Fungal Diversity in GenBank: Problems and Possible Solutions

Summary

The importance of a genetic data base for fungal systematics as well as for other organisms is widely known. The total number of nucleotide fungal sequences in GenBank is close to 3.2 million, to be more precise 3,157,367 (on 7/15/10). The aim of this work is an estimation of the existing situation concerning fungal diversity in GenBank and provision of this diversity with type material. This work has become possible thanks to the previously developed format of the specialized database FungalDC (www.vkm.ru/fungalDC.htm), which incorporates three following sources: (1) a modern classification scheme of fungi, (2) fungal species diversity deposited in GenBank; and (3) fungal culture species diversity in the world’s collections. In the database names of all fungal taxa are included, from ranks of kingdom to genus. This includes all species names in GenBank and the catalogues of the world’s 485 collections. The percentage of fungal taxa present in GenBank has been estimated, including taxa from Chromista and Protista, which are maintained traditionally by fungal collections and herbaria (for instance Dictyostelium etc.). The integration of resources can help to pool fragmentary data that are available in different databases, simplify access, and ensure their simultaneous use. One of the most important trends in developing these integrated databases is the organization of cooperation when making special formats to introduce comments and analytical notes concerning different records deposited in GenBank. It should be noted that data volumes change rapidly and continuously. To permanently trace and direct the inflow of new data and corrections there is the need of collaboration among specialists working with diverse data types, but united with the same purpose. We hope that in the immediate future these problems can be solved on the basis of coordination of various institutions’ efforts in open access for all interested users.

Introduction

The importance of a genetic data base for fungal systematics as well as for other organisms is widely known. Recently, such fields as phylogeny, systematics and quick identification of particular fungal taxa of different ranks on the basis of sequence comparison ITS1/ITS2 (Braun et al. 2003, Nilsson et al. 2005, Druzhinina et al. 2006), LSU rDNA, SSU rDNA (Padovan et al. 2005, Tang et al. 2007), CO1 (cytochrome C oxidase 1 gene) have been developed (Seifert et al. 2007).

The international integrated database on DNA sequences, International Nucleotide Sequence Database Collaboration (INSDC) (www.insdc.org), was formed in 1986. This database includes data...
from GenBank (the National Center for Biotechnology Information - NCBI, USA), EMBL (Bank at the European Molecular Biology Laboratory, UK) and DDBJ (the DNA Data Bank of Japan, Japan). Each of these databases is daily updated at the expense of interchanging the new DNA sequences submitted to any one of them (Pruess 2004).

According to recent information, GenBank’s size exceeds 195 GB and the number of sequences therein is doubled every 18 months (Benson et al. 2009). In the judgment of Pennisi (Pennisi 2008) only 150,000 nucleotide fungal sequences were deposited during 2007, whereas in 2009 this number was increased to more than 1,000,000 records. The total number of nucleotide fungal sequences in GenBank now is close to 3.2 million, to be more precise 3,157,367 (on 7/15/10). GenBank contains data on the number of sequences for any specific name, for example Saccharomyces pastorianus – 981,669 sequences, Saccharomyces cerevisiae – 61,569; Blumeria graminis – 38,498 etc.

The aim of this work is an estimation of the fungal diversity in GenBank and provision of this diversity with type material.

Materials and Methods

Data obtained from several on-line sources were analyzed:

- GenBank NCBI, Taxonomy - National Center for Biotechnology Information www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi
- Database IndexFungorum (CABI, CBS) www.indexfungorum.org/Names/fundic.asp
- Database StrainInfoNet www.straininfo.net
- FungalDC www.vkm.ru/fungalDC.htm

The analysis of fungal diversity has been carried out as part of the common initiative seeking to study the diversity of cultured fungi. This work has become possible due to the previously developed format of the specialized database FungalDC (www.vkm.ru/fungalDC.htm), which incorporates three sources: (1) a modern classification scheme of fungi system; (2) fungal species diversity deposited in GenBank; and (3) fungal culture species diversity in the world’s collections (Ozerskaya et al. 2010). In the database names of all fungal taxa are included, from ranks of kingdom to genus. This includes all species names in GenBank and the catalogues of the world’s 386 fungal collections. The classification of higher taxa is given in compliance with the current Dictionary of the Fungi (http://www.indexfungorum.org/Names/fundic.asp).

Results and Discussion

The percentage of fungal taxa presently in GenBank has been estimated, including taxa from Chromista and Protista, which are maintained traditionally by fungal collections and herbaria (for instance Dictostellium etc). Special attention must be given to the fact that DNA sequences are not always deposited with the correct species name. Presently, from the more than 55,000 fungal names entered in GenBank, only 21,400 have definite specific names equating to 3,497 genera (on 7/15/10). The remainder are represented at the level of higher taxa – families, orders, classes etc. A considerable number (more than 11,000) do not have any rank at all and are designated as fungal isolates extracted from natural environments and other non specific designations, e.g. “Ascomycota”, “Porl cocos/Tremella fuciformis fusi”, “Dothideomycetes sp. B15”, etc.

After analyzing the dynamics of fungal data for the last 15 years it can be summarized that the initial stage of this period is characterized by the deposition of known taxa sequences (Fig.1). In the last few years in GenBank, however, the number of unidentified samples has increased logarithmically. This is partially due to the fact that more journals require GenBank accession numbers for publication (Ryberg et al. 2009), but also reflects the increase in environmental projects cataloging DNA diversity. Numerous names are derived from environmental sequences obtained from BLAST results. This reflects deficiencies within the set of sequences available for BLASTing due to the following reasons:

1) Incomplete fungal taxonomic diversity in GenBank (Vigalsys 2003, Nilsson et al. 2006).
2) GenBank is not an authorized nomenclature and taxonomy system (Hibbett et al. 2007). On each page there is a corresponding notification thereof – “Disclaimer: The NCBI taxonomy database is not an authoritative source for nomenclature or classification - please consult the relevant scientific literature for the most reliable information.”
3) The amount of new incorrectly performed records significantly exceeds the number of its corrections (Pennisi 2008).
4) Erroneous sequences (about 20%) to which the new data are compared with the help of specific computer programs (Bridge et al. 2003, Bitardonto et al. 2008).

Thus the assignment of a certain species name to an organism depends on the researcher’s qualification and therefore cannot exclude the effect of so-called human factor, namely:

The author can simply misidentify the species relying on other diagnostic characteristics;

The author can follow a certain specific classification scheme resulting in a volume conception of a particular taxon which is different from other conceptions;

The living culture or herbarium specimens subjected to sequencing are contaminated resulting in erroneous data and wrong conclusions.

However, in spite of the above-mentioned limitations, molecular-genetic databanks are undoubtedly important for fungal systematic (Bridge et al. 2005), and GenBank fulfils an extremely important archival function, maintaining a diversity of sequences isolated from different organisms and affording an opportunity of quick data access for compara-

Continued on following page
tive analysis. In this connection, it is absolutely necessary to deposit molecular-genetic data in GenBank on type specimens (ex-type cultures or herbarium samples) for different fungal species.

It is known that type specimens and authentic samples are maintained in Biological resource centers and fungal herbaria (Hawksworth 2004a). It should be pointed out that this task must be performed not only by workers of collections and herbaria, but also by those researchers who use type specimens and authentic samples in their work. The study of type samples is of great importance for generating new species and variants, particularly if they are maintained in the regional collections with limited resources. In such cases it is necessary to conserve them in duplicated collections and herbaria, and to assume measures, where possible, for molecular-biological study of the given samples, and to deposit the obtained sequences in available databases.

When considering the total diversity in GenBank, with regard to fungal higher taxa, we can note that the leading number of sequences of known genus and species is within the Ascomycota (64.7% genera, 57.7% species) and Basidiomycota (30.3% genera, 37.7% species). Other phyla represent only a small number of sequences; Zygomycota 3.1% genera and 1.5% species, with the rest of the taxa representing less than 4%.

Fungal genera present in GenBank compared with the Index Fungorum database has made it possible to estimate the level of individual taxa identified by molecular-genetic methods. The data obtained revealed which taxa have the greatest amount of “Unknowns” and which have the most sequences deposited in GenBank. Due to incomplete submission data it is impossible to determine how many of these were obtained from type cultures or specimens. The necessity to designate type sample use in different areas of mycological research has been frequently noted by different authors, and also advocated by open letters written by members of the scientific community (Agerer et al. 2000, Hawksworth 2004b, Romano et al. 2005). In several journals numerous authors cite the numbers of taxa studied with molecular-genetic methods but do not often specify whether they are isolated from types or not (Tang et al. 2007), nor do they give other designations of the studied samples. Often only GenBank accession numbers are indicated (Padovan et al. 2005).

Such disregard to the type designation results in the uncertainty of comparative data taxonomic value according to molecular-genetic research. To be more definitive on the status of studied samples it is necessary to make labor-intensive verifications of their numbers by comparison of relevant collection and herbarium catalogues, and this is possible only if they are openly accessible.

The possibility of providing an interface between the EMBL genetic database and the database on microorganism cultures maintained in the CABRI collections (Common Access to Biological Resources and Information - www.cabri.org) has been successfully demonstrated by StrainInfo (Ozerskaya et al. 2010). The central problem is connected with the lack of precise data indicating which strains are ex-type. Unfortunately, the new format of the GenBank database (Version 8.3, April 2010) introduced by INSDC for data entry in DDBJ/EMBL/GenBank does not include a special field for indicating whether the organism - source of consequence - is a type sample or a type culture for the given species (INSDC - www.insdc.org/files/documents/feature_table.html). The table of data description asks some questions about sources of sequences, but it can be ignored by submitters. These matters should be policed at journal level.

**Conclusion**

The integration of resources can help to pool fragmentary data which are available in different databases, to simplify access, and to ensure their simultaneous use (Pruess 2004). One of the most important trends in developing these integrated databases is the organization of cooperation when making special formats to introduce comments and analytical notes concerning different records deposited in GenBank. Currently the letter signed by 256 mycologists and published in Science magazine has been actively discussed (Bridge et al. 2005). It examines the possibility to make corrections of erroneous fungal sequences by third parties unaffiliated with GenBank. Due to the fact that GenBank acts as both an archive and a database, the freedom to change submitted data is restricted by the willingness of the original submitters to allow this (Pennisi 2008). Efforts are under way to allow for third party notes to be added to the database without explicit changes to the original data.

We suggest solving the problem in another way – not correcting the records that have been deposited in GenBank, but placing the relevant materials in FungalDC. This would allow real time tracing of the accumulated data on nomenclature types for different species. For this purpose it would be possible to use both FungalDC and MycoBank formats (Crous et al. 2004) by means of addition of on-line links with GenBank on the basis of accession numbers for fungal type
cultures. Thereby it would be possible to pool within one database the information about sequences generating from types, the comments of different researchers, and the information concerning other properties of type samples (morphology, physiology, diagnostic characters, illustrations etc.). A similar data organization scheme already exists at StrainInfo.net, the network of Biological Resource Centers, which consolidates data on microorganism cultures relating to one common strain and maintained in different collections. We propose that access be open to this database and the information on each species, similar to “Wikification” suggested previously (Pennisi 2008, Salzberg 2007).

It should be noted that data volumes change rapidly. To permanently trace and direct the inflow of new data and corrections there is the need for collaboration between specialists working with diverse data types, and united with the same purpose. We hope that in the immediate future these problems can be solved on the basis of coordination of various institutions’ efforts in open access for all interested users.

SM Ozerskaya
GA Kochkina
NE Ivanushkina
All-Russian Collection of Microorganisms,
G.K.Skryabin Institute of Biochemistry and Physiology of Microorganisms RAS,
Russia

Acknowledgements

The authors highly appreciated the valuable comments provided C.Schoch (GenBank taxonomy, National Institutes of Health/NLM/NCBI, Bethesda, MD, USA).

Literature Cited


Dear fellow mycologists,

I just returned from this year’s MSA meetings in Lexington, home of the Kentucky Derby, the Bourbon Trail, Barbecue, and Bluegrass music. This year’s MSA meetings were held jointly with the International Symposium on Fungal Endophytes of Grasses (ISFEG), offering a special opportunity to observe the role of fungi in the biology of Kentucky Bluegrass and other forage grasses. Program Chair Tom Horton worked very hard with local hosts Lisa Vaillancourt and Chris Schardl (both faculty U of Kentucky) to put together an excellent program of broad interest to many of our members. The Karl Ing lecture this year was given by professor Sally Smith (Univ. of Adelaide), who presented an informative and energetic talk on phosphorus metabolism in arbuscular mycorrhizal fungi. As in the past, our annual meeting could not have happened without the support of dozens of volunteer members and students who contributed their time to help with the pre-meeting foray, staffing tables for registration and t-shirt sales, and helping with the MSA auction. Whilst in Kentucky, I passed the presidential gavel over to incoming president Tom Bruns. I’m thankful for the chance to serve as president, especially knowing that the MSA will continue to be in good hands for the foreseeable future!

This past year has been a pretty good one for the MSA. In spite of an ongoing recession, mycologists are still finding jobs in academia and the private sector. MSA’s financial situation appears stable, with about a half-million dollars of endowment that allows us to support a large variety of research and travel awards each year. It would not be that difficult to imagine the MSA Endowment eventually reaching a million dollars. If you have benefited in the past from MSA support, please consider making a donation to one of the named mentor-awards. This is a great way to honor your mentors and also support future mycologists.

Mycologia and Inoculum continue to reflect the high quality of research and other activities by our society. Jinx Campbell has done a great job moving our Society Newsletter Inoculum online (and on schedule). Mycologia has especially blossomed in the last year under the watchful care of Editor-in-Chief Jeff Stone. Jeff has worked very hard with Allen Press and Hiwire Press to streamline the on-line submission and review process, resulting in faster turnaround time to publication. Jeff has also implemented a fast-track option for news-breaking research reports, along with on-line access to articles that are ‘in press’. The quality of the journal is also evident in the stunning cover photos and color figures in each issue. Thanks to both Jinx and Jeff, for your important service to the MSA!

This is my last column as MSA president. I’d like to specially thank my fellow MSA Council members who helped to make the MSA run smoothly this past year. MSA Secretary Jessie Glaeser earns rookie of the year award for jumping into her role with both sleeves rolled up. The other key person I’d like to thank is outgoing MSA Treasurer Sabine Huhndorf, who has been overseeing the MSA’s bills and ledgers for the past 3 years. Thank you Jessie and Sabine from all of us!

If you missed the MSA meeting, the mycological meeting season is still not over! Many MSA members including myself also plan to attend the 9th International Mycological Congress in Edinburgh, Scotland, from August 1-6 (www.imc9.info). MSA will be co-sponsoring several receptions at the Congress, so be sure to come by the MSA info table to pick up tickets (free to MSA members). If we don’t see you in Edinburgh, then be sure to attend next summers MSA meeting in Fairbanks, Alaska!!

Best regards to all of you,

Rytas
President Vilgalys
and our newsletter. To ensure that you receive Society blasting more and more on email to bring you the latest MSA information up-to-date in the MSA directory? The Society is re-

The meeting was called to order at 0800 in Lexington, KY Conference Center, Grand Ballroom A&B, Minutes of the 2010 MSA Business Meeting

Deaths: I am saddened to report the passing of Dr. C. Terrence Ingold, a prominent mycologist in London, at the age of 104. It is impressive to think of someone whose career extended throughout most of the 20th century!

REMINDER: MSA Directory Update: Is your information up-to-date in the MSA directory? The Society is relying more and more on email to bring you the latest MSA news, awards announcements and other timely information, and our newsletter. To ensure that you receive Society blast

The first step is for everyone who is currently a member to renew for the upcoming year. And don’t forget to recommend MSA to your professional colleagues who are interested in fungi – be they pathologists, geneticists or ecologists. There is room in MSA for all!

—Jessie A. Glaeser
MSA Secretary

Minutes of the 2010 MSA Business Meeting

Wednesday, June 30, Hilton Hotel and Conference Center, Grand Ballroom A&B, Lexington, KY

(1) The meeting was called to order at 0800 in Grand Ballroom A & B of the Hilton Hotel and Conference Center in Lexington, KY by President Rytas Vilgalys. President Vilgalys introduced the Society Officers: Past President Roy Halling, President Elect Thomas Bruns, Vice President David Hibbett, Secretary Jessie Glaeser, and Treasurer Sabine Huhndorf. President Vilgalys thanked all those involved in planning the 2010 Annual Meeting, especially Chris Sharift and Lisa Vaillancourt (Local Arrangements Co-Chairs) and Tom Horton (Program Committee Chair) for their wonderful job of organizing this joint meeting with the International Symposium on Fungal Endophytes of Grasses (ISFEG). President Vilgalys then called for the approval of the minutes of the 2009 MSA Business Meeting held in Snowbird, UT [Inoculum 60(5)], referring to reference copies on the tables. The minutes were unanimously approved by the membership.

(2) President Vilgalys presented the highlights of his annual report [Inoculum 61(4)], in particular thanking the membership for volunteering time and moving the interests of the Society forward. One item of alarm is the steady decline of membership, which is a common problem of all scientific organizations in the current economic climate. President Vilgalys urged everyone to be attentive about renewing their membership and to encourage their colleagues and students to join MSA. It is important to increase membership, especially as Mycologia goes on-line in the upcoming years ahead. MSA is doing fairly well financially with an endowment of approximately $500,000. President Vilgalys announced the beginning of a capital campaign to bring the endowment up to $1 million – a very realistic goal. In 2010, MSA supported 14 student mentor awards and 8 IMC travel awards. President Vilgalys thanked Mycologia Editor-in-Chief Jeffrey Stone for an excellent job in producing Mycologia, which is being printed ahead of schedule. He then introduced Helen Refrew, Fairbanks Tourism Bureau, who gave an interesting presentation about Fairbanks, AK, the site of the 2011 meeting. Lee Taylor, the Local Arrangements Chair for the 2011 meeting, was also introduced.

(3) Vice President David Hibbett reported on the results of the election of Council members for 2010. A total of 200 votes were cast in the election; 189 by electronic balloting and 11 by paper balloting. The following new councilors and officers were elected for 2010-2011 and will start their terms after this business meeting: Frances Traill, Councilor Cell Biology/Physiology; Anne Pringle, Councilor – Ecology/Pathology; Imke Schmitt Councilor – Genetics/Molecular Biology; Brandon Matheny, Councilor – Systematics/Evolution; Mary Berbee, Vice President; Marc Cubeta, Treasurer. Vice President Hibbett thanked everyone who nominated candidates and everyone who agreed to stand for election. He urged the membership to vote.

(4) Secretary Jessie Glaeser presented the names of 8 Emeritus candidates for approval by the membership: Kenneth Conway, Stillwater, OK; Everett Hansen, Corvallis, OR; Maren Klich, Crandon, WI; John Landolt, Sheppardstown, WV; James W. Lorbeer, Ithaca, NY; A.J. Meyers, Kinsport, TN; Ira F. Salkin, West Sand Lake, NY; Paul J. Sainsbury, University of Texas at Austin. The motion to approve these new Emeritus members was unanimously passed by a vote of the membership. Secretary Glaeser next presented 96 new or returning members for approval, the motion for which was also unanimously passed by a vote of the membership. Secretary Glaeser asked for a moment of silence for those MSA members and/or prominent mycologists who passed away during the past year. These included Gopi Podila and Maria Davis, for whom this meeting is dedicated, and also Lois Tiffany, Patricia Crane, and C. Terrence Ingold.

(5) Secretary Glaeser referred to her midyear [Inoculum 61(2)] and annual [Inoculum 61(4)] re-
ports and briefly reviewed the highlights of the Mid-Year Executive Council Meeting [Inocu-

lum 61(2)] and MSA Annual Council Meeting [Inoculum 61(4)]. She noted that the mid-year Executive Council meeting was conducted as a conference call, which saved the Society approximately $5000.

(6) Treasurer Sabine Huhndorf presented the Treas-

urer’s annual report [Inoculum 61(4)] and briefly presented some highlights, including the number and levels of student awards that will be presented at the annual banquet on Thursday. She announced that the Cramer Mentor Student Award (travel) has reached the $10,000 mark necessary for disbursement and expects a new fund for Dr. Barniki-Garcia (travel or research, to be determined) to also reach this level soon. Treasurer Huhndorf also noted the overall de-

cline in membership first mentioned by Presi-

dent Vilgalys.

(7) Awards Presentations (please see Inoculum 61(4) for full details of 2010 MSA awards.

(a) President Vilgalys began by asking those members in attendance who were MSA Past Presidents, Secretaries, Treasurers, re-

cipients of the Alexopolous Prize, the West-

on Award, and Distinguished Mycologists to stand and be recognized.

(b) President Vilgalys introduced Greg Mueller, member of the Honorary Awards Committee, who presented the MSA Fel-

loows Award to Dr. Steven Stephenson, reading a brief summary of the highlights of Dr. Stephenson’s impressive career and his devotion to mycology. Dr. Stephenson was unable to attend the meeting this year, but the award was received in his absence by Dr. Adam Rollins.

(c) Honorary Awards Committee Member Mueller then presented Jose Carmine Di-

anese as the nominee for 2010 Honorary Member, summarizing his major impacts on plant pathology and mycology research in Brazil. The motion to approve Jose Carmine Dianese as the 2010 Honorary Member was approved unanimously by the membership. Dr. Dianese spoke a few words, thanking the Society, and inviting everyone to the 6th Brasilia Mycological Congress in November, 2010.

(d) President Vilgalys introduced the Chair of the MSA Distinctions Committee, Walter J. Sandburg. Dr. Sandburg thanked the other members of his committee, which was short staffed this year, with Chair James Kimbrough. The 2010 recipient of the Alexopolous Prize for outstanding early-care-

er mycologist was presented to Anne Pringle. Dr. Pringle was collecting in Bor-

neo and could not attend the meeting to col-

lect her award in person. The Weston Award for Excellence in Teaching was awarded to Joey Spatafora, who thanked the society, especially Meredith Blackwell. The Distinguished Mycologist Award was pre-

sented to Gary Samuels, who gave a very moving tribute to his mentors.

(e) President-Elect Bruns presented Certifi-

cates of Appreciation to Society members in recognition of exceptional service. These included: Betsy Arnold, as Chair of the En-

dowment Committee; Rick Kerrigan, as Chair of the Editorial Advisory Board; Lisa Vaillancourt and Christ Shardi, as Co-

Chairs of the Local Arrangements Commit-

tee; Tom Horton, as Chair of the Program Committee; Amy Rossman, as Book Re-

view Editor; Sabine Huhndorf, as retiring Treasurer; and Rytas Vilgalys as retiring President.

(8) President Vilgalys announced the locations of future MSA meetings: 2011 in Fairbanks, AK; 2012 tentatively in the northeastern U.S. (Boston or Providence); 2013 tentatively in Austin, TX as a joint meeting with APS. Priscilla Chaverri in-

vited everyone to participate in the next Latin American Mycological Congress in Costa Rica; the announcement will be available in October.

(9) President Vilgalys introduced the new President of the Mycological Society of America for 2010-

2011, Thomas Bruns, who thanked everyone for the attention and adjourned the meeting at ap-

proximately 0930 with a tap of the presidential gavel.

---

Minutes of 2010 General Council Meeting

Saturday, June 26, 2010, Hilton Hotel and Convention Center, Crimson Clover Room, Lexington, KY

Call to Order and Approval of Minutes

(1) The 2010 MSA Annual council meeting was called to order by President Rytas Vilgalys at 0900, Saturday, June 26, in the Crimson Clover Room of the Hilton Hotel and Convention Cen-

ter in Lexington, KY. Present were: President Vilgalys; President Elect Thomas Bruns, Vice President David Hibbett; Secretary Jessie Glas-

er; Treasurer Sabine Huhndorf; Past Presi-

dents Roy Halling (2008-2009) and Don Hemmes (2007-2008), Councilors Anthony Glen, Jason Stajich, Thomas Horton, and Tim James, and invited guest Mycologia Editor-in-

Chief Jeffrey Stone. Councilor Georgianna May joined the meeting by Skype at 1400. Apologies were received from Councilor Lee Taylor and newly elected Vice President Mary Berbee, Treasurer Marc Cubeta, and Councilors Frances Trail, Ann Pringle, Imke Schmitt, and Brandon Matheny. Secretary Glaeser distributed hard copies of the meeting packet that had been supplied in the electronic format to Council and guests prior to the meeting. The annual meeting packet included the meeting agenda, MSA 2010 Annual Reports, minutes of the 2009 Annual Council Meeting held at Snowbird, UT [Inoculum 60(5)], minutes of the 2010 Executive Council Meeting held by teleconference [Inocu-

lum 61(2)], MSA 2010-2011 Official Roster showing upcoming vacancies, and a copy of the Society Constitution and Bylaws.

Motion 1 (approved unanimously) Moved by Secretary Glaeser and seconded by President-

Elect Bruns that the minutes of the MSA 2009 Annual Council Meeting be accepted as pub-

lished in Inoculum 60 (5) 2009. President Vilgalys suggested that any discussion of the Annual Council Meeting minutes or the Executive Council Meeting minutes, including updates on action items, be addressed in related Officer and Publications reports.

Officers’ Reports (excluding Financial)

(2) President Vilgalys began his oral report by wel-

coming all present to Lexington, KY and thank-

ing Program Chair Tom Horton and Local Arrangements Co-Chairs Chris Shardi and Lisa Vaillancourt for their hard work in organizing the annual meeting. He also thanked all of the MSA members who donate their time to the Society. Issues that are included in the agenda of the Council meeting are 1) possibility of MSA holding a joint reception at IMC, perhaps with the Mycological Society of Japan, 2) comments or ideas of MSA becoming more politically ac-

tive on legislative affairs, and 3) where to have annual meetings in 2012 and beyond. Several positions on the MSA roster were recently filled, positions on the MSA roster were recently filled, including: Betsy Arnold, as Chair of the En-

dowment Committee; Amy Rossman, as Book Re-

tee; Tom Horton, as Chair of the Program

Committee; Walter J. Sandburg, as Chair of the Distinctions Committee; Amy Rossman, as Book Review Editor; Sabine Huhndorf, as retiring Treasurer; and Rytas Vilgalys as retiring President.

