves and the conidial concentration in water were obtained by identifying and recording the presence of developing conidia on leaf discs and identifying and counting conidia on membrane filters, respectively. A winter peak and a summer peak in total frequencies of occurrence on leaves in each seasonal cycle were found. Species composition and relative frequencies of occurrence of species in communities differed in successive years. Seasonal peaks of total frequencies of occurrence were due to the establishment of either warm or cold season species groups and low total frequencies of occurrence between peaks were due to the transition of species groups during seasonal changes in water temperature. The patterns in total frequencies of occurrence on leaves did not agree with those of total conidial concentration in water, which had a single peak in winter. The correlation between relative frequency of occurrence on leaves and relative conidial concentration in water was not consistent over time.

THE CORRELATIONS AMONG CONIDIAL ATTACHMENT EFFICIENCIES, GERMINATION PERCENTAGES AND COLONIZATION ABILITIES OF AQUATIC HYPHOMYCETE ON SUBMERGED LEAVES. Tao Yun and Carol Shearer, Department of Plant Biology, University of Illinois, Urbana, IL 61801.

Attachment efficiency and germination percentage of aquatic hyphomycete conidia were measured in the field by comparing conidial concentration in water with the number of conidia on membrane traps and counting germinating conidia on membrane filters, respectively. The change of Kendall's tau coefficient between attachment efficiency and frequency of occurrence on leaves of all species had a bell shaped curve over the study period (Feb. to Aug. 1995) in which the communities on leaves changed from cold to warm season species groups. In contrast, the correlation between germination percentage and frequency of occurrence showed an opposite trend. When the majority of conidia in water were from cold season species in a warming environment, germination percentage was not as much correlated to the colonization of the species on leaves as at the time that either of the seasonal species groups was established. Attachment efficiency, as a possibly less temperature sensitive trait, emerged with a higher correlation with colonization on leaves in the transition stage of seasonal species groups. Highest attachment efficiencies were found for species with tetraradiate conidia and high germination percentages were found for species with sigmoid conidia.

MANAGING VAM IN A SEMI-ARID AGROECOSYSTEM. John Zak1, Bobbie McMichael2, Dan Upchurch, 2 and Alan Brashear2, 1Dept. Biol. Sci., Texas Tech University; and 2USDA, ARS, Lubbock, TX.

Effective management of VAM in agricultural systems should provide benefits by reducing plant stress during periods of adverse weather, and low nutrient availability. One method that can be used to enhance the VAM inoculum in soils is through the planting of suitable companion plants. On the Southern High Plains, planting winter wheat before planting cotton, and then leaving the wheat stubble and root system intact was found to increase VAM colonization levels of cotton during the seedling stage. The high yearly variability in rainfall and temperatures prior to planting and during seedling development does impact on how the cotton-wheat system will respond to VAM. Moreover, winter temperatures and moisture availability appear to significantly influence VAM inoculum dynamics. Effective management of VAM is feasible when the effects of agricultural practices and abiotic constraints on VAM dynamics are understood.
Notes