(3) President-Elect Bruns presented his oral report. He is currently working on filling positions on the Roster and has brought Certificates of Ap-

preciation for key retiring MSA officers and committe chairs.

(4) Vice President Hibbett presented the results of the election. Officers elected for 2010-2011 were: Mary Berbee (Vice President), Marc Cubeta (Treasurer), Frances Trail (Councilor), Ann Pringle (Councilor), Imke Schmitt (Councilor), and Brandon Matheny (Councilor). A portion of his written report included information on who was asked to run for various positions and who declined. This information will be kept confi-

dential (i.e. not published in Inoculum).

Action Item: Secretary Glaeser will give a copy of the full Vice President’s report to the Nomina-

ting Committee for the 2011 election so that they will know who has been previously asked to run and who has declined.

President Vilgalys stated that it is important to engage young people to run for Councilor posi-

tions but also important to get them to come to the council meeting. President-Elect Bruns sug-

gested a shorter meeting that does not involve an entire separate day for travel.

Action Item: Secretary Glaeser will discuss rescheduling the Council meeting with the 2011 Local Arrangements Committee.

(5) Secretary Glaeser referred to her written report [Inoculum 61(4)] on Council activities for the past five months. Council activities prior to the Mid-Year Executive Council meeting (i.e. from August 2009 through January 2010) were previ-

ously summarized in the Secretary’s Mid-year report [Inoculum 61(2)].

Action Item: Secretary Glaeser will get a copy of the MSA contract with Allen Press to deter-

mine whether the cost of distributing hard copy ballots to members is an additional charge.

Financial Reports

(6) Treasurer Sabine Huhndorf presented her re-

port [Inoculum 61 (4)] and reviewed amounts re-

ceived from the 2009 MSA meeting with the Botanical Society of America. Publication ex-

penses in 2009-2010 appear more stable than in

Continued on following page
previous years – 6 issues of Mycologia will be published before the end of the fiscal year which simplifies tracking costs. Although there is some variation in cost among issues due to length and number of color, the cost variations seem within a predictable range since there are many fixed costs. A continuing problem has been the contract with University of New Mexico for editorial assistance. It has been very difficult to finalize the contract with them and to set up a regular billing schedule. Money has been allocated but not paid for over one year of continued service. Treasurer Huhndorf hopes to get this matter resolved before July 31, 2010; the new contract will be good for five years.

Membership numbers continue to decline. Subscription income is also down compared to last year when the income had increased due to an increase in subscription cost. The amounts paid out for awards for the 2010 meeting and the international awards for travel to ICMP are presented in the written report. All variable rate awards were paid out at 4%, resulting in the 14 awards at $400 each. All interest on the endowment funds is paid out as awards – nothing is reinvested in the accounts. Due to low interest rates in the current economy, the endowment interest must be supplemented with uncommitted endowment funds to pay out this level of funding. During 2009 – 2010, $15,000 was contributed to the mentor Travel Funds and $1500 to Research Funds. T-shirt and auction sales at the 2009 meeting contributed $9670 to the uncommitted endowment fund and are a significant source of revenue. All newly formed endowments must reach $10,000 before being eligible for disbursement. President Vilgalys observed that many of the endowment funds were close to the $10,000 level; a strong financial campaign for the society would probably result in many of these funds surpassing $10,000. This could best be done by appointing “point people” for each fund. Meredith Blackwell’s genealogy of mycologists would be a good source of information for potential contributors to the different award funds.

Another way to increase revenue would be to institute some new endowment funds for individuals who have trained large numbers of students and influenced the field of mycology. New awards are designated “emerging funds” until they reach a principle of $10,000; a strong financial campaign for the society would probably result in many of these funds surpassing $10,000. This could best be done by appointing “point people” for each fund. Meredith Blackwell’s genealogy of mycologists would be a good source of information for potential contributors to the different award funds.

Action item: President Vilgalys will find MSA members to spearhead funding campaigns for all endowment funds below $10,000 and to explore the creation of new funds.

(7) Report of the Endowment Committee. With the absence of the Endowment Chair, Secretary Huhndorf made several observations:

1) The numbers provided in the Endowment Committee report, provided as a separate handout, corresponded with the numbers from the Treasurer.

2) The Endowment Committee needs to be restructured so that the Chair is not solely responsible for all of the duties. Duties need to be assigned to each committee member, as done in the Program Committee. It might be desirable to classify it as a Rotating Committee rather than a Standing Committee.

3) President-Elect Bruns will need to find a new Chair.

Action item: President-Elect Bruns will ask Karen Hughes whether she is interested in assuming the Chair or if she has recommendations for a committee chair or committee member.

(8) Report of the Finance Committee: No report was provided by the Finance Committee in time to be considered by Council but it will be published in Inoculum [61(4)].

Publications and Web Management

(9) Mycologia Editor-in-Chief Stone presented his report [Inoculum 61(4)]. Mycologia has been going very well, due to work of assistant and associate editors and reviewers who are providing prompt and helpful comments and reviews. Issues are being released early; there will be six issues this fiscal year. Size of issues has been increasing generally. Papers are appearing earlier online, often six months before print. Online versions can also include supplemental materials, including videos. A new publishing platform that will be adopted in 2011 by HighWire Press may result in even more opportunities for supplemental material and other online features. A discussion ensued as to whether supplements could be linked to download automatically with the pdf version of the paper. This might be possible with the new publishing platform. A problem with linking the Mycologia web page to searches in PubMed needs to be resolved.

Action item: Jason Stajich will follow up on whether automatic imports of Mycologia articles in PubMed will fix link with the Mycologia webpage.

Submissions of articles to Mycologia have been increasing while acceptance rate has decreased slightly since 2007-2008. Approximately 70% of submissions are from outside of North America and often require additional editing since they are written by non-native speakers. Covers have become a special topic of pride with competition among authors.

President Vilgalys commented that Mycologia is looking better and better and suggested that we consider an award for the best paper of the year, whether the most accessed, most cited, or generally best student paper. This would increase visibility of the journal. It was suggested that reviewers and journal editors nominate papers and a nonmonetary award be given by the Editor-in-Chief at the annual meeting.

Action item: EIC Stone will discuss the formation of a “Best Paper” award with the Editorial Committee.

EIC Stone has had inquiries about Mycologia’s open access option policy. European journals are adopting this by charging the authors a separate fee to offset printing costs. Some granting agencies, especially publicly funded research, are also requiring that results be available by open access. Although other journals have adopted a fee of $2000 - $5000 for full open access, paid by the author, it was thought that a lower fee would attract a larger number of high quality, highly visible papers.

Motion 2: (approved unanimously) Moved by VP Hibbett and seconded by Former President Halling that the open access fee for Mycologia be set at $1000. EIC Stone will include information about this in the Instructions to Authors.

A discussion ensued about Mycologia’s Impact Factor and whether the journal should be managed with the objective of increasing the impact factor. EIC Stone felt that the best way to increase the impact factor would be to continue to publish high quality papers that fill a specific niche. Although the impact factor of Mycologia has fallen somewhat since the previous year, the 5- and 10- year factors show that the journal retains relevance. Councilor Horton suggested that attracting an important annual review article might revitalize the journal. One possibility would be to have a dedicated issue devoted to the Fungal Environmental Sampling and Informatics Network (FFESIS) next year when the project is concluded.

The largest category of papers submitted to Mycologia continues to be in the field of systematics. Few other journals publish papers in this field, as opposed to other areas of mycology, such as ecology, genetics and cell biology. EIC Stone noted that in the past year, there was a nice mix of articles including cell biology, genomics, ecology and lichens. Vice President Bruns suggested a targeted issue about ecology, and again the idea of an issue devoted to the FFESIS project was mentioned.

EIC Stone recommended that Mycologia institute a Memorials Editor who would have the full access of an Associate Editor.

Motion 3: Moved by Former President Halling and seconded by President Elect Bruns that a Memorials Editor, with full access to the review system as an Associate Editor, be designated. The Memorials Editor would be listed on the inside cover of Mycologia.

EIC Stone also suggested that Mycologia institute some sort of nomenclatural review to avoid the publication of invalid nomenclature.

Action item: EIC Stone will discuss possible options for improving nomenclatural review, including the possible addition of a formal nomenclatural review and nomenclatural editor to oversee accepted articles that involve publication of new taxa.

Annual Meetings

(10) MSA 2011 Fairbanks, AK – Local Arrangements: Lee Taylor and Gary Larson Planning for the 2011 meeting in Fairbanks, AK is progressing well. The meeting is planned for four days. VP Bruns suggested that an open day or an additional foray could be planned during the meeting if there isn’t enough scientific content. President Vilgalys and VP Bruns stated that people are excited to go to Alaska so there might be good participation despite the cost of getting there.

(11) MSA 2012 Several possibilities have fallen through, including a cruise off of Mexico and meeting with APS in Providence, RI (the latter due to the small size of the venue).

Action item: President Vilgalys will continue to search for a suitable venue for the 2012 meeting, preferably in the Boston area or some other part of New England.

(12) MSA 2013 Action item: VP Bruns will investigate the possibility of meeting with APS in Austin, TX.

(13) MSA 2014 Action item: President Elect Hibbett will continue to search for an appropriate venue.
**Other Considerations**

(14) **International Mycological Congress 9,** Edinburgh, Scotland, August, 2010

Organizer Nick Read joined the meeting by Skype at 1300.

**Informational items:**

The IMC website being updated and will include the Congress program with times of talks and posters. Have approximately 1600 registrants representing over 80 countries. MSA member John Taylor is the keynote speaker. There are approximately 1200 posters in four poster sessions. The social activities in last night of meeting will be spectacular.

Exhibition on fungi at Royal Botanical Gardens in new Gateway Exhibition Center. “From Another Kingdom – the Amazing World of Fungi.”

This will be the biggest public outreach about fungi ever done in UK and will eventually be a traveling exhibit.

Over $100,000 has been given in bursaries, especially to scientists from low- and middle-income countries.

**Items for consideration by Council**

Receptions – Currently two receptions are planned, of 400 guests each, at Royal Botanical Gardens – the site of the Exhibit. Due to the size of the venue there is a limit of 400 people for each reception. The possibility is open for MSA to co-host one of these receptions. The total cost of a reception is 10,000E. Other guests at the reception would include members of the British Mycological Society, invited speakers, members of the International Mycological Society, and senior members of other mycological societies. Initially only one reception was planned, but the organizers want to expose as many people as possible to the Exhibit so are inviting MSA to co-host one of the receptions, allowing MSA members to participate. Cost to MSA would be 7500. President Vilgalys expressed concern that MSA members would be restricted to the second “overflow” reception and would not be in favor of supporting this. Organizer Read assured Council that tickets could be distributed equally between the two receptions and be given out to MSA members at a predetermined location on a “first come, first serve basis.” Dr. Read left the meeting at 1330. Discussion of this proposal was extensive.

**Motion** by Former President Halling and seconded by VP Hibbett (passed unanimously) that MSA support both IMC receptions at a fee of $7500 and that our portion of the tickets will be allocated and distributed to MSA members.

**Action Item:** President Vilgalys will contact Dr. Read and agree to contribute 7500 to co-host both receptions at IMC. Tickets for MSA members will be available for MSA members at the MSA publicity table on a “first come, first serve basis.”

**Action Item:** President Vilgalys will organize the arrangement of materials and staffing for the MSA table at IMC. Graduate students who are recipients of the MSA International Travel Awards will be contacted to help staff the table. MSA organizational materials, including copies of Mycologia and membership applications, will be made available.

**Action Item:** President Vilgalys will check with Elsevier to make certain that we are not being charged a table fee.

(15) **International Mycological Congress 10** Puerto Rico bid by Sharon Cantrell.

President Vilgalys announced with disappointment that the IMC bid for 2014 went to Thailand instead of Puerto Rico. The Council thanks Sharon Cantrell for putting together an excellent proposal and hopes that she will resubmit it for consideration for 2018. It was noted that Thailand had submitted an application once before.

(16) **MSA and public advocacy** – Several MSA members have expressed a desire that MSA act more as a lobbying agency in Washington D.C. and advocate support of scientific, especially mycological, research.

Education: One way that this could be achieved is to get more involved with education, including the development of workshops for high school students and teachers that stress the importance of fungi. This is also a goal of many granting agencies. One way to do this may be through FESIN – this is its final year and it is supposed to include educational opportunities. President Vilgalys observed that everyone is developing educational materials piecemeal. President Elect Bruns noted that it would be good to put teaching materials on the MSA website. Councilor May suggested that the Weston awardees would be a good source of content.

**Action item:** Secretary Glaeser will contact Webmaster Kathie Hodge or her successor to organize the posting of teaching materials and committee content on the MSA website.

Other lobbying activities: Former President Halling made note that Article VIII, Section D of the MSA Bylaws states that “No substantial part of the activities of the Society shall consist of carrying on propaganda or otherwise attempting to influence legislation.” Therefore, MSA cannot legally lobby but is represented by other societies with a strong political component, including AIBS and AAAS. Councilor Glen also thought that we could work with APS on topics that are important to MSA.

**Action Item:** Treasurer Huhndorf will check on the status of AAAS membership as no bill has been presented.

(17) **Web submission of abstracts.** Councilor Horton expressed the need to redesign the abstract submission process since there is no standardized format or process; currently arrangements vary each year and are dependent on the organization that is hosting the meeting or the conference facility or university. This year it was particularly difficult. Councilor Stajich stated that there are open software packages to do this and will find more information. Secretary Glaeser stated that abstract submission for the 2011 meeting is in place.

**Action Item:** Councilor Stajich will research software available for conference organization.

(18) **MSA Archives:** The historical documents of MSA are located at the Brooklyn Botanical Gardens in unlabelled boxes so it is impossible to use them or be able to find anything in them. Historian Ron Peterson had an estimate of $15,000 to curate and organize the papers (labor only, no archiving supplies). Occasionally historical documents have been needed, including the Articles of Incorporation, but it has been easier to obtain replacements than to find the original copies.

**Action Item:** Secretary Glaeser will contact Don Pfister to see if he has any ideas about archiving the documents. Historian Peterson will be copied on all correspondence.

(19) The meeting ended at 1430 EDT.

### MSA 2010 Annual Reports

#### Officers

**Annual Report of the President**

Not submitted in time for publication.

**Annual Report of the Vice President**

**MSA 2010 Election Results**

This year, the offices of Vice President and Treasurer were up for election, as well as four Council positions. Winners are listed below.

**Vice President:** Mary Berbee

**Treasurer:** Marc Cubeta

**Councilor—Cell Biology/Pathology:** Frances Trail

**Councilor—Genetics/Molecular Biology:** Imke Schmitt

**Councilor—Systematics/Evolution:** P. Brandon Matheny

**Councilor—Ecology/Pathology:** Anne Pringle

189 votes were received via the website and eleven by direct mail.

—David Hibbett

### Annual Report of the Secretary

The Secretary’s Midyear report, published in *Inoculum* 61(2), summarized activities from August 2009 to January, 2010. Since that time I have:

- Assisted President Rytas Vilgalys at the midyear Executive Committee meeting that was held as a teleconference on February 1, 2010. It was estimated that a teleconference saved MSA approximately $5000 and perhaps more due to the inclement weather during the week of Feb. 1. I arranged for the teleconference lines and prepared the meeting agenda and mid-year reports that were submitted to the Executive Council before the meeting. The minutes of the meeting and the mid-year reports from officers and committee chairs were published in *Inoculum* 61(2). Among items discussed and approved by Executive Council included:
  - Approval of the 2009 Executive Committee minutes.
  - Approval that funding be made available to the Membership.

Continued on following page
Committee for proposals designed to increase membership.

- Implementation of eight International Travel Awards at $750 each for attendance at the International Mycological Congress in Edinburgh.
- A meeting of Mycologia Associate Editors at the 2010 MSA annual meeting. Travel expenses for Assistant Editor John M. Donahue to the annual meeting will be paid by the Society.
- Support of the bid to have IMC10 in Puerto Rico. MSA pledges funding of $15,000 to support the meeting if it is held in Puerto Rico, primarily in the area of travel awards. If Puerto Rico is awarded the bid, the MSA annual meeting will be conducted during the IMC.
- Selecting the name of the Young Mycologist Award for North America, as requested by the International Mycological Association (IMA). This award shall be designated the “A.H. Reginald Buller Award.” Originally this award was going to be presented at IMC9, but the IMA decided to postpone this presentation.

• Moderated email correspondence and numerous items of discussion with Full Council and Executive Council including email polls that 1) approved the nominations of one Honorary Fellow and one Honorary Member as proposed by the Honorary Awards Committee, chaired by James Anderson; 2) approved Thomas Volk, Mary Palm, and Roy Halling as members of the Editorial Advisory Committee; 3) approved Wendy Untereiner as an Associate Editor of Mycologia; 4) approved a motion brought by EIC Jeffrey Stone that MSA join the DC Coalition “Principles for Free Access to Science” against proposed legislation by the House for the Federal Research Public Access Act, H.R. 5037 that would require final manuscripts of peer-reviewed, private sector journal articles reporting on federally funded research be made freely available on government-run websites no later than six months after publication.

• Assisted President Vilgalys and IMA Representative Sharon Cantrell in writing and editing the bid to get the International Mycological Congress in Puerto Rico in 2014.

• Assisted Vice President David Hibbett in preparing and distributing the MSA Annual Spring Ballot. Due to the early annual meeting and timing requirements in the By-laws, it was not possible to have Allen Press mail out hard-copy ballots to members whose email addresses were missing or invalid. For this reason, I personally mailed hard-copy ballots with a letter to remind individuals to update their email addresses through Allen Press. Over 130 email addresses were missing or invalid. The cost of the mailing, including international/domestic postage, envelopes, and mailing labels was Sxx. I assembled the hard-copy ballots that were mailed to me (only 12 were returned via mail but many people voted online receiving the hard-copy ballot) and notified Vice President Hibbett of the vote totals after being notified of the election results by Allen Press.

• Issued a call to all Society Officers, Councilors, committee chairs and Society representatives for annual report and agenda items in preparation for the Annual Council meeting at Lexington, KY, June 26, 2010. Worked with President Rytas Vilgalys to complete the agenda for the Council meeting. Compiled and edited all received reports, along with the agenda, updated the Society Roster, Constitution and Bylaws, minutes of the previous midyear and annual meetings into the Council package for distribution electronically prior to the meeting. Printed copies were prepared for the Council meeting.

• Updated the Society Roster showing upcoming vacancies for President-Elect Thomas Bruns.

• Advised President-Elect Thomas Bruns on the production of Certificates of Appreciation for retiring MSA Officers.

• Worked closely with Local Arrangements Chairs Lisa Vaillancourt and Chris Shardl on numerous preparations for the annual meeting. Provided a list of members invited to the Volunteers’ Social and estimated the number based on those who had registered for the meeting.

• Issued a call for Manual of Operations revisions to all Society 2009-2010 roster members including committee members, Council members, editorial appointments, special appointments and society representatives.

• Issued an invitation to all MSA volunteers, including all Assistant Editors of Mycologia, committee members, Council members, editorial appointments, special appointments and society representatives to attend the Volunteers’ Social at the annual meeting in Lexington, KY.

• Assisted President Vilgalys in preparing the agenda for the Annual Business Meeting to be held on June 30 at Lexington, KY. Assisted Awards Coordinator Faye Murrin, President Vilgalys, and President-Elect Bruns in ensuring that plaques and certificates of appreciation were prepared for awards winners and that committee chairs or their representatives were present to give out all awards. Prepared a list of 96 new or returning members and eight requests for Emeritus Membership for approval by the MSA membership. The applications for emergitus membership were received from: Kenneth Conway, Stillwater, OK; Everett Hansen, Corvallis, OR; Maren Klich, Crandon, WI; John Landolt, Sheppardstown, WV; James W. Lordeh, Ithaca, NY; A.J. Meyers, Kinston, TN; Ira F. Salkin, West Sand Lake NY; Paul J. Szamiszlo, University of Texas at Austin.

• Received with sadness the reports of the deaths of the following MSA members and/or noted mycologists: Drs. C Terence Ingold and Patricia Ellen Crane.

• Prepared email express columns (April and June) for Inoculum that included summaries of Council activities as well as names of new members and emergitus candidates as received monthly from Christy Classi of Allen Marketing and Management.

• Monitored and approved the sending of blast emails to the Society members through Christy Classi at Allen Marketing and Management. These included: 1) announcements and reminders of annual meeting registration and abstract deadlines; 2) extensions of annual meeting deadlines; 3) the scheduling of an informal symposium on white-nose syndrome of bats during the annual meeting; 4) MSA call for auction items; 5) numerous annual meeting reminders.

• Responded to email and hard copy mail enquiries on a wide variety of issues from Council, committee members and chairs, MSA members, and others. Sent out 1135 emails on many different topics in the past 11 months.

I would like to thank everyone who volunteers their time and expertise in various ways to MSA. I am especially grateful to Lisa Vaillancourt who has spent many sleepless nights organizing this year’s annual meeting in Lexington, KY. Faye Murrin, as past-Secretary and current Awards Coordinator, has made my job much easier this year. I can’t quite imagine taking on that job as well as the duties of Secretary! Cathie Aime, the immediate past-Secretary, has provided invaluable advice and has left me with a cache of valuable documents and an organized structure by which to find them (something that does not come to me naturally!). Many thanks to the Officers and Council members with whom I have worked in the past year. I look forward to starting all over again in July!

—Jessie A. Glaeser

Annual Report of the Treasurer

Meeting, Awards and Symposia finances:

For the 2009 meeting in Snowbird, UT, $20,450 was paid out in travel, research and student awards (12 mentor travel awards @$500 each; FFE @$1500; Martin-Baker @$2500; Rippon @$500; Rogerson @$1150; Alex Prize @$1000; NAMA @$2000; Backus @$1000; 2
Grad Fellowships @ $2000 each; 4 student paper/posters @ $200 each) and $2464 was paid for the Karling Lecture. For the six symposia, a total of $6000 was allocated, and $4799 was requested and paid out. $14,614 was paid out of the endowment account and $13,099 was paid out of the operating account for a total of $27,713 paid out for awards and symposia. For 2009, the Graduate student Fellowship awards were paid out of the operating account. The awards for 2009 were paid out at approximately 5% interest income. There were no applicants for the Smith Award for 2009. MSA paid for one registration ($405 for Don Johnston of the Mushroom Society of UT), council report binding ($170.50), trophies and postage ($229) and t-shirt production ($2325). T-shirt and auction sales generated $9670. Our share of the meeting revenue from the BSA was $2787.

For the 2010 meeting in Lexington KY, $550 in transportation and $400 in foray expenses have been paid to date and $3000 in symposium funding has been allocated and $6000 in international travel awards (8 @ $750) has been distributed. The variable-amount awards are funded at 4% this year ($5600 for mentor travel awards = 14 @ $400 each). Paul Stamets contributed $2000 for the Forest Fungal Ecology Award; $1000 per year will be awarded in 2010 and 2011. Award amounts allocated for 2010 are Martin-Baker @ $2000; Rogerson @ $1000; the remaining award amounts are allocated as listed above for 2009.

Publication finances:

For FY2010 to date we have paid production costs for 5 issues of Mycologia with production, manuscript tracking, editorial office and online publication costs of $163,521. Invoices for one additional issue are expected to be paid before the end of FY2010 on July 31. Still missing from the tracked expenses for 2010 is the editorial office costs for editorial assistants (approximately $50K). The contract with University of New Mexico has been accepted and the invoice is expected shortly. With these additional tracked costs, this will bring 2010 publication expenses above previous years’ costs. Total Allen Management costs for this year to date are $35,642. Over the past three years, the cost for the production of Mycologia ranged from $29,000 to $35,000 per issue. A breakdown of this production cost includes the printing costs ranging from 18K to 26K per issue; AllenTrack and editorial costs ranging from $6K to 9K per issue; online publication costs ranging from $4K to $5K per issue. The total production cost per page is about $200. Estimated production cost per single copy of Mycologia is $25; $150 per year for the journal. The total Allen Management costs are fixed at approximately $36,000 per year.

<table>
<thead>
<tr>
<th>Publication</th>
<th>2010 to date</th>
<th>2009</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total publication costs (Inoculum, Allen Management and Mycologia)</td>
<td>$205,349</td>
<td>$281,146</td>
<td>$245,975</td>
</tr>
<tr>
<td>Breakdown of costs: Inoculum</td>
<td>$6187.23</td>
<td>$9033.47</td>
<td>$3635.47</td>
</tr>
<tr>
<td>Management fees</td>
<td>1044.99</td>
<td>567</td>
<td>2391.58</td>
</tr>
<tr>
<td>author billing</td>
<td>716.34</td>
<td>1066.03</td>
<td>321.04</td>
</tr>
<tr>
<td>back issue mailing</td>
<td>2409.88</td>
<td>3591.84</td>
<td>321.04</td>
</tr>
<tr>
<td>back issue storage</td>
<td>320.26</td>
<td>425.99</td>
<td>535.17</td>
</tr>
<tr>
<td>base mgmt. fees</td>
<td>28938.26</td>
<td>28,095.40</td>
<td>27180.00</td>
</tr>
<tr>
<td>online services</td>
<td>0</td>
<td>0</td>
<td>141.8</td>
</tr>
<tr>
<td>renewal notices, ballots</td>
<td>2216.43</td>
<td>1913.48</td>
<td>2044.70</td>
</tr>
<tr>
<td>TOTAL MANAGEMENT</td>
<td>$35641.16</td>
<td>$35697.74</td>
<td>$35432.29</td>
</tr>
<tr>
<td>Mycologia printing</td>
<td>130400.23</td>
<td>147,788.23</td>
<td>118390.44</td>
</tr>
<tr>
<td>AllenTrack</td>
<td>5041.94</td>
<td>4625.00</td>
<td>3317.50</td>
</tr>
<tr>
<td>Editorial office</td>
<td>1106.84</td>
<td>45528.45</td>
<td>54235.20</td>
</tr>
<tr>
<td>Marketing</td>
<td>0</td>
<td>0</td>
<td>600.00</td>
</tr>
<tr>
<td>Online Publication</td>
<td>24855.48</td>
<td>35,197.45</td>
<td>24968.02</td>
</tr>
<tr>
<td>author reimbursement</td>
<td>516.5</td>
<td>3113.50</td>
<td>5968.30</td>
</tr>
<tr>
<td>TOTAL MYCOLOGIA</td>
<td>163,520.99</td>
<td>236,252.63</td>
<td>207,479.46</td>
</tr>
<tr>
<td># issues per year</td>
<td>5 issues</td>
<td>8 issues</td>
<td>6 issues</td>
</tr>
<tr>
<td>Cost per issue</td>
<td>$32000/issue</td>
<td>$29000/issue</td>
<td>$35000/issue</td>
</tr>
</tbody>
</table>

Membership:

Membership numbers are down from this time last year (this year = 1023; 31 May 2009 = 1066) and subscriptions down from this time last year (this year = 629; 31 May 2009 = 656). In June-July FY2009 the numbers for both membership and subscriptions increased so I expect the same for this year. But both membership and subscriptions are still moving in a steady downward trend. By the end of FY2010, subscription dollars may reach the same amount as in FY2009 but we are not seeing the same increase as in the past few years because the 2010 increase in subscription cost was lower than in the past few years.

<table>
<thead>
<tr>
<th>Membership and subscription numbers</th>
<th>Fiscal Year - 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Members</td>
<td>Subscriptions</td>
</tr>
<tr>
<td>2000</td>
<td>1291</td>
</tr>
<tr>
<td>2001</td>
<td>1252</td>
</tr>
<tr>
<td>2002</td>
<td>1342</td>
</tr>
<tr>
<td>2003</td>
<td>1295</td>
</tr>
<tr>
<td>2004</td>
<td>1226</td>
</tr>
<tr>
<td>2005</td>
<td>1232</td>
</tr>
<tr>
<td>2006</td>
<td>1185</td>
</tr>
<tr>
<td>2007</td>
<td>1199</td>
</tr>
<tr>
<td>2008</td>
<td>1134</td>
</tr>
<tr>
<td>2009</td>
<td>1121</td>
</tr>
<tr>
<td>2010</td>
<td>1023</td>
</tr>
</tbody>
</table>

Continued on following page
Endowment Finances:

The endowment fund amounts tracked by the treasurer are given in the table below. During this year, over $15,000 in contributions were made to the Mentor Travel Funds and almost $1500 were contributed to the Research Funds. T-shirt and auction sales from the 2009 MSA meeting contributed $9670 to the Uncommitted Endowment account, with a total of over $11,000 going into the Uncommitted Endowment. Going forward from this year, all newly-created Funds must reach the fully-funded level of $10,000 before being eligible for award dispersement. During this year, the Kramer Mentor travel fund reached the fully-funded level of $10,000. Collections totaling $5494 have been received for a new fund set up in the name of S. Bartnicki-Garcia. The group spearheading this effort will decide if the fund will be a travel or research fund (listed as travel fund in the table below).

—Sabine Huhndorf

PUBLICATIONS

Annual Report of the Mycologia Editor-in-Chief

One year done!

The optimist fell ten stories
and at each window bar
he shouted to the folks inside
‘doing all right so far…’

As always, thanks are due to all of the Mycologia Associate Editors, Assistant Editors Mitch Donahue and Jerry Hebert, and Managing Editor Karen Snetselaar for their hard work to keep the publication pace on track. The Associate Editors and all who provide reviews for Mycologia have been doing a huge service to the journal and the MSA by providing timely and insightful comments and improving the quality of all papers. The AEs do an enormous amount of work to constantly improve Mycologia and their contributions are greatly appreciated. The editors and staff of Mycologia are doing all we can to provide our authors with prompt, informed and helpful reviews, timely decisions, accurate editing, on-time publication and attractive print and online formats to showcase their research. We have also been working hard to ensure that Mycologia is widely read and cited by making improvements to the Mycologia website and adding the most current search features and reference linking technologies.

Welcome, and thanks, to Wendy Untereiner who has agreed to serve as a Mycologia Associate Editor. Thanks also to Roy Halling, Mary Palm, and Tom Volk who have agreed to serve on the Editorial Advisory Committee, which is chaired by Rick Kerrigan.

Mycologia volume 101 (2009) consisted of 931 pages and comprised 93 regular research articles and 5 memorials. Issue 101.6, which completed the volume was released on Oct 27, 2009. As of this writing, issues 102(1) through 102(3) have been published, 754 pages comprising 69 regular articles and one memorial. Issue 102.3, the May-
June issue was released 13 May, 2010. The remaining three issues of volume 102 are now complete and in press. All papers accepted for volume 102 (except memorials) have been published ahead of print online in the ‘in press’ section of the Mycologia website, and papers are now being assigned to volume 102 (2011). The ahead of print online publishing process with HighWire is mostly working well, although there are some annoying technical problems. Karen Snetselaar has been instrumental in keeping the ahead of print system working and coordinating with authors, HighWire and Allen Press.

As usual, the majority of papers submitted and published in Mycologia last year were in the systematics subject area, including several important papers in molecular evolution and systematics. However, there have also been several noteworthy papers in ecology, genetics/genomics, physiology, medical mycology, plant pathogens and lichens that have helped continue Mycologia’s tradition of publishing a wide range of fungal biology research. Mycologia has continued to attract significant and influential papers in fungal systematics as well as other subject areas.

During calendar year 2009 there were 225 new papers submitted. Of these 115 were accepted for publication (56%), 89 were rejected, and 21 are still pending decision. Our review and decision times have been substantially decreased over the past 3 years (Table 1). Average processing times for manuscripts for 2009 were about 45 days from submission to the first decision and about 90 days to final decision. The number of new submissions received in 2009 was slightly more than for 2008 (217). So far for 2010, 120 manuscripts have been submitted, of which 23 were accepted (34%), 41 were rejected and 56 are pending decision. Processing times for papers submitted in 2010 to date averaged 30 days for the first decision and about 40 days for a final decision.

The number of submissions for 2010 is roughly the same as for the first half of last year. Submissions of new manuscripts have been steady or slightly up from the past two years (Table 1). As would be expected, papers submitted by authors from the USA are the largest single group by country of origin (Table 2). However this group accounted for less than 30% of the papers submitted over the past 18 months. Nearly 70% of manuscripts are submitted by authors from outside the USA and Canada. Papers submitted from China comprised about 13% of the papers submitted over the past 18 months, the second largest group by country. It is surprising and somewhat disappointing that only one paper was submitted by authors from the UK, but it is encouraging that Mycologia is attracting papers from many countries.

Statistics for online access (Table 3) show that Mycologia online content is being well used, but also that access to the Mycologia home page and full text html has apparently decreased somewhat since 2008. Access statistics are similar for the first five months of 2010 compared to the similar period for 2009; numbers of pdf downloads has been consistent.

HighWire Press is in the process of updating its online publishing platform, called H2O. This new platform will add new functions and features to the Mycologia website and will change its appearance and user interface. For example abstracts will appear from mousing over titles on the TOC page. Migration of Mycologia to H2O is now planned for Sept 2011.

A meeting of the Mycologia editorial board is scheduled for June 27 at which several proposals for changes to editorial policies will be considered. It is likely that some proposals that will be submitted to council for consideration will result from our discussion.

—Jeffrey Stone

Continued on following page

| Table 1. Mycologia summary statistics for the past three years |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Papers submitted | Days to first decision | Days to final decision | Acceptance % |
| Jan 07 – Dec 07 | 185 | 103 | 183 | 65 |
| Jan 08 – Dec 08 | 185 | 95 | 157 | 65 |
| Jan 09 – Dec 09 | 230 | 45 | 88 | 57 |
| Jan 10 – Jun 10 | 120 | 30 | 37 | 34 |
| Jan 09 – Jun 10 | 349 | 40 | 75 | 51 |

| Table 2. Countries of origin by submitting author, Jan 09 – Jun 10. |
|--------------------------|--------------------------|--------------------------|
| Country* | # ms | % |
| Argentina | 8 | 2.33 |
| Australia | 5 | 1.46 |
| Austria | 6 | 1.75 |
| Belgium | 3 | 0.87 |
| Brazil | 23 | 6.71 |
| Canada | 8 | 2.33 |
| China | 46 | 13.41 |
| Croatia | 1 | 0.29 |
| Czech Republic | 2 | 0.58 |
| Denmark | 1 | 0.29 |
| Egypt | 2 | 0.58 |
| Estonia | 1 | 0.29 |
| Finland | 2 | 0.58 |
| France | 2 | 0.58 |
| Germany | 6 | 1.75 |
| Hungary | 3 | 0.87 |
| India | 16 | 4.66 |
| Ireland | 6 | 1.75 |
| Italy | 11 | 3.21 |
| Japan | 17 | 4.96 |
| Malaysia | 2 | 0.58 |
| Mexico | 5 | 1.46 |
| Morocco | 2 | 0.58 |
| Netherlands | 2 | 0.58 |
| New Zealand | 1 | 0.29 |
| Nigeria | 2 | 0.58 |
| Norway | 2 | 0.58 |
| Poland | 6 | 1.75 |
| Portugal | 3 | 0.87 |
| Slovak Republic | 1 | 0.29 |
| Slovenia | 1 | 0.29 |
| South Africa | 6 | 1.75 |
| South Korea | 5 | 1.46 |
| Spain | 15 | 4.37 |
| Sweden | 4 | 1.17 |
| Switzerland | 3 | 0.87 |
| Taiwan | 6 | 1.75 |
| Thailand | 2 | 0.58 |
| Tunisia | 1 | 0.29 |
| Turkey | 1 | 0.29 |
| United Kingdom | 1 | 0.29 |
| USA | 98 | 28.57 |

| Table 3. Mycologia website access summary statistics from HighWire Press. |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Access Events to: | Home Page | Current issue TOC | All TOCS Searches | Abstracts | Full text HTML | PDFs | Data Supplements |
| Jan – Dec 08 | 93,421 | 10,782 | 21,215 | 36,216 | 330,998 | 348,177 | 156,538 | NA |
| Jan – Dec 09 | 64,437 | 10,427 | 11,436 | 39,233 | 164,529 | 198,459 | 156,258 | 1,888 |
| Jan-Jun 2009 | 30,890 | 5,535 | 5,940 | 21,017 | 74,291 | 101,010 | 76,693 | 949 |
| Jan-May 2010 | 32,337 | 5,063 | 5,479 | 16,338 | 75,352 | 85,109 | 70,456 | 708 |
Annual Report of Mycologia Managing Editor  
Because the fiscal year is not yet complete, we do not have the whole picture of the financial situation at Mycologia. By the end of the year, I expect that we’ll be back on track and will have paid for six issues—this will help with accounting for future years. However, still overall expenses for journal publication are not accurately reflected in the books because we haven’t been paying the editorial office (see treasurer’s report). Once this situation is remedied, it will be easier to properly track publishing income and expenses. My sense is that publication expenses are well under control, but it will be helpful to get the editorial expenses back on track. Page charge income is down a bit on some previous years.

Publish-Ahead of Print (PAP). I have still struggled a bit to stay current with the Publish-Ahead of Print. One focus for this year has been to shift when we ask authors for copyright release forms—in the past these were requested at the same time as the page charge form, that is, at the proof stage. Since we are now publishing articles online ahead of print, we request copyright release upon acceptance of the manuscript, and do not publish ahead of print until the forms are received. A second issue is the way the PAP abstracts are compiled. It is based on the author-submitted forms in Allentrack, including the author profiles. If these are not correctly formatted (e.g. if authors do not update abstracts on resubmissions or include html formatting codes for italics etc.) then they have to be corrected.

Highwire changes. The online journal format will change slightly when we migrate to the H2O platform. This change was slated for March 2010 but was postponed. The overall look of the journal won’t initially change that much, but this totally XML-based platform is much more flexible and we could make considerable changes. We will have the capacity to link much more effectively with the society pages, embed advertising, and so on. As we contemplate a completely online Mycologia, we should consider moving our author submission facilities to Highwire instead of Allen Press if we are going to stay with Highwire for our online presence. This will entail the editors and assistant editors learning a new system and will thus be painful, but in the long run it makes sense to do it.

Mycologia Income and Expenses. Subscription rates were increased by 5% for this year and I’m recommending a similar increase for 2011. This followed three straight years of 15% increases, implemented after study showed that we were considerably underpriced relative to our comparison journals and that our subscription income was insufficient to cover journal expenses. We are still underpriced relative to comparison journals and we aren’t yet covering all publication expenses with subscription income. The continuing annual decrease in subscriber numbers is concerning, however it does not seem that the subscription rate increases affected subscription numbers, which are on a long slow decline.

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic</th>
<th>International</th>
<th>Online</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>144</td>
<td>156</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>140</td>
<td>156</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>160</td>
<td>172</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>160</td>
<td>172</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>175</td>
<td>190</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>190</td>
<td>205</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>196</td>
<td>219</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>203</td>
<td>230</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>245</td>
<td>265</td>
<td>207</td>
</tr>
<tr>
<td>2008</td>
<td>282</td>
<td>304</td>
<td>238</td>
</tr>
<tr>
<td>2009</td>
<td>324</td>
<td>350</td>
<td>274</td>
</tr>
<tr>
<td>2010</td>
<td>340</td>
<td>368</td>
<td>288</td>
</tr>
</tbody>
</table>

The chart below shows the effect of these increases (15%/year for the past three years) on allowing us to pay for the journal with subscription income rather than with member dues. Since 2010 is not yet complete, those data are not included.

—Karen Snetselaar

Annual Report of the Inoculum Editor  
This is my fourth year as editor of Inoculum. Production continues to be under the management of Production Manager, Robyn Hearns, and his team at MSU.

Production. Production of Inoculum was $4000 for the FY 2010, and this was carried out at MSU. Inoculum is published six times a year in even numbered months: February (issue 1), April (issue 2), June (issue 3), August (issue 4), October (issue 5), December (issue 6). The deadline for submitting material is the 15th of odd numbered months: January, March, May, July, September, November. Printing of Inoculum remains at 108 copies for those members who do not have web access. The hard copy of Inoculum is in black and white and is mailed around 7-10 days after the on-line version goes live. This delay is to ensure that any errors that make it into the on-line version get corrected before it is printed. Printing and mailing is carried out at MSU. Changes incorporated to make Inoculum easier to read online include hyperlinked pages. Find the article you want to read in the “In this Issue” list on the front page. Click on the title and you will go straight to that article. To return to the front page, simply click anywhere on the page that you are on and you will go back to the first page. Also all web addresses are hyperlinked so you can click on the link to be taken directly to that webpage.

Journal workload. Each issue of Inoculum for FY 2010 averaged 26 pages. Regular sections in each issue include MSA Business, with a message from the President and the Secretary, and Mycologist’s Bookshelf, which contains reviews of newly published books. Additionally Inoculum publishes short articles, news about upcoming symposia, conferences and workshops, and circulates information on awards, nominations, endowments and honors.

—Jinx Campbell

Continued on following page
MSA STANDING COMMITTEES

Annual Report of the Endowment Committee


This fiscal year, which commenced August 1, 2009, has seen significant growth in the MSA Endowment in the midst of challenging economic times. As of June 1, 2010, our endowment total is $562,127.25, representing an increase of $28,734.25 since the start of the fiscal year. This increase represents the exceptional generosity of our membership, business donors, and friends of our society. We cannot thank our donors enough: their support is of immeasurable value to sustaining and cultivating mycology as a field. On behalf of the Endowment Committee, I offer our sincere thanks.

Mentor Travel Funds

Our Mentor Travel Funds have benefited greatly from the generosity of our diverse contributors over the past year months, with $15,728.75 in donations received since August 1, 2009. We are especially grateful to those who have worked hard to organize two new named funds: the Charles Kramer Mentor Travel Fund, and the Solomon Bartschnick-Garcia Fund (which will either be designated as a Mentor Travel Fund or a Research Fund; for record-keeping purposes it is listed in the Mentor Travel Funds for this report).

All of our Mentor Travel Funds are instrumental in supporting student participation in our annual meetings and are a terrific way to honor our mentors, mycological forbearers, and next-generation mycologists. Please consider donating to our Mentor Travel funds – and thank you to all who have done so.

Mentor Travel Funds Donations, Fund totals, August 1, 2009- June 1, 2010
Constantine J. Alexopoulos Travel Fund
Alina Whiffen Barkasdale Travel Fund
John P. Raper Travel Fund
Salomon Bartschnick-Garcia ‘Emerging Fund’
Margaret Barr Bigelow Travel Fund
Howard E. Bigelow Travel Fund
Edward E. Butler Travel Fund
William C. Denison Travel Fund
Harry Morton Fitzpatrick Travel Fund
Emerson-Fuller-Wheeler Travel Fund
Robert L. Gilbertson Travel Fund
Richard P. Korf Travel Fund
Charles Kramer Travel Fund
Everett S. Lutrell Travel Fund
Orson K. Miller Travel Fund
Harry D. Thiers Travel Fund
James M. Trape Travel Fund
Francis A. (Bud) Uecker Travel Fund
Kenneth Wells Travel Fund
Total
$15,728.75
$160,834.75

Research and Lecture Funds

Our research and lecture funds have grown by $1487 over the past fiscal year to a total of $169,064. We acknowledge with gratitude the donors to these funds.

Research and Lecture Funds Donations, Fund totals, August 1, 2009- June 1, 2010
Constantine J. Alexopoulos Prize Fund
Myron P. Backus Award Fund
George W. Martin Fund
Gladys E. Baker Research Fund
John Rippon Graduate Research Award
Clark T. Rogerson Fund
Alexander H. & Helen V. Smith Fund
John S. Karling Annual D Lecture Fund
Undergraduate Research Award
Total Research/Lecture Award Funds
$1487
$169,064

As of the present date, our total for the Restricted Endowment (sum of our Mentor Travel Funds and Research and Lecture Funds) is $329,928.75, reflecting growth of $17,215.75 since August 1, 2009.

Uncommitted Endowment. Our Uncommitted Endowment has had a strong year, growing by $11,518.50 to a total of $232,198.50. This growth reflects our membership’s very active participation in the 2009 auction, t-shirt sales during and after the 2009 meeting, and the generous donations of many members and friends.

Special thanks are due to our outstanding auctioneers from the Snowbird meeting, to the local organizing committee for their tremendous help in making the evening a success, to graduate students who assisted greatly in the organization and presentation of auction materials and t-shirt sales, to Cathie Aime and Sabine Huhndorf for gathering auction payments so efficiently and pleasantly, to all who entered our T-shirt design competition, and to the members of the society who so generously donated items to the auction — and kept up the MSA spirit of ‘bidding high and bidding often.’

More generally, MSA Endowment has benefited greatly from the efforts of Sabine Huhndorf, who — as Treasurer — has contributed careful and patient work to tracking these funds. Thank you, Sabine.

On behalf of the Endowment Committee, I extend sincere thanks to all who have donated both time and money to the growth of our endowment, and to all who have supported our efforts to keep the MSA Endowment healthy and actively growing.

—Betsy Arnold, Chair

Annual Report of the Finance Committee

The total market value of the MSA investment portfolio as of June 30, 2010 is $757,816, an increase from $740,552 on July 31, 2009.Assets in the Endowment Account are now $514,946 and assets in the Operating Account are currently at $242,870. As of July 31, 2009, the values of the two accounts were $492,914 and $247,638 respectively. The very slow and fluctuating market recovery is reflected in our slow growth and expenditures for the 2010 meetings are reflected in the Operating Account totals.

With our current strategy of investing the majority of MSA assets in conservative fixed income securities (solely FDIC insured CDs at this time) and a limited percentage of our accounts in conservatively managed mutual funds with the idea of these funds generating some limited amount of current income and capital appreciation, our ability to generate new moneys from interest on our assets is limited. Present interest rates on CDs are very low for 6 month, 1 year or even 2 year certificates. Interest rates on currently purchased CDs this past year (2010) range from 0.49% (6 month), 0.7% (1 year), 1.74% (1 ½ year) or 2.37% (2 year) with an average of 1.33% for those invested moneys in fixed CDs in the Endowment Account and 0.7% for a 1 year CD in the Operating Account (see summary below). The interest rates fluctuate and obtaining a reasonable, albeit low, interest is often a matter of timing. Interest generated this coming year from these investments will be certainly lower than in past years.

Our Mutual Funds investments are beginning to show some recovery from the broad economic downturn since earlier in the year (December) these accounts posted higher interest rates (4.10% on average in the Endowment Accounts), and those yields are now at 4.27% in the Endowment Accounts. The Mutual Fund investment for the Operating Account is more conservative producing a yield of 1.60%.

The MSA portfolio managed by Well Fargo Advisors is set up as two separate accounts, the Operating Accounts and the Endowment Accounts. Moneys in those accounts are invested in the following percentages for each account as of June 30, 2010. In the Operating Account the funds are apportioned currently as 44.61% in Cash, 28.82% in Fixed Income Securities and 28.78% in Mutual Funds. For the Endowment Account the funds are distributed as 7.07% in Cash, 54.17% in Fixed Income Securities and 38.76% in Mutual Funds.

The Society’s need to realize more income from investments to support our Endowment programs resulted in the development of a conservative investment in Mutual Funds. That strategy worked very well.
until just recently since the value of the mutual funds increased steadily because of the higher interest rates. We periodically sold shares to lock in capital gains from those funds and to maintain our total portfolio below 50% in Mutual Funds to keep our risk low or moderate. This strategy helped our assets grow more quickly than would have been possible otherwise and greatly enhanced our ability to support ongoing programs. After consultation with our consultant at Wells Fargo Advisors, we believe this very conservative investment strategy is still sound and it will continue to be employed.

<table>
<thead>
<tr>
<th>Summary of MSA investments as of June 30, 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Account</td>
</tr>
<tr>
<td>Mutual Funds</td>
</tr>
<tr>
<td>Fundamental Investors</td>
</tr>
<tr>
<td>Certificates of deposit</td>
</tr>
<tr>
<td>Cash</td>
</tr>
<tr>
<td>Total Account Value</td>
</tr>
<tr>
<td>Endowment Account</td>
</tr>
<tr>
<td>Mutual Funds</td>
</tr>
<tr>
<td>Capital Income Builder</td>
</tr>
<tr>
<td>Income Fund of America</td>
</tr>
<tr>
<td>Certificates of Deposit (mkt. value)</td>
</tr>
<tr>
<td>Money Market</td>
</tr>
<tr>
<td>Total Account Value</td>
</tr>
</tbody>
</table>

—Timothy J. Baroni, Chair (2006-2010)

Annual Report of the MSA Nomenclature Committee

The International Committee was responsible for selecting the winners of the eight travel award grants for travel to IMC. The applications were mostly of extremely high quality and the applicant’s highly varied work truly reflects the expanding future of mycological research. It was therefore not easy and actually turned out to be a long and agonizing process to have to select down to 8 winners. Many more than the chosen 8 are worthy for sure.

A few applications were discounted because of simple reasons: e.g. a few did not provide all the necessary documentation, and one from India is a senior scientist, not a post grad or post doc. We took many factors into account to select a mix of candidates including (not in any particular order of priority):

- Location (including wanting to include at least some non-North American candidates)
- Grad or post-doctoral, and years in
- How well the science, nature and broader implications of their current project(s) was expressed and understood by the candidate
- Track record, including publications
- If an ongoing research pathway was expressed by the candidate
- Rationale given for attending the conference
- Quality and novelty of the abstract for IMC
- Contents and nature of letter of support from their advisor
- Other financial support indicated
- Adherence to the submission instructions (e.g. one or two did not provide an advisors letter in time).

In order to make the judging process a bit smoother, I recommend the following items:

- Make it clear that no correspondence other than the application itself is to be made by the applicants with the MSA Chair of Committee. Some applicants emailed me separately to request confirmation of receipt, and some emailed me later to ask about when notifications would be sent out. [Note: Awards Coordinator Faye Murrin disagreed strongly about adopting this as an accepted practice. JAG]
- Also make it clearer that the advisors/professors supporting letter must be submitted on time and be incorporated in the one PDF document submitted. Submit only one PDF file. (some applicants submitted them late or separately).

- It would be big help if candidates were asked to put their name in the file label/name of the PDF file that they submit.
- Other information to be provided in application:
  - **Current position**
    - Clearly state your current position/status in your covering letter.
    - (It was quite hard to work out the position of some applicants.)
    - State years and locations of (as appropriate): Undergraduate study, MSc., PhD., and Post-Doc.
  - **Funds**
    - State if matching or any other funds are likely and the amount and source of those funds.
    - State if no matching funds are being sought or if no other funds are considered possible.
    - Indicate how you are currently funded/financially supported. (This information was well given by some candidates but not by some others)

—Neale Bougher

Annual Report of the MSA Nomenclature Committee

During the past year, we have continued to assist MSA members with nomenclatural issues and answer questions involving the International Code of Botanical Nomenclature (ICBN). One interesting case involved easing Emory Simmons’ puzzlement regarding the application of Art. 46.4 by the Index of Fungi to “correct” some of his 2007 Alternaria author citations. We are pleased to report that Emory’s citations were error-free and that the next Index of Fungi will issue a retraction.

Our most important contribution was suggesting that Mycologia institute a pre-publication nomenclatural review process to ensure nomenclatural accuracy and advise members of the proper nomenclatural technicalities needed to conform to the Code. New Committee member Drew Minnis, who initiated and developed the proposal, joined the June 27 Mycologia editorial meeting in Lexington to outline previous nomenclatural infractions (e.g., using illegitimate or invalid names in table and text, incorrect grammatical endings and author citations, mis-citations, omissions) and offered suggestions on how best to implement a nomenclatural review for accepted papers. Mycologia Editorial Advisory Committee and Editor-in-Chief Jeff Stone, who responded favorably, are currently working out review procedures. Drew replaces retiring member, Wendy Untereiner, on the Nomenclature Committee.

The IAPT General Committee, now ramping up for next year’s Nomenclature Section at the International Botanical Congress (IBC) in Melbourne, receives nomenclatural recommendations from the permanent Nomenclature Committee for Fungi (CF). MSA Nomenclature Committee members Norvell (Secretary) and Redhead and MSAers Lee Crane, Vincent Demolin (Chair), David Hawksworth, Teresa Iurriga, and Paul Kirk are all now active on the 14-member CF. Proposals currently under consideration to be voted on during August include conservations of Cortinarius speciosissimus, Hemipholiota, Aspicilia aquatica, Mixia, Olivea tectonae (T.S. Ramak., & K. Ramak.) R.L. Mulder, Aspicilia farinosa, Psoroma (Degelieilla) versicolor, Craterellus cinereus (Pers.: Fr.) Donk, Lichen (Leptogium) lichenoides, Stertsonia A.L. Sm., Hebeloma cylindrosporum, Dermatocarpon (Placoprenium) buceki, Lactarius (with L. torrinus as type), Cladina, Thelephora (Vuillenima) comedens, Glomus as a name of neuter gender, and Agaricus rachodes with that spelling and rejections of Verrucaria thelostoma, Pyrenula umbonata, and Degelieella comedens. Results of the August ballot will be published in Inoculum later this fall.

The 2011 Melbourne IBC also votes on proposals to change the Code. Last year we reported on Props. 16–20 regarding the governance of Fungi that, if passed, would change the title of the ICBN to the International Code of Botanical and Mycological Nomenclature and transfer control of CF elections and solely fungal related proposals under the jurisdiction of future International Mycological Congresses. New Props. 117–119 by Hawksworth et. al. (2010: 58: 663–664 & Mycologia 108: 505–508) require pre-publication deposit of key nomenclatural infor-

Continued on following page
mation in a recognized repository, such as MycoBank (currently required by Mycologia).

The Special Committee on Names for Pleomorphic Fungi (Amy Rossmann, Chair; Scott Redhead, Secretary) continues to evaluate the impact of modifications or elimination of the ICBN’s controversial Article 59. Formal proposals are yet to be published.

Nomenclature is also spotlighted at the upcoming IMC9 in Edinburgh through three two-hour nomenclature sessions. The symposia under the direction of Chair Ron Petersen, Vice-Chair Scott Redhead, and Convener/Rapporteur David Hawksworth will consider (Session 1) the governance of fungal nomenclature, the Committee for Fungi, and exclusion of Microsporidia; (Session 2) pre-publication deposit and electronic publication of names, cultures of fungi as types, making illustrations mandatory for valid publication of fungal species; and (Session 3) moving to one name for one fungus (i.e. Art. 59) and ending the requirement of a Latin diagnosis for valid publication. As the programme notes: “If you ever use fungus names, this session may affect you.”

Those who are/were unable to attend the Edinburgh symposium but wishing to voice their opinions on the above items, are welcome to contact one of us for the Symposium questionnaire. We continue to urge anyone perplexed by a nomenclatural question to contact the MSA Nomenclature Committee for advice. May you all be as satisfied as the esteemed Dr. Simmons!

—Lorelei Norvell, Chair Scott Redhead
Drew Minnis

MSA ROTATING COMMITTEES: AWARDS

Annual Report of the Mycological Distinctions Award Committee

A. Committee Members:

B. Committee assignment changes/modifications made during Spring 2010.
1. Nick D. Read was due to be 2009-2010 Chair of the Committee. However, because of his involvement organizing the Mycological Congress, Nick D. Read had to resign his MSA Distinctions Committee position (early March 2010).
2. When Joey Spatafora, next in line as Committee Chair (for 2010-2011), was not able to assume the Chair position due to prior research time commitments, Walter Sundberg served as Committee Chair for Spring 2010.
3. Although committee work time was shorter due to above changes, the Committee functions in preparation for the 2010 annual meeting were completed.
4. Although requests were made by the committee Chair, a replacement (temporary or otherwise) for Nick Read was never appointed. Thus, the committee operated short one committee member this year.

C. Recommendations for 2010-2011
1. 2009-2010 Current Committee (noted below)
   2009-2010 Nick Read (resigned; not replaced)
   2010-2011 Joey Spatafora
   2011-2012 Walter Sundberg (served as Chair for 2009-2010)
   2012-2013 Alex Weir
   2013-2014 Linda Kohn
   ex officio (Past Chair) James Kimbrough
2. 2010-2011 Committee—notes below for consideration
   2010-2011 Joey Spatafora, Chair
   2011-2012 ?? Walter Sundberg (served Chair for 2009-2010)
   2012-2013 Alex Weir
   2013-2014 Linda Kohn
   2014-2015 ?? — new appointee
   ex officio (Past Chair) ?? — Walter Sundberg ???

—Walter Sundberg

Annual Report of the Research Awards Committee

Agreeing to one more year as Chair, 2010 was quite an active year on some fronts and less active on others. The year began with the appointment of Dr. Ning Zhang to the committee. Unfortunately, her appointment was not made clear on the website and one applicant inadvertently sent his application to all of the committee members, including a former member and neglected Dr. Zhang. In the end, all proper committee members received all materials needed for each applicant. The wording on the website for where to send the application for each award should be kept updated so this does not happen again. Other specific recommendations and clarifications to the MOP and website were suggested to the MSA Secretary and the Awards Coordinator.

The Forest Fungal Ecology and the Rogerson awards had the most applicants, 8 and 6 respectively. Many of the applications were very good and it was difficult to make a clear choice. A weighted voting process was more effective at delineating winners than non-weighted voting. Photos were requested of awardees and all received by mid-May for Inoculum. In total, 16 applications were received for 3 of the awards. There were no applicants for the Alexander H. and Helen V. Smith Award, and no new applicants for the John Rippon Award. The winners for 2010 are:

Adam Rollins for the Martin-Baker Award
Michael Gruenstaid for the Clark Rogerson Award
Napaulik Zimmerman for the Forest Fungal Ecology Award

All awards were notified by 30 April 2010, which was the date of the final pre-registration discount for the annual meeting. The rejection letters were sent out within the next two weeks for all awards.

I want to thank the entire committee for their hard work, timely responses and feedback. I also appreciate the suggestions from Dennis Desjardin. Thinking back, one thing I would have done differently during my tenure is to recruit or solicit applications. This is a component of the committee that should be stressed more. For example, the Smith award had no applicants during my 2 years as Chair and the Rippon award had only one (and the same) applicant for both years. This could partially be due to my lack of recruitment. Here in Seattle, an advertisement at the University of WA Medical Center and in the Microbiology Department, would have been a good idea and may have yielded applicants for the Rippon Award. Sending an email blast to universities that have students working on macrofungi would be helpful for the Smith award. Moving forward, it might be a good idea to have “canned” advertisements or solicitations for the Rippon and Smith awards that the Chair could distribute to institutions throughout the country. Since these two awards have very little action, they need more work on the recruitment end.

Annual Report of the Student Awards Committee

This report covers the Student Awards Committee’s activities in 2010 prior to the MSA meeting in Lexington, Kentucky. Committee members for 2010 include Brian Perry (chair), Kentaro Hosaka, John McKenny, Imke Schmitt and Andrew Methven (ex-officio). The application deadline for MSA Graduate Fellowships was extended to March 15th, 2010 to account for the late posting of the call for applications. The committee received a total of four applications for MSA Graduate Fellowships, Backus Award and NAMA Memorial Fellowship. The committee unanimously decided that all four applications should be awarded and notified Faye Murrin, the Awards Coordinator, of our decision on April 2, 2010. The awardees were notified on April 5, 2010, and encouraged to attend the 2010 MSA meeting, including the MSA Social and Auction. The 2010 Graduate Fellowships ($2000 each) were awarded to Jana M. U’Ren (University of Arizona; A. Elizabeth Arnold advisor) and Nhu H. Nguyen (University of California, Berkeley; Thomas D. Bruns advisor). The NAMA Memorial Fellowship ($2000) was awarded to Valerie L. Wong (University of California, Berkeley; Thomas D. Bruns advisor), and the Backus Award ($1000) was awarded to Donald M. Walker (Rutgers University; Amy Y. Rossman and James F. White advisors). The awardees were asked to provide a brief biographical sketch and photograph to Faye Murrin for use during the
 awards ceremony and inclusion in *Inoculum*. The committee is currently preparing to judge student oral and poster presentations at the Kentucky meeting.

—Brian Perry

**MSA ROTATING COMMITTEES – GENERAL SERVICE**

**Annual Report of the Karling Annual Lecture Committee**

I would like to thank the members of the 2009/2010 Karling Annual Lecture Committee, Tim James, Greg Douhan, and Brian Shaw for their effort in the selection of this year’s Karling Lecturer. We are very privileged to have Dr. Sally Smith speaking on ‘Hidden’ phosphorus transfer in arbuscular mycorrhizas: a dominant role for the AM fungi’. We felt this topic meshed very nicely with this year’s theme: Symbioses. Dr. Smith’s research interests are in the development and function of mycorrhizal symbioses, particularly arbuscular mycorrhizas. Current interests encompass both basic and strategic research, with projects ranging from the control of development of the symbiosis in mutant plants through aspects of roles of mycorrhizas in phosphate nutrition of plants and implications of the symbiosis for plant competition, crop productivity and alleviation of arsenic toxicity. Dr. Smith continues to have a huge impact in the field of mycorrhizal symbioses. She has co-authored three editions of the classic *Mycorrhizal Symbiosis* (Ed 1 with Professor JL Harley FRS, Eds 2 and 3 with Professor Sir David Read, FRS). According to Google Scholar, this work has been cited over 5500 times. She has edited three additional books and contributed chapters to 55 others. She has also contributed to 177 research papers with high impact given an average of 24.5 citation per paper. We are honored to have her as our speaker for the MSA 2010 Karling Lecture. The estimated costs to date are $4,929.23. This does not include meals, but it does include the $500 honorarium.

—Daniel Durrall

**Annual Reports of the Program Committee and Local Arrangements Coordinators 2010**

Preparations are complete for the 2010 MSA annual meeting, to be held jointly with the International Symposium of Fungal Endophytes of Grasses (ISFEG) at the Downtown Hilton Hotel, Lexington, Kentucky, June 28-July 1, 2010. The draft program for the 2010 MSA/ISFEG meeting was posted on line the first week of June. Program books will be handed out at the meeting, along with a CD of abstracts. We have over 300 registrants, roughly 60% for MSA and 40% for ISFEG. More than 260 abstracts were submitted. Approximately 100 people signed up for the June 27 pre-meeting foray, which will be the Bernheim Forest, run by a private research foundation. The 2011 MSA meeting will be held in Fairbanks Alaska and the local organizing committee is moving forward. Helen Renfrow from the Fairbanks tourism bureau will attend the Kentucky meeting and give a presentation at the council meeting. The local organizing committee is hoping to get an early start on symposia for advertising on the web to facilitate selection of sessions for abstract submission. The tentative theme for the 2011 MSA meeting is “High latitude mycology.”

—Tom Horton, Lisa Vaillancourt and Chris Shardl

**MSA ROTATING COMMITTEES: SPECIFIC EXPERTISE**

**Annual Report of the Biodiversity Committee**

The committee desires to design a web page to explain its function and to provide information. Unfortunately we did not hear anything back from the Webmaster about the details of the website that we are supposed to assemble, i.e. if there is a desired format, etc. In order to design a website, we will need some technical and potential content feedback as currently we are working totally in the dark. (Secretary’s Note: Similar observations were also made to me orally by Michael Castellano, Chair of the Fungal Conservation Committee).

**SPECIAL MSA APPOINTMENTS**

**Annual Report of the Local Arrangements 2012, Fairbanks, AK**

- Locked in our meeting dates with UAF housing office and MSA for August 1-6. There will be plenty of “apartment” style housing available (e.g., adequate for 300+).
- Reached agreement with 7 local hotels to 1) hold blocks of rooms, with release if not booked 2-3 weeks before conference, 2) incur NO financial liability for a minimum # of rooms, or for rooms that are not booked.
- Have worked with Fairbanks Conference and Visitors Bureau (FCVB):
  1. They will assist with web site and provide conduit to C-VENT conference registration system, including lots of data tracking/summarizing, credit card transactions, etc. NOTE: The fees for this service would be 5% of registration costs. We have not signed the MOU with FCVB yet.
  2. They will send a representative to the Kentucky meeting to man a display booth and make 10 min. brief tourism presentations at the MSA and ISFEG business meetings.
  3. They will organize volunteer’s who can help with airport greeting, preparing conference packets, handing out packets at registration, etc.
- Have sought support from the University of Alaska:
  1. Were awarded $8,563 by the UAF Vice Chancellor for Research to support a grad student who will assist with meeting planning (Ina Timling).
  2. Were awarded an additional $3,662 by the UAF Provost to cover her fees and tuition.
- Acquired verbal agreement from the Institute of Arctic Biology to officially host the meeting. Have put in formal request to IAB for IT support (web site, including a sophisticated abstract submission system), accounting support (setting up an account to hold registration fees, pay vendors, etc.), and funds for graduate student travel awards.
- Have initiated a conference web site, which should be live by now. NOTE: we will not make the registration, abstract submission and housing pages live until the appropriate times. The key content now is the welcome page with conference dates and links to tourism info.
- Have designed a flyer/postcard, which will be distributed in Kentucky by FCVB.
- Have designed a conference logo, subject to further revision.
- Have requested OIT support for registration, computer café (for participants to check e-mail, etc.), requested that buildings/rooms to be use are WiFied for personal laptop use, and smart lecture hall classroom configuration support.
- Will seek some level of partial support for graduate student travel.
- Have proposed a conference theme “high latitude fungi in a changing climate” to the Program Committee.
- Campus parking for $15 for a 7-day week (Kiosk purchase by driver); website URL link will be www.uaf.edu/parking for rates, maps, lots, etc. as per Tracy of UAF Parking Services.
- All potential meeting rooms have been requested and are now in the process of being sequestered (locked in for our use).
- Preparing ourselves for now beginning a series of MSA Committee Chair meetings.
- Final schedule update with approval of Program Committee:
  - Sunday July 31: housing available for early arrivals (e.g. for council meeting and/or workshops)
  - Monday August 1: Council Meeting; possibly workshops; arrival, registration and evening social for ‘regular’ attendees.
  - Tuesday August 2 - Friday August 5: 4 days of talks/symposia. MSA Banquet on Fri eve.
  - Saturday August 6: Foray and possibly additional workshops; departure for most ‘regular’ attendees.

Continued on following page
MSA INTERSOCIETY REPRESENTATIVES

Annual Report of the International Mycological Society

As of this writing there was no decision on the bid for IMC10. There is no other business to report. [Secretary's note: we have since learned that the bid by Puerto Rico was not successful and that Bangkok, Thailand was chosen as the venue for IMC10.]

—Sharon Cantrell

Annual Report of the Natural Science Collections Alliance

The Natural Science Collections Alliance has not had a meeting since May 16, 2009 so there are no updates.

—Joseph Bischoff

Annual Report of the MSA Historian

MSA archives: An inquiry to the Director of The New York Botanical Garden Library (Susan Fraser), the location of the MSA archive, produced a report that the archive consists of 38 boxes of unsorted, uncataloged materials. Roy Halling reports that in a previous search for specific items, he was unable to locate them. Susan Fraser has volunteered to estimate the costs involved to sort and catalog the archive and I have asked her to do so. That estimate is expected soon. Unless some MSA member with such expertise and living in the neighborhood wishes to perform these tasks, a temporary archivist and costs for supplies will be necessary. Until the archive is made useful through such work, it serves little purpose to continue to deposit items in it.

Estimated cost of archiving the MSA historical documents (update) – Susan Fraser: There are 36 boxes equaling about 45 linear feet of material. The Society of American Archivists suggest that processing archival collections takes about 18-20 linear feet per month per ft. From our experience, we think it is closer to 17 linear feet per month. We estimate it would take 2 1/2 - 3 months to process the collection. Our last grant funded archivist was paid about $45,000 plus benefits so we think a part time project archivist might demand about $20-24 per hour. It seems it would take about $15,000 to process the whole collection. I could break out a more accurate budget if needed but I think this is in the ballpark.

Note from Ron Peterson: Please note that her estimate does not include supplies (plastic sleeves, reprint holders, cards, etc.). I would guess that $1000 might approach that aspect of the job.

—Ronald Peterson

Annual Report of the Memorials Committee

During the past year three memorials have been submitted to Mycologia and have been accepted for publication: Lois Tiffany (by Maren Klich), Orson Miller (by Cathy Cripps), and James Gerdemann (by Jim Trappe). A memorial for Bob Bandoni is still being crafted by Jim Ginns (cology) and have been accepted for publication: Lois Tiffany (by Maren Klich), Orson Miller (by Cathy Cripps), and James Gerdemann (by Jim Trappe). A memorial for Bob Bandoni is still being crafted by Jim Ginns and Scott Redhead. No additional deaths of MSA members have been reported. The Chairperson of the Memorials Committee serves at the pleasure of MSA President, so the term of appointment is for one year, ending with the 2010 annual meeting. [Technically this is not correct! The MSA Historian can serve as long as he wishes! JAG]

—Ronald Peterson

Annual Report of the MSA Representative to CollectionsWeb

CollectionsWeb <http://www.collectionsweb.org/> is an NSF-sponsored Research Coordination Network for Building a Community of Natural History Collections (NSF - 0639214).

The goals of CollectionsWeb are the following:

1) Identify the institutions and people that define the natural history collections community and facilitate dialogue about how best to serve needs of collections and researchers.  
2) Identify major challenges and opportunities in the current environment and foreseeable future, and develop a strategic plan for the future of collections research.

3) Determine how to strengthen and modernize the role of collections in education and outreach.

4) Identify the primary needs of collections regarding care, curation, storage and accessibility.

Activities of CollectionsWeb include workshops, symposia, internships, a survey of natural history collections, a year of science project, and a catalogue of educational programs in NHC. Annual workshops offer the best opportunity for participation by individual MSA members, and the expenses are paid by the grant.

Completed workshops:

1) Opportunities and Challenges of Small Collections (Held in East Lansing, MI, April 2008, 27 participants, organized and hosted by Alan Prather, with the goal of identifying the opportunities and challenges of small collections and identify mechanisms to overcome the challenges and realize the opportunities. MSA member Merlin White participated.).

2) Enhancing the Interface between Collections and Systematists (Held in Fairbanks, AL, June 2009, 25 participants, organized by Larry Page and Jim Woolley, hosted by Andrés Lopez, with the goal of developing a vision for the role of natural history collections in contemporary Systematics and a plan to help collections realize that vision. MSA member Sharon Cantrell participated.).

3) New Research Opportunities Emerging from Integrating Data Across Different Taxonomic Collections (Held in New Orleans, LA, March 2010, 23 participants, organized by Hank Bart and Meredith Blackwell, hosted by Hank Bart, with the goal to explore new research opportunities and synergisms that can emerge when data are integrated across research collections representing different major groups of organisms. MSA members Tom Bruns and Karen Hughes participated.).

Upcoming Workshops (Check the website for announcements and the possibility of MSA member participation) are the following:

4) Strengthening Connections between the Collections Community and Database Initiatives and Programs (tentatively planned for March 2011 in Norman, OK).

5) Developing New Strategies for Integrating Collections into Education (tentatively planned for 2011).

6) Enhancing the Relationships between Collections and Stakeholders (tentatively planned for 2012).

Partner Societies are the following:

• American Institute of Biological Sciences, Robert Gropp, Core Participant
• Natural Science Collections Alliance, Hans-Dieter Sues, Core Participant
• Society for the Preservation of Natural History Collections, James Macklin, Core Participant

Participating Groups are mostly taxon-based professional societies that play an important role in bringing together people involved with natural history collections across many disciplines. They include the following with an assigned core participant for each:

• American Malacological Society, Gary Rosenberg, Core Participant
• American Ornithologists’ Union, Kevin Winker, Core Participant
• American Society of Ichthyologists and Herpetologists, Larry Page, Core Participant
• American Society of Parasitologists, Eric P. Hobeg, Core Participant
• American Society of Plant Taxonomists, Wayne J. Elisens, Core Participant
• Botanical Society of America, Steve Manchester, Core Participant
• Entomology Collections Network, Michael Wall, Core Participant
• Entomological Society of America, Chris Dietrich, Core Participant
• Interagency Working Group on Scientific Collections, Office of Science Policy and Technology Policy, Mike Schauff, Core Participant
• Mycological Society of America, Core Participant, Meredith Blackwell

Continued on following page
MSA AWARDS 2010

Distinguished Mycologist Award: Dr. Gary J Samuels

Awarded annually to an individual who has established an outstanding mycological career, this is one of the highest awards bestowed by the MSA and marks a distinguished career. Nominees for the award are evaluated on the basis of quality, originality, and quantity of their published research, and on the basis of service to the MSA or to the field of mycology in general.

Gary J Samuels was born in Grove City, Pennsylvania in 1944. He obtained a B.Sc. degree in Botany from Pennsylvania State University in 1966, and then went to the New York Botanical Garden where he became a graduate fellow, matriculating in the Ph. D. Program in Biology at Columbia University. He earned his M.A. Degree in 1968 and a Ph. D. degree in 1971 with Clark T. Rogerson. Dr. Samuels was a scientist with the New Zealand Department of Scientific and Industrial Research, Plant Diseases Division in Auckland from 1973 until 1985. During that time he studied the fungi that cause plant disease, as well as ascomycetes occurring naturally in New Zealand. In 1977–1978 he was a Visiting Guest Researcher in the laboratory of Prof. Emil Müller, Eidg. Technische Hochschule, Institut für Spezielle Botanik, Zürich where he studied the ascomycetes that he collected on a 1977 expedition to Brazil. In 1985 he joined the staff of the New York Botanical Garden as a Research Associate, where he was supported by grants from the National Science Foundation to study the Hypocreales of Tropical America. In 1989 he joined the staff of the United States Department of Agriculture, Agriculture Research Service, Systematic Botany and Mycology Lab (now Systematic Mycology and Microbiology Lab.) in Beltsville where he has worked for the past twenty-one years. Dr Samuels has carried out fieldwork in Australia, Brazil, Cameroon, Costa Rica, Ecuador, French Guiana, Ghana, Guyana, Indonesia, Jamaica, Japan, New Zealand, Sri Lanka, Thailand, and Vietnam. His main focus has been on taxonomy of the Hypocreales with emphasis on Trichoderma. His publications include an online guide to Trichoderma, and, with his long-time collaborator Amy Rossman and others, “Hypocreales of the South-eastern United States: An identification guide,” and “Genera of Bionectriaceae, Hypocreaceae and Nectriaceae (Hypocreales, Ascomycetes),” in addition to approximately 250 scientific articles that describe ascomycetes of Indonesia, New Zealand and the neotropics.

Mycological Society Distinctions Committee: Walter Sundberg, Chair; Joseph W Spatafora; Linda Kohn; Alex Weir; James Kimbrough, ex officio, Past Chair
**Weston Award for Excellence in Teaching: Dr. Joey W Spatafora**

*Awarded annually to an outstanding teacher of mycology at the undergraduate and/or graduate levels.*

Joseph (Joey) Spatafora was born in Monroe, Louisiana in 1964. He obtained a B.Sc. in Zoology from Louisiana Tech University and a Ph.D. in Botany from Louisiana State University, and did postdoctoral work at Duke University. Joey became interested in fungal biology after meeting Meredith Blackwell and spending countless hours in her laboratory smoking cigarettes and looking at dung fungi. He has since quit smoking, but his interests in fungi have only grown. Joey began his position in the Department of Botany and Plant Pathology at Oregon State University in 1995 and now also serves as the OSU’s Faculty Athletic Representative to the PAC10 and NCAA (GO BEAVS!). He teaches courses in Mycology, Evolution, and Advanced Mycology. While letting the fungi “teach themselves”, he is demanding of both the students and himself. Student comments repeatedly reflect on his teaching ability—its affect on students is profound. “The way he presents class material makes it accessible and enjoyable”. “My experience in mycology class affected the way I view the world and the path I would I follow in my life.” “His teaching of Introductory Mycology inspires students to pursue a degree option in fungal biology or consider advanced degrees in mycology.” “Joey’s research interests are in fungal evolutionary biology with emphases on insect-associated fungi and phylogenomics of the Kingdom Fungi. Joey is married (wife Elizabeth) with three children (Anna, Gioia, and Nicolas).

**Mycological Society Distinctions Committee:** Walter Sundberg, Chair; Joseph W Spatafora; Linda Kohn; Alex Weir; James Kimbrough, *ex officio*, Past Chair

---

**Alexopoulos Award: Dr. Anne Pringle**

*Awarded annually to an outstanding mycologist early in their career. The nominees are evaluated primarily on the basis of quality, originality, and quantity of their published work.*

Anniversary Pringle was born in Malaysia and spent her childhood chasing birds through Southeast Asia and West Africa. After becoming fascinated with plants as an undergraduate at the University of Chicago, she spent several years teaching elementary, middle- and high-school science in Brooklyn, NY. She subsequently moved to Duke University and over the course of a Ph.D. became obsessed with fungi. She has yet to leave the kingdom. After the Ph.D., Anne took a fellowship at the University of California, Berkeley, and now teaches at Harvard University. Her research explores the dispersal, establishment, and evolution of fungi within the context of anthropogenic change. She is increasingly focused on conservation biology. Anne is married to a very patient non-mycologist and has two daughters who are the perfect height for foraging mushrooms in the forests.

**Mycological Society Distinctions Committee:** Walter Sundberg, Chair; Joseph W Spatafora; Linda Kohn; Alex Weir; James Kimbrough, *ex officio*, Past Chair

---

*Inoculum 61(4), August 2010 21*
MSA Fellow: Dr. Steven L. Stephenson

MSA Fellows are selected from members who have completed at least 11 years of service after their Ph.D. They are members who are outstanding mycologists on the basis of one or more criteria: a solid record of mycological research, and/or successful teaching and development of teaching materials for mycology, and/or significant service to the Society. This is meant to recognize a core group of mid-career mycological achievers and outstanding MSA volunteers.

Dr. Steven L. Stephenson, Research Professor at the University of Arkansas, is an exemplary researcher and outstanding mycological educator. Dr. Stephenson earned his M.S. and Ph.D. degrees from Virginia Polytechnical Institute and State University under the guidance of Dr. Orson K. Miller. Before moving to the University of Arkansas, he taught for 27 years at Fairmont State College (now University) in West Virginia. In 1987, he was a Fulbright Scholar at Himachal Pradesh University in India, and in 2002 he was the William Evans Visiting Fellow at the University of Otago in Dunedin, New Zealand. Over the course of his impressive research career, he has carried out mycological research on all seven continents and in numerous countries. As a result of these efforts, he has made significant contributions to mycology as evidenced by his more than 200 papers in peer-reviewed journals (more than 30 in Mycologia alone) and his many other publications (including five books on slime molds and fungi). His work on the slime molds has largely shaped our current understanding of their distribution and ecology as well as setting the stage for modern (and future) ecological research related to the group. As a result of Dr. Stephenson’s quality work, he has been able to obtain over two and a half million dollars of funding to support his mycological research. He has had continuous funding from NSF for more than 20 years. Most notable has been his involvement as PI and Project Director for the Planetary Biodiversity Inventories Project entitled “Global Biodiversity of Eumycetozoa”. Currently, he is the PI on the NSF grant for the study of fungal biodiversity in northern Thailand. (Adapted from the nomination letter by Dr. Adam Rollins)

Honorary Awards Committee: Chair, James B. Anderson, Timothy J Baroni, Gregory Mueller, Martha J Powell, ex officio, Past Chair

MSA Honorary Member: Dr. José Carmine Dianese

Honorary members are distinguished senior scientists with a long record of significant contributions to the science of fungal biology and who reside in and work in countries other than the U.S. and Canada.

Dr. José Carmine Dianese, Professor at the Universidade de Brasilia, is an outstanding mycologist and the newest Honorary Member of the Mycological Society of America. Born in Minas Gerais, Brazil, he received his BS degree in agronomy from the Federal University of Viçosa in 1962 and his MS and Ph.D. degrees in plant pathology from the University of California at Davis, in 1968 and 1970 respectively. One nominator noted that he is a true pioneer as he was the first Brazilian Ph.D. from UC-Davis and only the second from all the USA. Dr. Dianese has been with the University of Brasilia since 1971, where he has served as Dean of the Institute of Biological Sciences and as the Chair of the Department of Plant Pathology. Dr. Dianese has made significant contributions to our knowledge of South American fungi, especially leaf inhabiting fungi from understudied and threaten habitat in Brazil, notably those of the Cerrado Forest. He has had a productive research career with 100 ref-grant for the study of fungal biodiversity in northern Thailand. (Adapted from the nomination letter by Dr. Adam Rollins)

Honorary Awards Committee: Chair, James B. Anderson, Timothy J Baroni, Gregory Mueller, Martha J Powell, ex officio, Past Chair

Continued on following page
Two MSA Graduate Fellowships are awarded annually to promising graduate students in mycology. Applicants are evaluated on the basis of their scholastic merit, research ability and promise shown as a mycologist.

Jana M. U’Ren is a Ph.D student in the Division of Plant Pathology and Microbiology, School of Plant Sciences, University of Arizona. Jana completed her BA in Biology while playing Division I softball at the University of Missouri-Columbia. After graduating in 2001, she worked for one year as a laboratory technician with Dr. Brandon Gaut at the University of California-Irvine, focusing on molecular evolution of Zea mays ssp. mays. From 2003 to 2006, she served as research specialist at the Center for Microbial Genetics and Genomics at Northern Arizona University with Dr. Paul Keim. Her research focused on utilizing high-throughput molecular methods to study the population genetics, evolution, and ecology of bacterial pathogens such as Bacillus anthracis, Coxiella burnetii and Burkholderia pseudomallei. Jana is currently a fourth-year Ph.D. student studying with Dr. Betsy Arnold at University of Arizona and an IGERT fellow in Genomics at UA. Her dissertation research looks at the evolutionary relationships and diversity of fungal endophytes, saprotrophic fungi, and endolichenic fungi associated with diverse plant- and lichen hosts. The MSA Graduate Fellowship will provide needed funds for Jana to test hypotheses regarding the functional traits that underlie the evolution of major trophic transitions in the Pezizomycotina.

Nhu H Nguyen received his B.S. in Biology from Louisiana State University in 2006 where he did undergraduate research with Dr. Meredith Blackwell from 2002-2006 working on the fascinating yeasts that live in the guts of insects. He is presently a Ph.D. student under the supervision of Dr. Tom Bruns in the Department of Plant and Microbial Biology at UC Berkeley. His research interests are in the intricacies of symbiotic interactions between fungi and other organisms. His dissertation title is “Microbial communities associated with digestive organs of fungi, plants and animals.”

Student Awards Committee: Brian Perry Chair; Kentaro Hosaka; John McKemy; Imke Schmitt; Andrew Methven, ex officio, Past Chair
NAMA Memorial Fellowship: Valerie L. Wong

The NAMA Memorial Fellowship is awarded annually to promising graduate students in mycology. Applicants are evaluated on the basis of their scholastic merit, research ability and promise shown as a mycologist.

Valerie Wong is a Ph.D. candidate in the Department of Plant and Microbial Biology at the University of California Berkeley, mentored by Dr. Thomas Bruns. Valerie received a Bachelor’s in Biological Chemistry from Wellesley College, where she studied rhododendron carotenoids and plant actin-binding proteins. During the summer of 2000, Valerie worked at the University of Hawaiʻi Manoa to optimize carotenoid production in algae. She took a brief stint studying animals as a research assistant for Dr. Joan Ruderman at Harvard Medical School, working on understanding the G2 to M phase transition in the cell cycle. For her dissertation, Valerie is investigating interactions between the obligate mycoheterotrophic plant Pterospora andromedea and its mycorrhizal host, Rhizopogon.

Student Awards Committee: Brian Perry Chair; Kentaro Hosaka; John McKemy; Imke Schmitt; Andrew Methven, ex officio, Past Chair

Backus Award: Donald M. Walker

The Backus Award is awarded annually to promising graduate students in mycology. Applicants are evaluated on the basis of their scholastic merit, research ability and promise shown as a mycologist.

Donald Walker started his Ph.D. program in August 2007 at Rutgers University with a solid background in mycology due to his undergraduate mentors Alex Weir, June Wang, and Tom Horton at SUNY ESF-Syracuse. He is now part of the NSF PEET program working on the systematics of the Diaporthales, Gnomoniaceae. While technically a student at Rutgers, he is shared between three mycologists, Jim White plus Lisa Castlebury and Amy Rossman at the USDA in Beltsville, MD. He conducts research that leads to monographic accounts of genera in the Gnomoniaceae but also has discovered new genes that are useful in determining evolutionary relationships within the Diaporthales. He has compared genomes from related fungi to find unique gene regions and then developed and tested primers for these markers. In addition, Donny has added a component on fungal biogeography to his research program. In this he has been inspired and guided by Lena Struwe at Rutgers who has conducted this kind of research on plants. Travelling to Costa Rica, Japan and throughout the US, Donny is collecting representatives of two genera of Gnomoniaceae so that he has enough data to obtain valid biogeographic data for these fungi. He expects to complete his Ph.D. in May 2012.

Student Awards Committee: Brian Perry Chair; Kentaro Hosaka; John McKemy; Imke Schmitt; Andrew Methven, ex officio, Past Chair

Student Presentation Awards

The student presentation awards are awarded annually to the two best oral research papers and the two best posters in mycology presented by graduate students at the annual MSA meeting.

Best oral presentation awards: Rodrigo Olarte & Daniel Lawrence

Rodrigo Olarte,
School: North Carolina State University
Advisor: Ignazio Carbone

Presentation: Direct genetic evidence to support the presence of sexual recombination within the life cycle of Aspergillus flavus.

Daniel Lawrence
School: University of Arizona
Advisor: Scott Kroken
Presentation: Interkingdom transfer of a hybrid NRPS/PKS gene from bacteria to the filamentous Ascomycota.

Continued on following page
Best poster awards: Tomas Rush & Kevin Beiler

Tomas Rush
School: Louisiana State University
Advisor: Cathie Aime
Presentation: Placement of the yeast genus Moniliella in the Ustilaginomycotina and description of a new species.

Kevin Beiler
School: University of British Columbia
Advisor: Daniel Durall and Suzanne Simard
Presentation: Belowground spatial ecology and mycorrhizal networking of Rhizopogon vesiculosus and R. vinicolor in a mixed-aged Douglas-fir forest.

Student Awards Committee: Brian Perry Chair; Kentaro Hosaka; John McKemy; Imke Schmitt; Andrew Methven, ex officio, Past Chair. The MSA Student Oral Presentations and Poster Presentations were judged by Andy Wilson, Matt Kierle, Lorelei Norvell, Daniel Ballhorn, Todd Osmundson, and Andy Methven.

Student Presentation Award Winners

Mentor Travel Awards


C. J. Alexopoulos Award: Tomas Rush
School: Louisiana State University
Supervisor: Cathy Aime
Presentation: Placement of the yeast genus Moniliella in the Ustilaginomycotina and description of Moniliella milton-rushii sp. nov

Barksdale/Raper Award: Rodrigo Olarte
School: North Carolina State University
Supervisor: Ignazio Carbone
Presentation: Direct genetic evidence to support the presence of sexual recombination within the life cycle of Aspergillus flavus

M. Barr-Bigelow Award: Allison Walker
School: University of Southern Mississippi
Supervisor: Jinx Campbell
Presentation: Marine Fungal Diversity of Florida Barrier Island Beaches

H. Bigelow Award: Nhu Nguyen
School: University of California Berkeley
Supervisor: Thomas Bruns
Presentation: Community assemblage and specificity of bacterial associates within Bishop pine (Pinus muricata) ectomycorrhizal root-tips

E. E. Butler Award: Cedar Hesse
School: Oregon State University
Supervisor: Joseph Spatafora
Presentation: High-resolution analysis of microbial community structure from ectomycorrhizal mat soil using next-generation sequencing technologies

Continued on following page
W. C. Denison Award: Ryan Kepler  
School: Oregon State University  
Supervisor: Joseph Spatafora  
Presentation: New Taxa Associated with Clavicipitaceae and the Implications for Evolution of Host Affiliation

H. M. Fitzpatrick Award: Kelsea Jewell  
School: University of Wisconsin-Madison  
Supervisor: Nancy Keller  
Presentation: *Ralstonia solanacearum* alters reproductive mode and spatial arrangement in *Aspergillus flavus*

R. Gilbertson Award: Valerie Wong  
School: University of California Berkeley  
Supervisor: Thomas Bruns  
Presentation: How Mycoheterotrophic Plants Seduce Mycorrhizal Fungi: Transcriptional shifts in *Rhizopogon* during *Pterospora* germination

R. P. Korf Award: Daniel Lawrence  
School: University of Arizona  
Supervisor: Barry Pryor  
Presentation: Interkingdom transfer of a hybrid NRPS/PKS gene from bacteria to the filamentous Ascomycota (Oral) *Alternaria* and related genera systematics and phylogenetics

Kramer Award: Mia Maltz  
School: Sonoma State University  
Supervisor: Norman Terry  
Presentation: Combined effects of AM fungi and phytoextractive plants for increasing plant establishment in Boron contaminated sediments

E. S. Luttrell Award: Donald Walker  
School: Rutgers University  
Supervisor: Amy Rossman  
Presentation: Utility of three new single copy loci for systematics in the genus *Ophiognomonia* (Gnomoniaceae, Diaporthales)

O. K. Miller Jr. Award: Joey Tanney  
School: Lakehead University  
Supervisor: Leonard Hutchinson  
Presentation: The presence and probable antifeedant function of gloeocystidia on hyphae of *Sphaerobolus stellatus* and *S. iowensis*.

H. D. Thiers Award: Yazmin Rivera  
School: State University of New York  
Supervisor: Thomas Horton  
Presentation: Genetic Structure of the Ectomycorrhizal Basidiomycete *Suillus spraguei* in Continuous and Fragmented Forests of the Northeastern United States

J. M. Trappe Award: Kevin Beiler  
School: University of British Columbia  
Supervisor: Suzanne Simard  
Presentation: Belowground spatial patterns and network architecture of *Rhizopogon vesiculosus* and *R. vinicolor* genets in a mixed-aged Douglas-fir forest poster

**Mentor Travel Awards Committee**: Juan L Mata Chair, Peter Kennedy, Todd Osmundson, Heather Hallen-Adams, József Geml, ex officio, Past Chair
The George W. Martin and Gladys E. Baker Research Award supports new or ongoing research in mycology by a recent-Ph.D. mycologist (preferably within 5 years of receiving the degree), who also has significant teaching commitments.

Dr. Rollins received his B.S. degree (Biology) from Fairmont State College (now University) in West Virginia and his M.S. degree in Forest Ecology from West Virginia University. He completed a Ph.D. in the Department of Biological Sciences at the University of Arkansas under the direction of Steven Stephenson and is currently continuing work on the Eumycetozoa Project. His research takes him to interesting locales, including Costa Rica, Puerto Rico and Mexico, while examining myxomycete ecology on scales ranging from microhabitat to global. Adam is presently Assistant Professor of Biology at Lincoln Memorial University.

Research Awards Committee: Michelle Seidl Chair, Thorsten Lumbsch, Dennis Desjardin, Teresa Pawlowska, Merlin White, Terry Hill, ex officio, Past Chair

**Forest Fungal Ecology Research Award: Napaukk Zimmerman**

This award supports ecological research by a graduate or undergraduate student, examining fungal interactions in old growth forests or other unique or endangered ecosystems. Studies should address innovative approaches to examining fungal systems or interactions of individuals, or groups of fungi, with hosts or substrates in old growth forest or other sensitive ecosystems.

Napaukk is presently working towards a Ph.D. in Ecology at Stanford University as part of Peter Vitousek’s biogeochemistry lab. He is broadly interested in the intersection between ecosystem ecology and community assembly patterns, and is currently examining it in the context of endophytic fungal communities via molecular methods. By following the way leaf vs soil fungal communities interact after leaf senescence and through decomposition across an environmental matrix in Hawaii, he hopes to get a better understanding of the ecological roles played by the very diverse - but still quite mysterious - fungal endophytes in tropical leaves.

Research Awards Committee: Michelle Seidl Chair, Thorsten Lumbsch, Dennis Desjardin, Teresa Pawlowska, Merlin White, Terry Hill, ex officio, Past Chair

**Rogerson Student Research Award: Michael Gruenstadl**

The Clark T. Rogerson Student Research Award supports student travel to herbaria and/or field sites to conduct research. Grants are available to undergraduate or graduate students who are members of the Mycological Society of America

Michael Gruenstaeudl is a student at the University of Texas at Austin in the Section of Integrative Biology under the supervision of Dr. Robert K. Jansen. His area of research is Plant-AM fungal co-evolution. With the help of MSA’s Clark T Rogerson student research award he will work on his Ph.D. project entitled “Correlated diversification between arbuscular mycorrhizal fungi and their plant hosts – an interdisciplinary case study”. The project aims to answer the question whether evolutionary diversifications of arbuscular mycorrhizal (AM) fungi and their vascular plant hosts are correlated through their mycorrhizal linkage. To that end, molecular phylogenetic trees of either symbiont are compared in order to identify clade patterns indicative of co-cladogenesis or joint speciation driven by geographical isolation or ecological constraint. Preliminary data indeed suggest a reciprocal influence in the evolutionary diversifications of vascular plants and AM fungi under study, raising the possibility of co-evolution between the two symbionts. For more information, please visit http://www.sbs.utexas.edu/gruenstaeudl/

Research Awards Committee: Michelle Seidl Chair, Thorsten Lumbsch, Dennis Desjardin, Teresa Pawlowska, Merlin White, Terry Hill, ex officio, Past Chair
The primary purpose of the Alexander H. and Helen V. Smith Research Award is to encourage the study of specimens of fleshy Basidiomycetes and Ascomycetes collected by Alexander H. Smith and his associates. The Fund distributes grants-in-aid to be used towards covering the expenses of visiting the Smith Collection at the University of Michigan Herbarium and of working with the collections and materials relating to them.

Research Awards Committee: Michelle Seidl Chair, Thorsten Lumbsch, Dennis Desjardin, Teresa Pawlowska, Merlin White, Terry Hill, ex officio, Past Chair

John. W. Rippon Research Award Winner: No Award

This award supports graduate student research, which employs innovative approaches to studying medically important fungi. Studies may be clinical in nature or may encompass various research areas, such as genetics, systematics, genomics, ecology, distribution, epidemiology, mechanisms of pathogenicity, life cycles, or other appropriate approaches to the study of medically important fungi.

Research Awards Committee: Michelle Seidl Chair, Thorsten Lumbsch, Dennis Desjardin, Teresa Pawlowska, Merlin White, Terry Hill, ex officio, Past Chair

A. H. & H. V. Smith Research Award Winner: No Applicants

The primary purpose of the Alexander H. and Helen V. Smith Research Award is to encourage the study of specimens of fleshy Basidiomycetes and Ascomycetes collected by Alexander H. Smith and his associates. The Fund distributes grants-in-aid to be used towards covering the expenses of visiting the Smith Collection at the University of Michigan Herbarium and of working with the collections and materials relating to them.

Research Awards Committee: Michelle Seidl Chair, Thorsten Lumbsch, Dennis Desjardin, Teresa Pawlowska, Merlin White, Terry Hill, ex officio, Past Chair

International Travel Awards - IMC 9

Dr. Jiri Hulcr, Dept. of Bacteriology, University of Wisconsin – Madison

KHM Nazmul Hussain Nazir, Ph.D. Student, Lab. of Bioresources Chemistry, Graduate School of Bioresource and Bioenvironmental Sciences, Faculty of Agriculture, Kyushu University, JAPAN.

Kawinnat Buaruang, Faculty of Agriculture, Kasetsart University, Thailand

Joshua Birkebak, Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, TN

Donald M. Walker, Ph.D. Candidate, United States Department of Agriculture, Systematic Mycology and Microbiology lab, Beltsville, MD and Department of Plant Biology and Pathology School of Environmental and Biological Science, Rutgers University, New Brunswick, NJ

Dr. Mahajabeen Padamsee, Post-doctoral research associate, Department of Plant Pathology, Louisiana State University, Baton Rouge, LA

Dr. Suzanne Joneson, Postdoctoral Research Associate, Rosenblum Lab, University of Idaho, Department of Biological Sciences, Moscow ID

Martha Cecilia Giraldo, Ph.D. Candidate - Graduate Research Assistant Fungal Molecular Genetics Laboratory, Department of Plant Pathology Kansas State University Manhattan, Kansas

International Committee: Neale Bougher Chair, Omon Isikhuemhen, A Esperanza Franco, Havard Kaserud, Joanne Taylor, ex officio, Past Chair

Awards information was provided by Faye Murrin, MSA Awards Coordinator 2009-10
The Myxomycetes (or Myxogastria under the Zoological code) are a small group when compared to vascular plants, fungi, or animals, with just 62 genera and 888 species (Kirk et al. 2008). Their attractive fruiting bodies have made the Myxomycetes popular with mycologists, botanists and amateur naturalists. Because of this, the small number of species, and a relatively stable taxonomy, the Myxomycetes are reasonably well known in North America, Europe, and selected other parts of the world (e.g., Martin & Alexopoulos, 1969, Stephenson 2003). They may also be encountered by moist chambering suitable substrates where spores or plasmodia may occur (see Martin & Alexopoulos 1969, p. 14), often revealing fruiting bodies of species that are rarely seen in the field.

The distribution of myxomycetes in Canada is not very well documented. We know of only a few published data about the distribution of myxomycetes in Canada (about 10 early references cited in Davis and Sutton 1950, plus Gourley 1983 and Thorn 1981). Very little work has been done in the field and even less so in the last 50 years, with the notable exception of forays in Ontario by Martin Schnittler of the Botanical Institute and Botanical Garden, Ernst-Moritz-Arndt University, Greifswald, Germany (see http://asbot.botanik.uni-greifswald.de/personal/schnittler/myxcollection.htm). The latest available summary of myxomycetes in Canada (Davis and Sutton 1950) lists previous Canadian collectors and which provinces they worked in. This note reports the rediscovery of the Eli Davis myxomycete herbarium and documents its rescue from disposal, its contents and its significance.

Shortly before I (RGT) joined the faculty at the University of Western Ontario (UWO), I received an email announcing items designated for disposal following an effort to clear out the building where the UWO herbarium was formerly housed. An item listed as “one highly combustible collection of myxomycetes” caught my attention, and I asked that it be set aside from destruction until I arrived. When I arrived in late July 2000, I quickly determined that the Davis collection was potentially valuable; upon inquiry, it was discovered that this collection is well known among myxomycete specialists as one of a small handful of herbaria that document myxomycete distribution in Ontario and in Canada (M. Schnittler, personal communication).

Eli Davis (1890-1976, Fig. 1) was a horticulturalist by profession and an amateur naturalist. He was a staunch supporter of the local naturalist club in London, which had been founded by his good friend William E. Saunders (the first director of the Research Branch of the Canada Department of Agriculture). He learned of birds, mammal, plants, fungi, and slime molds from Saunders and John Dearness. He was a prolific collector of both vascular plants and myxomycetes and, when he died, his collections were donated to UWO. His vascular plants were kept and incorporated into the UWO herbarium, whereas the myxomycetes, unwanted in the vascular plant herbarium, were left forgotten in storage for years. Approximately 1400 specimens had been pre-
served with utmost care in matchboxes and arranged in shoeboxes according to genus. These were stored in large cardboard boxes, apparently in periodically damp conditions since some of the boxes and even some of the specimens themselves were overgrown with molds when they were rediscovered. Many collections had been obtained by the moist chamber technique. The ink used by Davis to label his specimen boxes was fading, many of them barely legible except for the impression left by his pen nib on the box (Fig. 2). We restored any writing that could still be made out and set aside the specimens whose locations could no longer be determined. About 200 specimens were lost due to faded labels.

Davis’ specimens were collected between 1930-1955, but the bulk of his collecting was done from 1935-1945. Some specimens go as far back as the 1890’s (e.g., an 1893 collection from Nicaragua by Shimek, and one from England in 1894 by Lister). He primarily collected on his own but he occasionally collected with J. Dearness, W.D. Sutton, E. West, J.H. Rispaud, H.C. Beardsley, or R. Hagelstein. A large number of Davis specimens were determined or confirmed by G.W. Martin or R. Hagelstein. The collection contains duplicate specimens from a variety of different herbaria including the University of Toronto (25, collected by R.F. Cain), Iowa (10, collected mostly by G.W. Martin), Kansas (70, collected mostly by T.E. Brooks) and the New York Botanical Gardens (130, collected mostly by R. Hagelstein & J.H. Rispaud). The herbarium contains many contributions from prominent mycologists, among them G. Lister, R. Hagelstein, G.W. Martin, J. Dearness, T.H. Macbride, R.F. Cain and W.D. Sutton. Most (700) of the specimens are from southwestern Ontario but many are from Quebec (60), New York (95), Florida (80), Pennsylvania (50), Colorado (25), Kansas (70), or New Hampshire (40). The herbarium also contains material from England, Nicaragua, Panama, Switzerland and Puerto Rico.

A database of specimens (available from RGT) was created recording data from the legible specimen labels. Species names were checked against recent literature for updated nomenclature. The species that were neither reported in Davis and Sutton (1950) nor reported from Canada by Martin and Alexopoulos (1969) were suspected as being first reports for Canada. The Davis collection includes 225 species, of which 150 were collected in Canada and 143 in Ontario. Many of the first reports for Canada in Davis and Sutton (1950) are represented, along with several that appear not to have been previously reported: Licea pedicellata (H.C. Gilbert) H.C. Gilbert (as Hymenobolina pedicellata H.C. Gilbert), Physarum diderma Rostaf. (as Physarum testaceum Sturgis), and Symphytocarpus trechisporus (Berk. ex Torrend) Nann.-Bremek. (as Stemonitis trechispora (Berk.) T. Macbr.) (Fig. 3).

The cryptogamic herbarium of the Royal Ontario Museum (TRTC) has 35 specimens collected by Davis (Martin Schnittler and the late John C. Krug, personal communication). All of the species represented among Davis’ collections at TRTC are also in our collection, and most of the specimens are duplicates of collections in our herbarium. Among the specimens in our herbarium are vouchers for reports of 51 out of the 80 species of myxomycetes from Canada reported by Davis and Sutton (1950); we assume that those not found in Davis’ herbarium must have been kept in Sutton’s collection now at DAOM. Some specimens of particular interest include the world’s second record of Elaeomyxa miyazakiiensis (Emoto) Hagelst. which

Figure 3. A selection of interesting specimens in the collection. From top to bottom, Macbrideola cornea (#1671), Arcyria globosa (#1266), Physarum diderma (#1323), and Symphytocarpus trechisporus (#1198).
Inoculum 61(4), August 2010 31

previously had only been found in Japan (Davis & Sutton 1950), a rare first for Canada, Diderma simplex (J. Schröt.) G. Lister with orange stalks, and two firsts for Ontario, Didanema harveyi Rex and Lepidoderma tigrinum (Schrad.) Rostaf. In addition, who alive today has seen Arcyria globosa Schwein. fruiting on the burs of the American Chestnut (Castanea dentata, Fig. 3), which was almost entirely eradicated in the early 1900s by chestnut blight caused by Cryphonectria parasitica? The discovery of this collection, just before it was scheduled to be discarded, highlights the real danger facing many small but important biological collections worldwide. This story has a mostly happy ending, but nearly did not. As interim curator of UWO (2001-2003) I was able to welcome these orphaned collections into the herbarium, but since the curatorial position came without any reduction in other faculty duties, little was done to incorporate them into the collection other than the sorting and databasing, which was done by the first two authors as undergraduate volunteers. Jane Bowles was hired as curator in 2003 and Sandra Mackin as curatorial assistant in 2004; both are part-time but their time is dedicated to actual curation and outreach associated with the collections. Collections are only assured when adequate facilities and the positions of trained staff dedicated to their curation are also assured. In this, the International Year of Biodiversity (http://www.cbd.int/2010/welcome/), we all need to work towards adequate support for and recognition of biological collections, both of preserved specimens and cultures.

—Claire Tuason, Samira Armin, and Greg Thorn (rgthorn@uwo.ca) Department of Biology University of Western Ontario London, Ontario, N6A 5B7 Canada

References Cited

Tracking Myxomycetes on a Foray at Boise, Idaho

Recent spring rains in the Boise area provided moist conditions for decaying logs and leaf litter on the forest floor of riparian habitats at Veterans Memorial State Park near Boise State University (BSU). Dr. Merlin White and his students Yan Wang, Emma Wilson, Eric Tretter and Donavon Carrie, along with Drs. Matias J. Cafaro (U Puerto Rico Mayaguez) and Harold W. Keller spent a productive afternoon on June 13, 2010 collecting myxomycetes (Fig. 1). Noteworthy observations included a yellow phaneroplasmodium (Fig. 2) that represents the largest, most colorful, and frequently seen plasmodial type in the field. This stage is visible to the naked eye and extends 10 to 14 centimeters across the anterior advancing, feeding and fan-shaped edge with the raised, three-dimensional network of veins trailing behind on the decayed bark substratum. Phaneroplasmadia leave behind evidence of their movements as plasmodial slime tracks (Fig. 3) where plasmodia have fed and migrated over the surface of bark either buried in leaf litter or on the inner surface of bark that has separated from wood of decaying logs. Plasmodial tracks are analogous to human footprints and can be recognized by excreted black waste matter along the vein margins resulting in two distinct black lines separated by a lighter area in the middle. Outer bark sloughing off from standing dead trees often has plasmodial tracks on the inner, unexposed surfaces. These habitats stay moist for longer periods of time, providing optimal conditions for the plasmodium to grow, migrate, and form fruiting bodies.

Comatricha typhoides is a common and cosmopolitan species occurring on decaying wood or bark of logs on

Continued on following page
The sporangia usually form in large numbers covering several centimeters of the wood surface but are rarely collected in a fresh, pristine condition with the silvery peridium intact. This stage is seldom seen in the field because the shiny, silvery, delicate peridium disappears early in development. The stages represented here have developed overnight, within a 24 hour period, and were photographed in the laboratory immediately after collection. This species also has a slime sheath that clings to the stalk but in more mature stages dries and is not as conspicuous as shown here. The agar or moist chamber culture of myxomycetes usually results in the immature stages developing at night or in the dark, with maturity promoted under lighted conditions. If you want to study the developmental stages of myxomycetes you have to be a “night owl” or be in the right place at the right time in the field.

It seems that a little bit of luck may have been involved to reveal such a diversity of slime molds and at their various stages, but for Dr. White and his students it was an eye-opening experience to see so many of these microorganisms on display by simply heading to the park, looking at and under bark, turning over the occasional log and getting just a little closer to nature. As Dr. Keller recently reflected, the “stages we saw were exciting even after all of the passing years and I hope your students enjoyed it. I sure did. We crammed a lot into three hours.” The “Team Tricho” laboratory at BSU www.boisestate.edu/biology/Mycology/index.htm could not agree more! It is outings like these that make you realize the possible diversity of these and other microorganisms that remain to be discovered, not only in Idaho, but most surely also in your own backyard. For those in a position to teach, be it grade school or higher, that backyard may also prove to be your living laboratory.

Acknowledgments: MMW gratefully acknowledges former and current NSF Awards (DEB-0344722 and -0918182) for support of biodiversity and molecular systematic research programs on gut fungi; the latter also supporting research and training programs in Idaho for four of his “Team Tricho” members pictured here, graduates ET, YW and EW and undergraduate DC.

—Harold W. Keller
University of Central Missouri
and Botanical Research Institute of Texas
—Merlin White
Boise State University
‘Hidden’ phosphorus transfer in arbuscular mycorrhizas: a dominant role for the AM fungi? Professor Sally Smith, School of Agriculture, Food and Wine, The University of Adelaide, Adelaide, Australia

Professor Smith’s research interests are in the development and function of mycorrhizal symbioses, particularly arbuscular mycorrhizas. Current interests encompass both basic and strategic research, with projects ranging from the control of development of the symbiosis in mutant plants through aspects of roles of mycorrhizas in phosphate nutrition of plants and implications of the symbiosis for plant competition, crop productivity and alleviation of arsenic toxicity.

Professor Smith continues to have a huge impact in the field of mycorrhizal symbioses. She has co-authored three editions of the classic Mycorrhizal Symbiosis (Ed 1 with Professor JL Harley FRS; Eds 2 and 3 with Professor Sir David Read, FRS). According to Google Scholar, this work has been cited over 550 times. She has edited three additional books and contributed chapters to 55 others. She has also contributed to 177 research papers with high impact given an average of 24.5 citation per paper. We were honored to have her as our speaker for the MSA 2010 Karling Lecture and she gave a wonderfully engaging presentation!!!
Through the kind generosity of the British Mycological Society, the full run of 91 volumes of Transactions of the British Mycological Society (TBMS) will soon be available on-line for free and open access through the Cyberliber website www.cybertruffle.org.uk/cyberliber. It is hoped that by making the journal openly accessible, mycology will be promoted in developing countries where library facilities are limited. The key mycological website, Index Fungorum, will use connections to TBMS in Cyberliber to enable users to see protologues for thousands of fungal names, a new service to be inaugurated by BMS President Prof. Lynne Boddy in a special ceremony at IMC9 in August in Edinburgh.

Adding TBMS to Cyberliber’s already extensive collection of mycological works will take the total number of pages of mycological literature freely available on this site to more than 300,000, and follows the lead of the Mycological Society of America whose Council generously agreed three years ago to permit back numbers of Mycologia also to appear on the site. Work digitizing Mycologia continues, and most volumes are now available through Cyberliber. Similar generosity by the Editorial Board of Mycotaxon has already resulted in more than 100 volumes of the important serial publication being available.

When work on Mycologia and TBMS is complete, it is hoped to add Persoonia and extend coverage of Sydowia up to volume 30 as the next step. The National Botanic Garden of Wales has also recently agreed to contribute material scanned from its recently established Stan Hughes Mycological Library to Cyberliber, so coverage of mycological literature is expected to improve over the next year.

Much of the scanning work to date has been supported by the UK Darwin Initiative. Mycologists who use this resource in preparing publications are asked, please, to include mention of Cyberliber in their acknowledgements.

Call for MSA 2011 Symposia Proposals

The program committee of the MSA is currently soliciting proposals for symposia and workshops for the upcoming annual meeting (2-6 August 2011 at the University of Alaska - Fairbanks). We invite symposia in all areas of mycology, including those related to the program theme “Fungi at high altitudes and latitudes”. To propose a symposium or workshop, please provide the following information: 1) a title; 2) a very short summary of why this topic is particularly timely or appropriate; 3) a tentative list of speakers; and 4) suggested possible sponsors. For the list of speakers, we assume that there will be a maximum of six, but the entire list need not be completed at this point. In fact, we encourage you to save at least two slots to be filled after reviewing abstracts submitted for the contributed oral and poster presentations. Proposals can be sent via electronic mail to D. Jean Lodge (dlodge@caribe.net) with a cc to other members of the program committee: Tom Horton (trhorton@esf.edu), Betsy Arnold (fungi@u.arizona.edu) and Andrew Miller (amiller@inhs.uiuc.edu). The deadline for receipt of proposals is 31 October, 2010.

Rhoda Benham Award

Dr. Paul J. Szaniszlo, Professor Emeritus at The University of Texas at Austin, was honored by being presented the 2010 “Rhoda Benham Award” by the Medical Mycology Society of the Americas for “meritorious contributions to medical mycology”. This year’s award was presented at its annual meeting in San Diego in May.

Dr. Szaniszlo’s former student, Dr. Leo Mendoza, who is now an Associate Professor at Michigan State University, was also honored at the same meeting by being awarded the “Billy Cooper Award”, which also is presented annually to an “outstanding contributor to the practice of diagnostic clinical mycology”.

Transactions of the British Mycological Society On-Line

Dr. Paul J. Szaniszlo, Professor Emeritus at The University of Texas at Austin, was honored by being presented the 2010 “Rhoda Benham Award” by the Medical Mycology Society of the Americas for “meritorious contributions to medical mycology”. This year’s award was presented at its annual meeting in San Diego in May.

Dr. Szaniszlo’s former student, Dr. Leo Mendoza, who is now an Associate Professor at Michigan State University, was also honored at the same meeting by being awarded the “Billy Cooper Award”, which also is presented annually to an “outstanding contributor to the practice of diagnostic clinical mycology”.

Call for MSA 2011 Symposia Proposals

The program committee of the MSA is currently soliciting proposals for symposia and workshops for the upcoming annual meeting (2-6 August 2011 at the University of Alaska - Fairbanks). We invite symposia in all areas of mycology, including those related to the program theme “Fungi at high altitudes and latitudes”. To propose a symposium or workshop, please provide the following information: 1) a title; 2) a very short summary of why this topic is particularly timely or appropriate; 3) a tentative list of speakers; and 4) suggested possible sponsors. For the list of speakers, we assume that there will be a maximum of six, but the entire list need not be completed at this point. In fact, we encourage you to save at least two slots to be filled after reviewing abstracts submitted for the contributed oral and poster presentations. Proposals can be sent via electronic mail to D. Jean Lodge (dlodge@caribe.net) with a cc to other members of the program committee: Tom Horton (trhorton@esf.edu), Betsy Arnold (fungi@u.arizona.edu) and Andrew Miller (amiller@inhs.uiuc.edu). The deadline for receipt of proposals is 31 October, 2010.

Rhoda Benham Award

Dr. Paul J. Szaniszlo, Professor Emeritus at The University of Texas at Austin, was honored by being presented the 2010 “Rhoda Benham Award” by the Medical Mycology Society of the Americas for “meritorious contributions to medical mycology”. This year’s award was presented at its annual meeting in San Diego in May.

Dr. Szaniszlo’s former student, Dr. Leo Mendoza, who is now an Associate Professor at Michigan State University, was also honored at the same meeting by being awarded the “Billy Cooper Award”, which also is presented annually to an “outstanding contributor to the practice of diagnostic clinical mycology”.

Transactions of the British Mycological Society On-Line

Through the kind generosity of the British Mycological Society, the full run of 91 volumes of Transactions of the British Mycological Society (TBMS) will soon be available on-line for free and open access through the Cyberliber website www.cybertruffle.org.uk/cyberliber. It is hoped that by making the journal openly accessible, mycology will be promoted in developing countries where library facilities are limited. The key mycological website, Index Fungorum, will use connections to TBMS in Cyberliber to enable users to see protologues for thousands of fungal names, a new service to be inaugurated by BMS President Prof. Lynne Boddy in a special ceremony at IMC9 in August in Edinburgh.

Adding TBMS to Cyberliber’s already extensive collection of mycological works will take the total number of pages of mycological literature freely available on this site to more than 300,000, and follows the lead of the Mycological Society of America whose Council generously agreed three years ago to permit back numbers of Mycologia also to appear on the site. Work digitizing Mycologia continues, and most volumes are now available through Cyberliber. Similar generosity by the Editorial Board of Mycotaxon has already resulted in more than 100 volumes of the important serial publication being available.

When work on Mycologia and TBMS is complete, it is hoped to add Persoonia and extend coverage of Sydowia up to volume 30 as the next step. The National Botanic Garden of Wales has also recently agreed to contribute material scanned from its recently established Stan Hughes Mycological Library to Cyberliber, so coverage of mycological literature is expected to improve over the next year.

Much of the scanning work to date has been supported by the UK Darwin Initiative. Mycologists who use this resource in preparing publications are asked, please, to include mention of Cyberliber in their acknowledgements.
Dear colleagues, I am writing to you about a special meeting on fungal conservation to be held in Edinburgh on 6 August 2010. Full information about that meeting is provided after this message. The objective of the meeting will be to launch the world’s first society explicitly and exclusively devoted to fungal conservation.

A copy of the draft constitution is attached in MS-WORD format. It can also be downloaded from www.euromould.org/proposed_society_for_fungal_conservation/draft_constitution.doc.

When this meeting was first proposed, the responses were universally strongly positive. You are therefore asked, please, to draw this event to the attention of anyone you know interested in fungal conservation.

It is ideal if you can attend in person, but that is not necessary. Those present at the meeting in Whitby of October 2009 will automatically qualify as Founder Members. Anyone else interested in fungal conservation can be a Founder Member simply by stating their support. If you wish to be considered as one of the Founder Members of this ground-breaking new society, please e-mail me at d.minter@cabi.org stating that you wish to be a Founder Member (you will be chased for subscriptions when they are organized!). You can also help by sending messages of support, and / or constructive comments to improve the draft constitution.

Thank you for your kind attention.

—David Minter

Fungal Conservation: A Special Meeting

2010 marks the eleventh year of mycological investigations in the Upper Potaro River Basin in the Pakaraima Mountains of Guyana. Our new NSF-funded surveys and inventories project, “Ectomycorrhizal fungal diversity of the central Guiana Shield”, aims to achieve the most complete documentation of ECM fungi to date from tropical rainforests. To accomplish this we are utilizing traditional sporocarp collecting and identification with intensive below-ground molecular-based sampling of ECM mycobionts from the roots of a wide range of host plants occurring across the Guiana Shield, including members of the Caesalpinioideae, Papilionoideae, Dipterocarpaceae s.l., Polygonaceae, Nyctaginaceae, and Gnetaceae. Projects undertaken over May-June 2010 by myself, collaborating taxonomist Cathie Aime (Louisiana State), post-doc Matthew Smith and PhD candidate Gwen Williams (Duke), Masters student Jessie Uehling and undergrad Thomas Walker (Humboldt State), technician Dillon Husbands (University of Guyana), and numerous Patamona Amerindian parataxonomists, included collection of fungi for taxonomic purposes and intensive ECM root sampling of host tree Dicymba corymbosa in long-term study plots. Additionally, a team led by collaborating botanist David Clarke (UNC-Asheville) executed a three-week reconnaissance of savanna woodland in the central Pakaraima plateau to map populations of Pakaraimaea dipterocarpaceae, the target ECM host plant species for our next expedition in January 2010.

—Terry Henkel

Peripatetic Mycology

Three members of the Mycological Society of America (Merlin White, Harold Keller and Matias Cafaro) were in attendance for a three-day, National Science Foundation (NSF)-sponsored workshop on Systematics Research at Primarily Undergraduate Institutions (PUIs) held June 13-17, 2010 at Boise State University (BSU). Systematics research at times can be underappreciated or misunderstood both in the broader community and perhaps even within the scientific community. This is as much from a historical perspective as it is a comment only relevant in modern times. Clearly mycology has recurrent and recent examples that highlight the value of systematic and taxonomic expertise, whether thinking about the determination of the cause of the potato famine in Ireland over a century ago or more recently the chytrid fungus killing frogs worldwide.

The NSF Award (DEB-1038069) issued to PIs Jim Smith (Dept. of Biological Sciences, Boise State University, ID), Marty Condon (Dept. of Biology, Cornell College, IA) and Rich Clopton (Dept. of Natural Science, Peru State College, NE) (Fig. 1) financially supported the workshop that came at the tail end of spring semester for many of the attendees (Figs. 1-4), who were from a number of different institutional types (e.g., both private and public) from across the USA with varying taxonomic interests (e.g., fungi, plants, protists, invertebrates, etc.). As much as possible attendees were from diverse disciplines,

Fig. 1 PIs, Jim Smith, Marty Condon, and Rich Clopton, workshop organizers. (Photos by Merlin White)

Continued on following page

Fig. 2 Workshop participants.
geographic regions, represented faculty at different stages of their careers, and types of institutions (4-year undergraduate only, 2-year junior college etc.). This gathering of scientists was to discuss mechanisms and priorities to maintain and enhance research endeavors in biodiversity, taxonomy, and systematics in primarily undergraduate teaching institutions. Understanding and documenting the biological diversity and evolutionary history of life on Earth is important research done by taxonomists and systematists. This research can be labor intensive and with logistical, theoretical, and analytical challenges, all of which can be accentuated for researchers at PUIs (search Award Abstracts online: www.nsf.gov/award-search), where PUIs are defined by the number (d”10) of PhDs granted per year in a discipline funded by NSF.

One of the goals was to report back to NSF based on a broadly surveyed perception of the needs of the systematics community. It was hoped that the meeting would offer a venue for perceived needs and concerns to be expressed, discussed and consolidated with ideas and suggestions for future actions. Prior to their arrival, attendees were asked to respond with answers to a questionnaire sent out in advance so that statistics and talking points would be available for the meeting. Approximately 50% of the surveys (over 100 sent by email) were returned, and served to initiate discussions by the 28 attendees. The meeting started with a flexible agenda but with the idea that it could be altered depending on interests and developments during the three-day period. It was a remarkably successful approach. Both the challenges and strengths of PUI based research and teaching programs were brought forth with multiple breakout sessions for consideration of ideas and issues. NSF Program Director, Dr. Rafael de Sa, also in attendance at the BSU campus, offered two lunch hour presentations (one on the various funding programs available at NSF and the other on general grantsmanship).

It was clear to those of us in attendance that the passion, energy and drive of systematists from various fields is very real and we wanted to share some of the details of the meeting here and possibly alert other potentially interested persons. Participants left with the goal of preparing grants and documents to advance systematics research at PUI’s, with a final report that will be forthcoming. Dr. Jim Smith (jfsmith@boisestate.edu) can be e-mailed for further information or a copy of the report as it becomes available. Our hope is that the inspiration gained from this experience will help chart a course of events and opportunities that will form a wave that will carry research and teaching programs in Systematics (of our various fields) for many generations to come.

Acknowledgments: The authors sincerely appreciate the financial support of this NSF Award (DEB-1038069) and the invitation to participate in the PUI Workshop. MMW also gratefully acknowledges former and current NSF Awards (DEB-0344722 and -0918182) for support of biodiversity and molecular systematic research programs on gut fungi, the latter also supporting research and training programs for two of his “Team Tricho” members pictured here, undergraduates PK and AC.

—Merlin White
Boise State University
—Harold W. Keller
University of Central Missouri and Botanical Research Institute of Texas
—Matias Cafaro
University of Puerto Rico Mayaguez
NAMA Foray — August 12-15, 2010

It’s still possible to register for the NAMA 50th Anniversary Foray, which will be held August 12-15 this year at Snow Mountain Ranch, near Winter Park in Colorado’s high country. It will be a unique experience, one that won’t be repeated for a long time. We have 14 professional mycologists to identify our mushrooms and all will be giving lectures on their specialty. There will be forays, classes, workshops, a cook and taste, the NAMA photography contest, and a champagne toast to the 50th anniversary. The collections will be photographed and preserved in The Field Museum in Chicago to be available on loan for any professional mycologist for research now or in future.

Do register soon however. It may still be possible to reserve a room at the Foray site, but most of the rooms at the YMCA Snow Mountain Ranch rooms are already booked. Local accommodations can also fill up early, since this area is a popular summer destination. The town of Granby is 10 minutes and Winter Park is 20 minutes from the foray site.

Registration cost: $150 per person for everything except room and board.

Room and board cost: The lodge room & board price (all meals included) per person for the 3 night foray (Thursday to Sunday) is $168 for one person sharing a room with 2 roommates. Linens and bedding are provided. We will match you with roommates if there are any spaces available. Call Linda deLeon at 303-748-5380 for information.

Camping: Our web site has information about camping at the YMCA ($25/night), at Forest Service campgrounds, and in Forest Service distributed camping areas, which would be the only free way to camp.


The Fifth Kingdom CD-ROM

Bryce Kendrick reminds Profs that they can get Version 5.5 of The Fifth Kingdom CD-ROM for their students at only $20 per copy. The CD is kept up-to-date weekly, has thousands of color pictures and full text, covering all aspects of mycology. Call Bryce at 250-655-5051 or E-mail bryce@mycolog.com. Partial previews available at www.mycolog.com

XVI Congress of European Mycologists

19-23 September 2011, Thessaloniki, Greece

The XVI Congress of European Mycologists will be held in northern Greece at the resort of Porto Carras on the Halkidiki peninsula. This Congress, the latest in an unbroken line going back well over fifty years, is located further south than any of its predecessors, and is the first to visit the Balkans. By coming to northern Greece, it will attract mycologists to an area famously rich in biodiversity and full of wonderful fungi. Halkidiki is the middle of three slender fingers of land stretching out into the Aegean Sea. To the west lies the rather flat Cassandra peninsula, to the east lies the very mountainous and mysterious peninsula of Athos, the holy mountain closed to all but male pilgrims. Halkidiki in the middle is a happy compromise: sufficiently mountainous to have superb forest ecosystems literally on the back doorstep of the congress location, and sufficiently accessible to ensure good seafood restaurants just a short stroll away.

The Congress Organizing Committee Chairman is Dr Stephanos Diamandis, Vice-President of the European Mycological Association. As leader of a research team dealing with biological control of chestnut canker, as author of the definitive guide to Greek mushrooms and toadstools, and as a leading light in the European Council for Conservation of Fungi, he is well placed to ensure that the Congress will have an attractive and challenging program. He has also had extensive experience in organizing international meetings. As a result, the Congress promises to be a most interesting and memorable event. There is a strong tradition of welcoming colleagues from North America and elsewhere to these Congresses, and we hope to be doing the same again in 2011. Please note that the dates of this Congress have recently been changed to avoid conflict with the congress on medicinal fungi being organized in Croatia, also in September. The information in the present notice has the new and correct dates. Full information can be found on the Congress website: www.xvicem.org.

David Minter, President, European Mycological Association
AFKHAMI, MICHELLE E.* and MCINTYRE, PATRICK J. 1Mutualist-mediated niche expansion and partitioning in a newly-discovered native grass-fungal endophyte symbiosis. The niche concept has been touted as central to our understanding of ecology and evolution. Niche research has focused almost exclusively on organisms’ abiotic limitations and negative impacts of competition/predation, but a potentially equally important component of niche theory has been virtually ignored: niche expansion associated with mutualistic interactions. In contrast to negative interactions, mutualists can expand species’ niches by conferring benefits that ameliorate (abiotic) stresses, and context-dependency of mutualisms could lead to niche partitioning within a species, if individuals associating with partners have different niches from those that do not. We examined how putatively mutualistic symbionts - fungal endophytes - affect the niche of their native grass host, Bromus laevigatus by combining survey data of endophyte frequency for ~100 B. laevigatus populations with climate data to generate two ecological niche models - one for symbiotic and one for non-symbiotic B. laeves. Comparison of these models strongly suggests geographic and climatic niche expansion of B. laeves via mutualism and niche partitioning between symbiotic and non-symbiotic plants. Consistent with niche expansion, the models detected high suitability for symbiotic plants (E+) in regions unsuitable for non-symbiotic plants (E-). Conversely, some regions were highly suitable for non-symbiotic but not symbiotic plants. Taken together, these data suggest niche partitioning between E+ and E- B. laeves. Endophyte-mediated expansion is further supported by the significantly larger niche breadth of symbiotic B. laeves compared to non-symbiotic plants across all climatic/geographic niche axes examined (~20-65% larger E+ breadth). Niche overlap between E+ and E- plants ranged from ~60-70%, indicating that they differ substantially in niches. Preliminary data indicate costs and benefits of endophyte-mediated herbivore deterrence may underly niche expansion/partitioning (in mixed symbiosis populations, E+ plants received 45% less damage). We are testing these results with common gardens of E+/E- plants at sites with naturally 100% and 0% symbiotic populations. Oral. University of California, Davis One Shields Avenue, 2320 Storer Hall, Davis, 95616, United States.

AFKHAMI, MICHELLE E.* and RUDGERS, JENNIFER1. Symbiosis Lost: Imperfect vertical transmission of fungal endophytes in native grasses. Vertically transmitted symbionts associate with some of the most ecologically dominant species on Earth, and their fixation has led to major evolutionary transitions (e.g., the development of mitochondria). Theory predicts that exclusive vertical transmission should favor mutualism and generate high frequencies of symbionts in host populations. However, host populations often support lower than expected symbiont frequencies. Imperfect transmission (i.e., symbiont is not transmitted to all offspring) can reduce symbiont frequency, but for most beneficial symbionts it is unknown whether vertical transmission can be imperfect or during which life history stage the symbiont is lost. Using quantitative natural history surveys of fungal endophytes in grasses, we show that transmission was imperfect in at least one stage for all seven host species examined (i.e. Elymus hymix, E riparius, E. virginicus, Festuca subvictulicata, Poa al sodes, P. sylvestris, and Sphenopholis nitida). Endophytes were lost at all possible stages: within adult plants, from adult tillers to seeds, and from seeds to seedlings. Despite this loss, uninfected seeds failed to germinate in some species, resulting in perfect transmission to seedlings. Viable but uninfected plants were removed on day 335 with year 1 data being used as a reference for toxico-accumulation. E+ n=4) cultivars, where they were maintained until delivery of foals. E+ mares were removed on day 335 to use as a reference for toxico-accumulation. The AR6 novel endophyte (Neotyphodium lolii) produces ergovaline that deters against the African black beetle, but also causes vasoconstriction that restricts an animal’s ability to dissipate body heat. An experiment was conducted with 3, 0.10-lia pastures of ‘Extreme’ perennial ryegrass (Lolium perenne L.) to compare vasoconstrictive responses in ewe lambs grazing grass pastures infected with AR6 (n=5 lambs), wild-type (WT; n=6), which produces ergovaline, or endophyte-free (Nil; n=5) for 14 days. A second phase was conducted to evaluate vasoconstrictive responses after switching AR6 lambs to Nil, and Nil lambs to AR6. Cross-sectional lumen area of the left auricular artery was measured using ultrasonography on days 13, 15, and 18 in phase 1 and on days 2, 4, and 6 in phase 2. Urine was collected on the first and fourth day of phase 2 for determining urinary lysergol/creatinine ratios. Lambs in phase 2 were heat challenged (32.5°C) in an environmental chamber on day 19. Lumen areas in phase 1 were less (P < 0.05) for AR6 and WT than for Nil. Lumen areas increased linearly (P < 0.05) after AR6 lambs were switched to Nil, and tended (P = 0.11) to decrease linearly in lambs switched from Nil to AR6. Between days 1 and 4 in phase 2, urinary lysergol/creatinine ratios for AR6 lambs switched to Nil decreased (P < 0.001) from 3.6 to 1.6 and Nil lambs switched to AR6 increased (P < 0.001) from 0 to 3.0. There were no differences among treatments in rectal temperatures or respiration rates during the heat challenge. Results indicated a rapid vasoconstrictive response in lambs exposed to ergovaline. Vasoconstriction was easier after AR6 lambs were placed on Nil, but lack of physiological adjustment to the heat challenge indicated ergovaline remained in the vasculature. Poster USDA-ARS Forage-Animal Production Research Unit N220 Ag Science North Lexington 40546 United States. 1AgResearch Lincoln Private Bag 4749 Christchurch 8140 New Zealand. 2AgResearch Ltd Cnr Springs Road and Gerald Crescent Christchurch Christchurch 8140 New Zealand. AL RASHED, HUSSAIN*, KISSL, ERIN, PARISH, JIMMY RAY, CHRISTIANSEN, DAVID, WALTERS, KEVIN, HOPPER, RICHARD and RYAN, PETER. Evaluation of a novel endophyte-infected tall fescue cultivar (PDF584) as a safe forage for pregnant mares. A two-year study evaluated the safety of novel (non-toxic) endophyte-infected tall fescue cultivar PDF584 (*PDF584 courtesy Noble Foundation) for pregnant mare consumption. Thirty six mares were matched by stage of gestation (293.78±4.1 days), blocked by age and assigned to one of four tall fescue pastures; PDF584 (n=12) or Jessa MaxQ6 (MaxQ, n=11), endophyte-free Jessa (E-, n=9), or toxic endophyte-infected Jessa (E+, n=4) cultivars, where they were maintained until delivery of foals. E+ mares were removed on day 335 with year 1 data being used as a reference for toxicoc
Endophyte infection was >88% for PDF584, MaxQ, and E+ pastures, while E- was <8%. Ergovaline content (ppb) of herbage mass of PDF584, MaxQ and E+ pastures were 4.9±0.2, 20.6±5.6 and 400.9±49.0 respectively. Blood samples were collected (x3/week) from mares for serum progesterone (P4) and from foals (12-24 h post-partum) for P4, complete blood count and IgG analyses. Mane urine samples were collected by urethral catheterization (x2/month). Placental and foal birth weights were recorded for birth/placental weight ratios (B/P). All mares delivered viable foals except in E+ group which had two viable, one stillborn-dystocia and one compromised foal, which was euthanized 72-hours post-partum. Serum P4 was similar (P>0.05) among PDF584, MaxQ, and E- mares. Urinary erg alkaloid content was <12 ng/mg creatinine for all groups except E+ mares. Foal B/P were similar for PDF584, MaxQ, and E- (9.0±0.6, 9.5±0.6, and 10.3±0.7 %, respectively). Foal serum P4 was similar on day 1 and 2 in all groups, but lower (P=0.049) in PDF584 (4.8±1.0 ng/ml) than the E- (9.5±1.1 ng/ml) foals on day 0. Neutrophil/lymphocyte ratios (~5:1) and IgG values (1626.3 to 1975.6±253.0 mg/dL) were similar among PDF584, MaxQ, and E- foals. Subsequent breeding/conception rates were not affected by pasture with the exception of E+ mares. These data suggest that PDF584 cultivar is safe for consumption by late-term pregnant mares.

Poster Mississippi State University 4025 Wise Center Mississippi State 39762 United States.

AMYOTTE, STEFAN G.*, KULSHRESHTA, SAURABH, DOTSON, PATRICK, CHANDA, BIDISHA, VENUGOPAL, PRATIBHA C., SEKINE, KEN-TARO, KACHROO, AARDRA, KACHROO, PRADEEP, BALLHORN, DANIEL J.1*, KAUTZ, STEFANIE2 and SCHMITT, IMKE1.

Mississippi State 39762 United States.

LANCOURT, LISA. The role of glycerol and glycerol-3-phosphate in Colletotrichum-host interactions. Glycerol-3-phosphate (G3P) is an important component of carbohydrate and lipid metabolic processes in plants as well as in fungi. Inoculation of Arabidopsis with the hemibiotrophic fungal pathogen Colletotrichum higginsianum was associated with an increase in G3P levels in the host. G3P and G3P-like endophytes based on endophytic fungal G3P dehydrogenase (G3Pdh) gene (encoding GLY1) resulted in reduced levels of G3P and enhanced susceptibility to C. higginsianum. Correspondingly, overexpression of GLY1 increased G3P levels and enhanced resistance to the pathogen. Manipulating endogenous G3P levels by genetic mutations, or by overexpression in transgenic plants of other genes affecting G3P biosynthesis, demonstrated that higher amounts of G3P were always associated with higher levels of resistance. In C. higginsianum glycerol metabolism is likely to involve cytoplasmic and mitochondrial G3Pdh, a G3P phosphatase (GPP), two gyceral kinases (GK), and a gyceral dehydrogenase (GLD). Deletion of the cytoplasmic G3Pdh in C.higginsianum resulted in reduced levels of G3P, and a significant reduction in pathogenicity to wounded or unwounded Arabidopsis leaves. The mutants could grow in culture only if gyceral was added to the medium. The mutants had cell wall defects, reduced apopressor, and significant alterations in fatty acid metabolism. Mutants were no more sensitive to osmotic stress than the wild type. Interestingly, the mutants regained normal pathogenicity on Arabidopsis GLY1 mutants containing reduced levels of endogeneous G3P. Together, these results suggest a novel and specific link between G3P metabolism in the host and pathogen during pathogenesis, perhaps operating through the host-pathogen interface consisting of the plant and fungal cell walls and membrane (apat). Studies are currently under way to characterize details of this metabolic pathway and all of the genes involved in production of G3P in C. higginsianum and in the related pathogen Colletotrichum graminicola, which causes anthracnose disease on the monocot maize. Comparative analyses will be presented on the role of gyceral metabolism and G3P during pathogenesis and development for both of these Colletotrichum spp. Oral University of Kentucky 201F PSB 1405 Veterans Drive Lexington 40546 United States.

ANDREWS, ROBERT* and TORZILLI, ALBERT. Invasive Chinese Lespedeza alters the root and rhizosphere fungal community of a Northern Virginia switch grass. Exotic plants can alter the fungal communities of soils outside their native range with possible impacts upon competing plant species. Based on an analysis of rhizospheric soil and endophyte (RhISA) communities from 120 bush honeysuckle plots across gradients of plant invasion and microscopic evaluation of roots for mycorrhizal colonization, we demonstrate that the invasive exotic Lespedeza cuneata altered the fungal communities of the roots and rhizosphere soils of the native prairie grass Panicum virgatum at a Virginia parkland site. When the plants grew separately, the roots and rhizosphere of L. cuneata significantly differed in fungal community structure compared to those of P. virgatum (p < 0.02 and p < 0.01, for roots and rhizosphere respectively) as determined by qPCR (real time PCR) analysis. Colitratrichum methods for production of the G3P, and then across the gradient from anthracnose lesions on common bean plants in the field in Brazil. We isolated a large number of teleomorphic Glomerella strains from anthracnose lesions on common bean plants in the field in Brazil. We iso-

Continued on following page
lated anamorphic Colletotrichum strains from the same lesions. We observed that anamorphic and teleomorphic strains behaved similarly during pre-penetration events of infection. However, plants inoculated with ascospores from the Glomeraella strains developed very mild symptoms when compared with inoculations using conidia from the anamorphic strains. Phylogenetic analysis based on the internal transcribed spacer (ITS) variable regions of the ribosomal DNA and on the high mobility group (HMG)-encoding sequence of the MAT1-2 mating type gene were performed. The phylogenetic data suggest that the teleomorphic Glomeraella strains are not related to Colletotrichum lindemuthianum, and may represent a new species co-infecting anthracnose lesions with C. lindemuthianum. To elucidate how the strains interact with the common bean plants and how they behave in the presence of C. lindemuthianum strains during infection, work is currently devoted to analysis of post-penetration events of infection using transformants expressing fluorescent proteins. Poster University of Kentucky 201F PSB 1405 Veterans Drive Lexington 40546 United States. 2University of Nebraska Department of Plant Pathology and Microbiology Lincoln 68583 United States. 3University of Nebraska Department of Agronomy and Grassland Science Lincoln 68583 United States.

BARTZ, FAITH1*, DANHEWORTH, DAVID2, GLASSBROOK, NORM1 and CUBETA, MARC3. The role of quinic acid in modulating the phenylacetic acid metabolic complex and the disease causing activity of Rhizoctonia solani AG-3. The soil fungus Rhizoctonia solani causes seedling diseases on plants in natural and agricultural ecosystems. Production of the plant growth regulators phenylacetic acid (PAA) and its hydroxy and methoxy derivatives contributes to the host infection process. However, little is known about how these compounds affect host plant physiology. To determine if PAA and its derivatives could cause plant responses similar to those of Rhizoctonia infection, PAA and each of its derivatives were added to Murishige and Skoog’s medium in concentrations ranging from 0-7.5 mM. Four replicate vessels of each medium were sown with 5 tomato seedlings, and seedlings were assessed for root necrosis after 12 days of development. The results showed that the area of root necrosis had the greatest correlation in the model of concentration of all compounds tested, though the severity of the necrosis response varied for each compound. This demonstrates that host responses to PAA and its derivatives are consistent with a typical Rhizoctonia disease symptom. The influence of quinic acid (QA) metabolism on the production of PAA by field isolates of R. solani was also examined. Isolates were grown in Vogel’s minimal medium amended with either 25 mM QA or no QA, and PAA and derivatives were quantified by gas chromatography-mass spectrometry. Addition of QA to the growth medium reduced total PAA production and caused a shift in the PAA/derivative ratio. These results suggest that modification of the carbon composition of the growth environment can influence PAA metabolism. Improved understanding of this mechanism may lead to novel approaches to suppress Rhizoctonia disease. Oral North Carolina State University Plant Pathology, Campus Box 7612 Raleigh 27695 United States. 2North Carolina State University Crop Science, Campus Box 7620 Raleigh 27695 United States. 3North Carolina State University Genomics Research Lab, Campus Box 8619 Raleigh 27695 United States. 4North Carolina State University 851 Main Campus Drive Raleigh 27606 United States.

BATES, SCOTT1*, MCGUIRE, KRISTA2 and FIERER, NOAH3. A cross-biome survey of soil fungal communities using a barcoded pyrosequencing approach. Fungi are important degraders that are essential to soil biogeochemical processes in many ecosystems. Despite this critical role for soils, variability across large spatial scales in the diversity and structure of these fungal communities, and the factors that influence these parameters, are poorly understood. Previous investigations have suggested communities of soil fungi are influenced by soil nutrient status or vegetational cover; however, these studies have typically examined a limited number of samples or sites. Here we used a barcoded pyrosequencing approach to comprehensively survey fungal communities in 55 soils that represent a variety of soil and ecosystem types across North and South America. Our results demonstrate the utility of using a high-throughput sequence-based approach to assess the diversity and structure soil fungal communities, permitting a robust analysis of the dynamics that shape these communities. Oral 1Cooperative Institute for Research in Environmental Sciences University of Colorado Boulder 80309 United States. 2Department of Biological Sciences Barnard College New York 10027 United States. 3Department of Ecology and Evolutionary Biology University of Colorado Boulder 80309 United States.

BAUCOM, DEANA1*, ROMERO, MARIE2, BELFON, ROBERT2 and CREAMER, REBECCA1. New Undifilum species from Astragalus locoweed of the Western United States. Locoweeds are predominant rangeland plants from the genera Oxytropsis and Astragalus. The plants are problematic for ranchers due to their associated fungal endophyte and its production of the toxin swainsonine. Swainsonine is an alpha-mannosidase inhibitor causing neurological problems that are responsible for significant losses to livestock. Testing of producing fungal endophytes isolated from Oxytropsis spp. have recently been characterized within the new genus Undifilum as U. oxytropis. However, isolates from Astragalus spp. appeared to be morphologically distinct from U. oxytropis. Characterization of fungal endophytes from Astragalus spp. was carried out using morphological comparisons as well as sequence analyses of both the internal transcribed spacer (ITS) region and the glyceraldehyde-3-phosphate dehydroge- nase (GPD) gene. In addition, the isolates were used for random amplification of poly- morphic DNA (RAPD) for molecular comparisons. Results show isolates that are morphologically and molecularly similar to U. oxytropis but have distinct features corresponding to new species within the genus. Poster 1New Mexico State University Box 30003, MSC 3B, Dept. EPPWS Las Cruces 88030 United States. 2New Mexico State University 945 College Ave Las Cruces 88003 United States.

BAUMAN, JENISE M.1*, KEIFFER, CAROLYN H.2, MCCARTHY, BRIAN C.3 and HIREMATH, SHIV1. Planting methods promoting ectomycorrhizal root colonization on blight-resistant chestnut hybrids in pine reclamation. The objective of this study was to evaluate planting protocols that may aid in alleviating the arrested succession of non-native grasslands on reclaimed coal mines in central Ohio. American chestnut (Castanea dentata) and blight resistant hybrid chestnut (C. dentata x mollissima) were used to evaluate the effects of soil treatments on seedling growth and colonization of beneficial ectomycorrhizal (ECM) fungi on roots. Twelve-hundred chestnuts were planted among four soil treatments established on a reclaimed strip mine: 1) a control plot left undisturbed, 2) plots mechanically cross-ripped, 3) plots plowed and disked, and 4) plots ripped + plowed and disked. Two-hundred and forty seedlings representing all treatment types were selected at root emergence and inoculated with ECM fungi isolated from non-native forbs, and the absence of ECM symbionts seem to act synergistically as mechanisms inhibiting seedling establishment. Employing methods of surface conditioning that alleviate compaction and competition while encouraging native ECM colonization and may be the catalyst required to facilitate the natural successional pathway into a closed canopy forest. Poster 1Miami University 400 East High Street Oxford 45056 United Kingdom. 2Miami University 114 Levy Hall Middletown 45042 United States. 3Ohio University 315 Porter Hall Athens 45701 United States. 4USDA Forest Service 359 Main Road Delaware 43015 United States.

RAYNES, MELISSA1*, PENDLETON, ROSEMARY2 and NEWCOMBE, GEORGE1. The effect of endophytic fungi on cheatgrass Bromus tectorum L.) growth and fecundity. Rangelands of western North America are among the most heavily invaded plant communities in the world. Cheatgrass (Bromus tectorum L.), native to Eurasia, is one of the worst invaders within these ecosystems. As an ecosystem engineer, this fire-adapted species has the potential to significantly alter invaded ecosystems by disrupting fire regimes and completely re-transforming vegetation. This invasive grass promotes a smooth sward through seed production. Traditional control methods have proven relatively unsuccessful in managing these populations. The focus of our research was to investigate a potential new control strategy through the use of fungal endophytes. We also explored whether endophytes might have a role in increasing seed production in cheatgrass plants. Over 700 fungal endophytes were isolated from 55 cheatgrass populations across western North America. From each population, large, robust plants as well as smaller, less vigorous plants were sampled. Endophytes were isolated on PDA from the lower stem node. Taxa were characterized via ITS sequences and morphology. In greenhouse and field trials select endophytes either increased or decreased the fecundity and biomass of cheatgrass. Endophyte effects were often population-dependent. In a New Mexico population, inoculation with an endophytic isolate of Morchella significantly increased cheatgrass fecundity, whereas endophytic Sporormiella decreased growth and fecundity. This research demonstrates that endophytes may either positively or negatively influence cheatgrass growth and fecundity. Understanding the influence that specific endophytes have on cheatgrass may lead to increased insight as to why this species is so invasive and on how to more effectively manage existing and expanding populations. Oral 1University of Idaho 975 W. 6th Street Moscow 83844-1133 United States. 2University of Idaho 975 W. 6th Street Moscow 83844-1133 United States. 3USDA Forest Service Rocky Mountain Research Station 333 Broadway SE Suite 115 Albuquerque 87102-3497 United States.

BEARD, CHARLES E.* and ADLER, PETER H. Trichomycetes and symbiotic biodiversity in aquatic Diptera of the southeastern coastal plains. Coastal plain streams of the southeastern United States have the potential to expand our knowledge of aquatic insect biodiversity. These streams are often characterized by low dissolved oxygen, and high organic material including phenolic compounds.
The trichomycete host species in these diseases also differ from other areas; for example, the black fly Simulium slosiaceae is common in coastal plain streams, and has become a pest in some areas, but is not found in other ecoregions. In coastal plain streams, we have documented the fungal trichomycetes (Harpellales) Harpella molusiaena, Pennella sp. and Simulomyces microsporus in black flies (Simulidae). A new species of microsporidian, Caduspora palustris, from Cephalia ophisthila has been described from habitats unique to coastal plains. The microsporian Janacekia debaisei was collected in other hosts. The symbiote Coelomyctidium simuli was documented in S. slosiaceae. The non-fungal trichomycete Paramibodrum sp. has been observed. Another non-fungal symbiote in coastal plains is Tetrahymena sp.; this protozoan was found in collections from the Alapaha River and Satilla River in Florida and Georgia. The tannins and humic chemistry might present challenges to the free-living stages (spores). The nutrition resources available might be different as a result of the different water chemistry, and lower oxygen levels will change the breakdown and availability of organic material. The distribution of these symbiotes in the coastal plains illustrates the success of symbiote dispersal and growth even in the challenges of coastal plain aquatic environments. 

**Beaulieu, WESLEY* and CLAY, KEITH. Morning glories and ergot alkaloids: A parallel endophyte symbiosis? Plants containing ergot alkaloids, including many grasses, sedges and morning glories, have a history of use by humans. Apparent natural, medicinal, spiritual and agricultural uses containing ergot alkaloids, except morning glories (family Convulvulaceae), were shown to be infected by systemic fungal endophytes (family Clavicipitaceae). Recently, three species of morning glories have also been shown to contain a clavicipitaceous fungus responsible for their ergot alkaloid production. Therefore, by extension, it is likely that all morning glories that contain ergot alkaloids host clavicipitaceous fungi. At least 2 species of Convulvus have been reported to contain ergot alkaloids. Infected morning glories exhibit several significant differences from endophyte-infected grasses including higher alkaloid concentration, interspecific variation in in planta distribution of alkaloids and insect-pollinated flowers. The goals of this research are to 1) compile literature reports and screen diverse morning glory species for ergot alkaloids, 2) determine if ergot alkaloid-producing species are infected by clavicipitaceous fungi, 3) determine the evolutionary relationships among the morning glory endophytes and between the fungi and plants, 4) isolate, culture and re-inoculate uninfected plants with their endophyte to fulfill Koch's postulates and 5) conduct ecological studies with fungicide-treated plants (plus infected controls) to elucidate possible costs and benefits of infection. Our data indicate that ergot alkaloid production in the Convulvulaceae is widespread, is dependent on endophyte infection and may have inhibitory effects on insect herbivory. Comparisons and contrasts with grass endophytes will provide new insights into the evolutionary origins and ecological significance of clavicipitaceous endophytes in plants. 

**BEAULIEU, WESLEY* and VAILLANCOURT, LISA. Crossing two closely related Fusarium graminearum strains generates progeny that are more aggressive than either parent. Fusarium Head Blight (FHB) is the principal causal agent of FHB in the United States. Population studies have shown high levels of genetic diversity among North American F. graminearum field isolates, although nearly all belong to a single genetic lineage. F. graminearum is a homothallic ascomycete fungi belonging to or previously affiliated with the Bitunicata ascomycete fungi. They are known to contain ergot alkaloids, except morning glories (family Convulvulaceae), were shown to be infected by systemic fungal endophytes (family Clavicipitaceae). Recently, three species of morning glories have also been shown to contain a clavicipitaceous fungus responsible for their ergot alkaloid production. Therefore, by extension, it is likely that all morning glories that contain ergot alkaloids host clavicipitaceous fungi. At least 2 species of Convulvus have been reported to contain ergot alkaloids. Infected morning glories exhibit several significant differences from endophyte-infected grasses including higher alkaloid concentration, interspecific variation in in planta distribution of alkaloids and insect-pollinated flowers. The goals of this research are to 1) compile literature reports and screen diverse morning glory species for ergot alkaloids, 2) determine if ergot alkaloid-producing species are infected by clavicipitaceous fungi, 3) determine the evolutionary relationships among the morning glory endophytes and between the fungi and plants, 4) isolate, culture and re-inoculate uninfected plants with their endophyte to fulfill Koch's postulates and 5) conduct ecological studies with fungicide-treated plants (plus infected controls) to elucidate possible costs and benefits of infection. Our data indicate that ergot alkaloid production in the Convulvulaceae is widespread, is dependent on endophyte infection and may have inhibitory effects on insect herbivory. Comparisons and contrasts with grass endophytes will provide new insights into the evolutionary origins and ecological significance of clavicipitaceous endophytes in plants. 

**Belanger, FAITH* and AMBROSE, KAREN. Deep transcriptome analysis to aid in understanding the Epilochle-grass symbiosis. It is well established that the Neotyphodium and Epilochle fungal endophytes of grasses confer numerous benefits to their hosts. However, the details of the interaction are largely unknown. One of the outstanding questions regarding the plant-endophyte relationship is what are the factors contributing to maintenance of a compatible interaction. Previous studies have established that gene expression in the plant is altered in response to endophyte infection. Our hypothesis is that these changes are important for the maintenance of the symbiotic interaction. Our approach is to use SOLID-SAGE to obtain a global quantitative comparison of the transcriptomes of endophyte-free and endophyte-infected plants. We have three samples in the comparison, all with the identical strong creeping red fescue plant genotype: 1) endophyte-free, 2) infected with an endophyte originally from strong creeping red fescue 3) infected with an endophyte originally from Chewsings fescue. The SAGE libraries were prepared in triplicate. We have obtained a total of over 54 million SAGE tags, with between 4 and 10 million tags per replicate. We are supplementing the SOLID-SAGE data with 454 transcriptome sequencing, looking for probes in the Epilochle festucae strain isolated from strong creeping red fescue and the plant infected with that strain. We expect to obtain quantitative data on most of the expressed plant and fungal genes. Analysis of the data will reveal 1) general plant transcriptional changes in response to fungal endophyte infection, 2) plant transcriptional changes that are specific to the infecting fungal endophyte genotype, and 3) relative transcript levels for fungal endophyte genes for two endophyte genotypes each infecting the same plant genotype. 

**BOEHM, ERIC* and SCHOCHE, CONRAD. A molecular phylogenetic reappraisal of the Hysteriaceae, Mytilinidiaceae and Gloniaceae (Pleosporomycetidae, Dothideomycetes). A reappraisal of the phylogenetic integrity of bitunicate ascomycete fungi belonging to or previously affiliated with the Hysteriaceae, Mytilinidiaceae, Gloniaceae and Patellariaceae is presented, based on an analysis of 121 isolates and four nuclear genes, the ribosomal large and small subunits, transcription elongation factor 1 and the second largest RNA polymerase II subunit. A geographically diverse and high density taxon sampling strategy was employed, including multiple species/species from the following genera: Ante- cronum (6/6), Encyphographis (1/1), Farlowiella (1/1), Gloniopsis (8/4), Gloni- um (4/2), Hysterium (12/5), Hysterobrevium (14/3), Hysterographium (2/1), Hys- terotella (2/2), Lophium (4/2), Mytilinidium (13/10), Oedohysterium (5/3), Ostreochionia (2/2), Patellaria (1/1), Psiloglumon (1/3), Quasiconcha (1/1), Rhi-thyhysteron (8/3), and 24 outgroup taxa. Molecular data instead support the premise of a large number of convergent evolutionary lineages, which do not correspond to previously held assumptions of synapomorphy relating to spore morphology. Thus, within the Hysteriaceae, the genera Gloniopsis, Glonium, Hysteri-
um and Hysterographium proved highly polyphyletic. This necessitated the transfer of two species of Hysterium to Oedoscyphus gen. nov. (Od. insidens comb. nov. and Od. simsec comb. nov.), the description of a new species, Hysterium bartrianum sp. nov., and the transfer of two species of Gloniopsis to Hysterobrevium gen. nov. (Hbr. similacs comb. nov. and Hbr. constratum comb. nov.). While Hysterobrevium, with the type Hg. fraxini, is removed from the Hysteriaeae, some of its species remain within the family, transferred here to Oedoscyphus (Od. pulchrum comb. nov.). Hysterobrevium (Hb. mori comb. nov.) and Gloniopsis (Gp. subrugosa comb. nov.) The genus Glioniom is now divided into Anteaglomin (Pleosporales), Glioniom (Gliomiales) and Psilomagom (Hysterobreviaeae). The Hysteromycetorum has evolved convergently no less than five times within the Pleosporomycetidae (e.g., Anteaglomin, Farlowiella, Glioniom, Hysterographium and the Hysteriaeae). Similarly, thin-walled mycelididi (e.g., Oestrchinum) and patellaridi (e.g., Rhytidhysteron) genera, previously in the Mytilinidiaceae and Patellariaceae, respectively, transferred here to the Hysteriaeae, have also evolved at least twice within the subclass. As such, character states traditionally considered to represent synapomorphies among these fungi, whether they relate to spore separation or the ascomata, in fact, represent symplesiomorphies, and most likely have arisen multiple times through convergent evolutionary processes in response to common selective pressures. Oral *1Dept. of Biology, Kean University 1000 Morris Ave. Union 07083 United States. *1NCBI, NIH, GenBank. 45 Center Drive Bethesda 20892 United States.

BONITO, GREGORY 1*, BRENNEMAN, TIMOTHY 2 and VILGALYS, RYTAS 3. *1Tuber species are dominant as ectomycorrhizae in pecan orchards (Carya illinoianaeformis) but are not prevalent in the spore bank. During the mid-1980's a native and edible truffle, Tuber lyonii, was found fruiting abundantly in commercial pecan orchards in Georgia, USA. Over the past decade truffle fruiting has declined at formerly productive sites, but the cause remains unexplained. To determine if this decline is correlated with an absence of T. lyonii mycorrhizae we sampled roots from 50 trees across five sites. Mycorrhizae were identified based on ITS and LSU rDNA sequence similarities. Forty-seven distinct phylotypes were detected. Hypogeous taxa including Tuber, Schleroderma, and Hymenogaster were abundant as ectomycorrhizae. Tuber lyonii (17%) and an undescribed Tuber species (~20%) were the two most abundant phylotypes detected as ectomycorrhizae and were present in truffle producing and non-producing sites. Therefore, the decline in truffle production does not appear to be due to a lack of T. lyonii mycorrhizae. To test whether the high abundance of Tubereoctomycorrhizae is the result of a prevalence of Tuber in the spore bank, we set up a bioassay experiment with soils collected from under truffle producing trees. Tuber ectomycorrhizae were recovered in the bioassay but in low frequency. Taxa in the Perizaeaceae and Hymenogaster were more frequently recovered. Although pecan seedlings are receptive to Tuber spores, these results show that the current dominance of Tuber beloground in pecan fields is not explained by a spore bank or host-specific effects. *2Duke University 139 Biological Sciences Building Durham 27708 United States. *3University of Georgia 2536 Rainwater Road Tifton 31904 United States.

BROSI, GLADE1*, NELSON, JIM1, BUSH, LOWELL2 and MCCULLY, REBECCA2. 1Will Neotyphodium infection influence tall fescue response to predicted climate change? Climate change will alter abiotic and biotic factors that influence plant growth and may potentially affect plant-microbial interactions. To assess this possibility, we investigated the response of tall fescue, Lolium arundinaceum, with (+E) and without (-E) the wild-type fungal endophyte, Neotyphodium coenophialum, growing in a mixed species hayfield community in central Kentucky (USA), to elevated temperature (+3°C) and altered precipitation (+30% of the long-term mean annual). A randomized complete block design was employed, with 5 plots each of the following 4 treatments: Control, + Heat (+H), + Heat + Precipitation (+HP), + Precipitation (+P). Individual tall fescue tillers were measured weekly for growth and destructively harvested three times in 2009 during simulated mowing events. Tillers were analyzed for tissue chemistry (percent hemicellulose, cellulose, lignin, carbon, and nitrogen) for each harvest date and +E tillers were analyzed for alkaloid content at the final harvest. The climate change treatments affected tall fescue growth differently depending on the season. For example, during the June-July period, tall fescue growth was dramatically reduced under the +H treatments. E+ tillers were more in +H treatments than E-. Tall fescue tissue chemistry varied across the growing season and interacted with both endophyte status and the climate treatments to produce complex effects on these parameters. Interestingly, loline and ergot alkaloid concentrations in the final harvest were lower at the +H sites. Across the climate change treatments, results suggest that predicted increases in temperature and precipitation in this region of the USA will lead to greater spring and fall tall fescue growth, but reduced mid-summer growth, and subtle, but also seasonally complex changes in tissue chemistry. *1Poster University of Kentucky Ag Science North Lexington 40546-0091 United States. *2University of Kentucky Dept Plant & Soil Sciences Lexington 40546-0312 United States.

BRUMMER, E. CHARLES1* and PHILLIPS, TIMOTHY D. 2. Breeding forage grasses. Improved forage grass cultivars can have a positive effect on animal nutrition, environmental stability, and producers’ economic bottom line. We will discuss current procedures involved with breeding outcrossing, polyloid forage grasses. In particular, we will focus on breeding methods for tall fescue (Lolium arundinaceum) containing common toxic and novel nontoxic Neotyphodium endophytes, drawing comparisons with techniques used to breed endophyte-free tall fescue and species without endophytes, such as orchardgrass (Dactylis glomerata) and switchgrass (Panicum virgatum). We will discuss the application of genomics technologies to grass cultivar development. *1Oral University of Georgia Department of Crop and Soil Sciences 111 Riverbend Road Athens 30602 United States. *2University of Kentucky Plant Sciences Bldg. / 1405 Veterans Dr. Lexington 40546-0312 United States.

BRYANT, JENNY*, JOHNSON, JAY, SCHARF, BRAD, KISHORE, DEEPAN, COATE, ERIC, EICHEN, PEGGY ANN and SPIERS, DONALD. Effect of endophyte-infected tall fescue on hepatic gene expression in cattle. Studies show that the effect of endophyte-infected tall fescue is toxicosis, which results in hepatic gene expression in rats. This work identifies the liver as a major participant in the pathology of fescue toxicosis, as it is the site where toxins are metabolized in the body. As a result of fescue toxicosis, gene expressions for cytochrome P450 are down-regulated and expressions of antioxidant enzymes are down-regulated. Various heat shock proteins associated with heat stress resistance, such as small stress protein and serum proteine are also down-regulated. Few studies have determined the effect of similar treatment on cattle. In a short-term study, a combination of Misouri- (n=10; 513.6 ± 13.6 kg BW) and Oklahoma- (n=10; 552.8 ± 12.0 kg BW) derived Angus steers were fed diets containing either endophyte-free (E-) or endophyte-infected (E+) tall fescue seed (30 μg ergoline/kg BW/day) at 19-22°C (TN) for 8 days. Feed intake (F) was recorded daily, with respiration rate and both skin and rectal temperatures were recorded six times daily. Blood and liver tissue samples were collected during pretreatment. Blood samples were collected again on Day 4 and liver samples were collected on Day 8 of treatment. There was a significant decrease (P<0.05) in FI of E+ steers from the beginning of treatment to Day 7, with the difference being 2.84 kg. Blood alkaline phosphatase level was significantly lower in E+ steers when compared to E- steers (P=0.05), with an absolute difference of 14.5 U/L. These results indicate that the E+ steers were exhibiting signs of fescue toxicosis. The next step will be to perform quantitative real-time PCR on hepatic tissue samples to determine the effect of fescue toxicosis on the expression of specific genes associated cytochrome P450s, antioxidant enzymes, and heat shock proteins. (USDA Agreement No. 58-6227-3-016) Key Words: Fescue Toxicosis, hepatic gene expression, cattle *1Poster University of Missouri 920 E Campus Dr Columbia 65211 United States. *2Oral University of Missouri 920 E Campus Dr Columbia 65211 United States.
The role of a signal peptidase component in the pathogenicity of *Colletotrichum graminicola* to maize. Anthracnose stalk rot, caused by the hemibiotrophic fungus *Colletotrichum graminicola*, is one of the most damaging diseases of maize. An inserted mutation in the 3′ UTR of the *Cgr* gene, encoding a transposable element Restless, T. inflatum also contains a unique repeat, the CPA element, which poses challenges to assembly with short reads alone. Methods to improve assembly accuracy and quality, and resolve repeats remain in their infancy for next-generation genome sequences of several ascomycetes, *Grosmannia clavigera* and *Sordaria macrospora*, demonstrate the potential of hybrid approaches using both Illumina/Solexa and Roche/454 next-generation sequencing technologies for de novo sequencing of fungi and other eukaryotic organisms. Using a hybrid approach, we are currently sequencing the genome of *Tolypocladium inflatum*, the producer of *N. coenophialum* (which produces high levels of alkaloids), strain AR577 (which produces intermediate levels of alkaloids), or uninfected (E-) plants. Plants were allowed to be colonized by bird cherry-oat aphids and many of those aphids were parasitized by *Aphelinus asychis* parasitoids. We followed aphid and parasitoid densities and plant growth during the summer growing season. We found that both aphid and parasitoid densities were greatest on E-, intermediate on AR577, and lowest on CS plants. Furthermore, the ratio of parasitoids to aphids was greatest on E- plants and lowest on CS plants. Both aphids and their parasitoids exhibited the greatest range in densities on E- plants, while CS supported less a variable range in densities of herbivores and parasitoids. We found the number of tillers produced by plants at the end of the season was greatest for plants infected by the CS strain and least for plants lacking endophyte infection. Our results suggest that the modification by *N. coenophialum* of bottom-up trophic cascades has a net positive effect on plant fitness. That is, detrimental effects of the fungus on the plant through reduced effectiveness of natural enemies are outweighed by beneficial effects the fungus provides through reducing herbivore damage to the plant. Further, these effects of the fungus are correlated with alkaloid production with greater production resulting in greater plant growth. We caution that our study was short term and focused on only one set of herbivores and parasitoids; results may differ for long term studies in which food webs are established other than the aphid-parasitoid one we studied. Oral Hope College 35 E. 12th St. Holland 49423 United States. 2Richard J. Daley College 7500 Hall Corvallis 97331 United States.

Managing perennial weeds is the number one limiting factor to successful establishment of summer dormant and summer active tall fescue. It was determined that annual grassy weeds is the number one limiting factor to successful establishment of summer dormant and summer active tall fescue. It was determined that annual grassy weeds should be controlled with glyphosate in the spring, prior to drilling tall fescue seed in the fall. In addition, it is important to delay planting until after a rainy fall occurs and temperatures decline in late September to germinate a second flush.
of weeds, followed by another application of glyphosate to control the emerged weeds. This method has allowed successful establishment of both summer dormant and summer active tall fescue in many environments. Legumes: In the southern Plains 10 winter and 10 summer legumes were evaluated with summer dormant and summer active tall fescue; it was determined that alfalfa had the greatest potential, since it was a perennial and provided the most consistent production. However, in some years/environments, there was excessive competition between tall fescue and alfalfa. In another set of experiments, it was determined that both tall fescue and alfalfa could be established together if they were planted on alternating rows. In the second year, cattle began to selectively graze the alfalfa. This selectivity could be managed and both species were successfully established if the alfalfa and tall fescue (summer dormant and summer active) were planted on an alternating and perpendicular row orientation. Production and Economics: In a four year cattle grazing experiment comparing an annual rye/ryegrass system to a perennial tall fescue system, it was determined that the perennial system could be profitable in the second year, if the stand life was amortized over five years; however the annual grass system provided greater returns due to increased number of grazing days and total gain. The economic analysis is sensitive to the stand life of the tall fescue; the fifth year data is currently under and it is expected that after five years, the two systems will not be statistically different, although the annual is numerically greater. Oral 1The Noble Foundation 2510 Sam Noble Parkway Ardmore 73401 United States. 2Texas AgLife HYW 70 Vernon 76358 United States.

BYLIN, ANJA* and HUSS DANELL, KERSTIN. Occurrence of Neotyphodium spp. in grasses in Sweden. In most parts of Sweden winters are long with frozen ground and a snow cover. Cattle, horses and sheep graze only a few months per year and are otherwise dependent on silage and hay. The most common cultivated forage grasses in Sweden are timothy, Phleum pratense, meadow fescue, Festuca pratensis, and ryegrasses, Lolium spp. Among additional forage grasses is bluegrass, Poa pratensis. Tall fescue, F. arundinacea, and hybrids between ryegrass and meadow fescue, Festulolium braunii, have been introduced only on a small scale on the Swedish market. Until recently no attention has been paid to occurrence of endophytic fungi, Neotyphodium spp., in Swedish grasses and the number of observations of Neotyphodium in cultivated grass species is still limited. Among non-agricultural grasses, F. ovina, F. rubra and F. vivipara are reported to be infected. Under agricultural conditions endophytes are reported from F. ovina, F. pratensis and F. rubra. The infection frequency in cultivars of F. pratensis and F. rubra is found in the range 0-50 percent. There are no national guidelines for seed testing with respect to endophytes, nor is presence of endophytes declared by seed companies in Sweden. So far, the importance of endophytes for performance of forage grasses as well as any effects on livestock has not been investigated. Poster Department of Agricultural Research for Northern Sweden SLU Umea SE-901 83 Sweden.

CARD, STUART1*, ROLSTON, PHIL2 and HUME, DAVID1. Comparison of endophyte detection methods with infected seed lots of Lolium perenne and Festuca arundinacea. A new endophyte detection technique, which exploited the biological interaction of Lolium decumbentium stomata and the external replacement of the stoma, was used in order to assess the level of endophyte infection within selected seed lots. For validation purposes, the bioequivalence of the infection layer technique was assessed, as compared to two reference methods, namely the tissue print-immunoblot technique (TPIB) and the seed squash method, practices used within the seed industry. Comparisons were made using three categories of seed; 1) stored seed, 2) freshly harvested seed and 3) seed harvested from stands treated with various fungicides. The infection layer method was found to be a simple and accurate test for predicting the level of viable endophyte in freshly harvested seed lots or those with a high endophyte storage capacity and was much more accurate than the seed squash method, which routinely recorded an over estimation of endophyte infection in stored and freshly harvested seed. However, it was not a substitute for TPIB in detecting viable levels of endophyte in compromised seed accessions, such as those affected by certain systemic fungicides. Keywords: Neotyphodium, embryo, immunoblot, microscopy Poster 1AgResearch Limited Tennent Drive Palmerston North 4442 New Zealand. 2AgResearch Limited Cnr Springs Road and Gerald Street Christchurch 4442 New Zealand.

CAVENDER, JAMES1* and CAVENDER, NICOLE2. Cellular slime mold species richness in Butterfly Woods, The Wilds, Ohio. The cellular slime molds (csm) occur in the humus layers of forest soils and feed as an amoeboal stage on soil bacteria. The purpose of this study is to determine the species richness of csm in Butterfly Woods, The Wilds. Collections of csm for species richness have been made in Ohio beginning in 1970 and continuing to the present. 119 sites of 8 physiographic regimes in 41 of 88 counties have been sampled. Most of the sites were woodlands located within ODNR Natural Areas or State Parks. After soils were processed in the lab using a soil dilution-bacterial enrichment technique, the number of species and average number per gram of forest humus were recorded for each site. All sites had at least four species and a total of 24 species were found. Several sites had 11 species and one had 12. However, one site in particular, Butterfly Woods at The Wilds, produced 14 species from the first collections in 2003. This site was, therefore, selected for further study. Isolations were made from a dormant set of 300. The results were a collection of 19 species with an average of 11.2 species per collection. Several individual soil samples yielded 8 species and one had 10. This is higher than has been reported thus far for any site in the temperate zone. We are attempting to uncover the factors which promote this high diversity of cellular slime molds by utilizing our knowledge of the occurrence of csm species in the 8 physiographic regimes sampled in Ohio. For example, certain species are favored by the northeast slope exposure, others by the limestone substrate and near neutral pH, others by the protective ravine habitat present while still others are associated with the mixed mesophytic forest with its high tree and herb diversity. Poster 1Ohio University Porter Hall Athens 45701 United States. 2The Wilds 14000 International Rd. Cumberland 43732 United States.

CAYINDER, BRAD*, HALLEN-ADAMS, HEATHER and TRAIL, FRANCES. The role of calcium signaling in ascospore discharge and spore shape. Ascospore discharge is an important mode of spore dispersal in the majority of ascomycete fungi, yet little is known of the mechanism of ascospore firing. We have developed Fusarium graminearum as a model system in which to study ascospore discharge. We have shown that two calcium ion channels that are involved in ascospore discharge, a mechanosensitive calcium ion channel, results in morphologically normal perithecia and asci, and with a loss of the ability to discharge spores. Gene disruption of Cchl1, an L-type calcium ion channel with homology to the voltage gated channels of mammalian cells, results in similar morphological characteristics. However, loss of Mid1 also affects spore shape in a large percentage of spores. In Caenorhabditis elegans, two calcium ion channels have been thought to function together, perhaps with Mid1 as the regulatory component. We will present new evidence for distinct roles for these two channels in ascospore development. These results suggest new and disparate roles for these two genes in filamentous fungi. Oral Departments of Plant Biology and Plant Pathology Michigan State University East Lansing 48824 United States.

CHARLTON, NIKKI1*, GHIMIRE, SITA1, NAKASHIMA, JIN1 and CRAVEN, KELLY2. The so locus plays a role in the mutualistic interaction between Epichloë festucae and fescue grasses. Epichloë endophytes are intimate fungal symbionts of cool-season grasses that generally grow as sparse, unbranched hyphae in the intercellular spaces of host tissues. Anatomosporas plays an important role in vegetative growth, colony establishment and sexual development of filamentous fungi. A so (soft) mutant of Neurospora crassa and aso-1 mutant of Alternaria brassicicola have been shown to be incapable of self-fusion. The inability to form interconnected networks of self-anastomosed hyphae may prohibit a fungus from producing structures of complex organization including sexual fruiting bodies. To test the hypothesis that the inability to anastomose would eliminate sexual stroma formation, we generated a so knockout in E. festucae by homologous recombination in ascospores, with the genetic complement of F. arundinacea (Festuca pratensis) and tall fescue (Festuca arundinacea) seedlings were inoculated with wild type and Aso to assess the development of the sexual fruiting body. We further hypothesized that the inability to anastomose should affect endophyte growth in vegetative tissues. However, plants infected with the so mutant showed increased tillering, severe stunting, and the infected plants died within two months of inoculation. Light microscopy of stem sections (0.3 μm) revealed that Aso-inoculated seedlings had more intercellular hyphae compared to the seedlings inoculated with wild type, suggesting a deregulation of hyphal growth. This study suggests that the so gene plays an important role in maintaining the mutualistic relationship between the Epichloë endophyte and its host. Poster 1The Samuel Roberts Noble Foundation 2510 Sam Noble Parkway Ardmore 73401 United States. 2The Samuel Roberts Noble Foundation 2010 Sam Noble Parkway Ardmore 73401 United States.

CHAVEIRRI, PRISCILA1*, BRANCO ROCHA, FABIANO1 and SAMUELS, GARY3. Trichoderma harzianum is a species complex. Trichoderma harzianum sensu lato (Ascomycota, Hypocreales, Hypocreaceae) (teleomorph Hypocrea lirii) is the most commonly encountered species in the genus. It is found in most parts of the world as an endophyte, soil inhabitant, wood rotter, and mycoparasite. The basic T. harzianum morphology includes pyramidal branched conidiophores, relatively short flask-shaped phialides, and globose green conidia. This morphology is shared to a greater or lesser extent by several related segregate species (e.g. T. aggressivum, T. amaziconum nom. prov., H. brunneoviridis, H. epiphycus, H. parepimyces, and T. pleuroticola). However, the taxonomic status of the core of T. harzianum species complex remains unresolved despite the existence of multiple cryptic species. One of the difficulties in clarifying
taxonomy of this group is the apparent lack of diagnostic morphological charac-
ters. The objectives of this study were to (1) revise the taxonomy of the T.
harzianum species complex and (2) define T. harzianum sensu stricto using mor-
phological and phylogenetic analyses. Many specimens from diverse geographic
origins and on many substrata were analyzed. “Genelogical Concordance Phy-
logenetic Species Recognition” based on sequences of four loci (i.e. act, cal, ITS
nrDNA, tef) and other species delimitation approaches, indicate the presence of
at least five species in addition to the apparently uncommon T. harzianum sensu
stricto, which is restricted to Europe and North America. Although morphology
remains of little diagnostic value, some of the recognized cryptic species correlate
to geographical distribution, ecology (e.g. endophyte, mycoparasite, or sapro-
phyte), and known teleomorphs. Teleomorphs in T. harzianum are apparently
rare, found only in a few clades. In addition, one of the endophyte species shows
possible host preference. Triohedra harzianum may be an example of the ‘end of
morphology’ in taxonomy where there are too few visible characters to account
for the rapid speciation and genetic isolation which generally precedes the diver-
gence of morphological character states. Oral University of Maryland 2112
Plant Science Building College Park 20742 United States. 2Universidad de
de Vicoisa, Department of Plant Pathology Av. P.H. Rolfs, s/n Vicoisa-MG CEP
36570-000 Brazil. 3USDA-ARS, Systematic Mycology and Microbiology Labo-
ratory 10300 Baltimore Avenue, B-011A, Rm. 301 Beltsville 20705 United States.

CHEN, YONGGAN*, II, YANLING and WANG, ZHIWEI. Microsatellite
variability in Chinese native epichloë endophytes. Epichloë endophytes were
genetically diverse and formed both antagonistic and mutualistic associations
with their host grasses. Here, we presented microsatellite variability to assess ge-
netic diversity and relationships of 28 fungal strains of epichloë endophytes from
China, America and Switzerland. These strains were highly polymorphic, 5 mi-
crosatellite loci ranging from 84 to 188 bp and 12 distinct core sequences were
identified. Multiple alleles at B9 and B10 loci of Neotyphodium sinensitae were
likely to be consistent with the alleles present at Epichloë yangzii and Epichloë
sp. respectively, indicating the interspecific hybrid origin. Epichloë strains obtained from Roegneria spp., Poa spp. tended to constitute a Roegner-
ia/Poa complex, except Rj5706 clustered with a Neotyphodium strain from Bra-
mus inermis. Such dispersion among Roegneria/Poa complex from a same col-
lection site revealed abundant genetic variability of this species. Moreover, microsatellite analysis further supported that E. yangzii native in China was dis-
tinctly distinguishable from E. bromicola domestic in Europe. *: This work was
fully supported by the National Natural Science Foundation of China (No. 30670008).
Poster Nanjing Agricultural University No1, Weigang Nanjing 210095 China.

CHEN, NA*, LI, CHUNJIE and NAN, ZHIBIAO. Transcriptomic identifica-
tion of candidate genes of Achintherum inebriens infected with Neotyphodi-
um gansuense responses to low temperature. Drunken horse grass (Achintherum inebriens), an intoxicating perennial bunchgrass, is typically asso-
ciated with a mutualistic assexual fungus Neotyphodium gansuense. A number of studies have shown that the association of the endophyte with A. inebriens have functional adaptations to biotic and abiotic stress conditions. However, the mo-
olecular foundations of those eco-physiological adaptations of fungal endophyte-
grass symbiont remain largely unknown. In present study, the germination at low temperature condition of two A. inebriens populations (E+: endophyte-infected and E-: endophyte-free) were compared and used Soecs deep sequencing to iden-
tify candidate genes showing differential expression. Based on the experiment of
different low temperature stress, we documented that endophyte could increase
the germination rate, accelerate germination speed and promote growth of radicle
and embryo of A. inebriens. Especially under 10 stress, the germination rate,
germination index and length of radicle and embryo of E+ seeds were significantly
higher than those of E- seeds (p<0.05). Up to 8762 genes were identified by soiec,
with 14.2% of which were differentially expressed (up- or down-regulated). In total, only 328 differential genes were found to have genes
homogenous with reported from Oryza sativa and Festuca pratensis. Differential
expression of these genes was confirmed by northern blotting. Many genes span-
ing almost all functional categories were up-regulated in E+ A. inebriens seed-
ing during seed germination under 10 condition, especially genes involved in ox-
idative stress and pathways related to stress adaptation. These differentially
expressed genes are highly congruent with physiological differences in the E+ A.
inebriens and could contribute a physiological advantage in seed germination
under low temperature, making them potential targets for natural selection. Poster
College of Pastoral Agriculture Science and Technology, Lanzhou University Ji-
ayuguan Xi6a 768 Lanzhou 730020 China.

CHI, MYOUNG-HWAN* and CRAVEN, KELLY. Functional characteriza-
tion of the gene encoding phosphoglucomutase in Neurospora crassa. Glucose
metabolism plays an essential role in both anabolic (cell component synthesis) and
catabolic (energy production) processes in fungal development. Phosphoglu-
comutase is an enzyme that lies at a central crossroad in carbohydrate metabolism
by catalyzing the conversion between glucose-1-phosphate and glucose-6-phos-
phate. So positioned, this enzyme directs glucose flux into glycolytic catabolism,
whereas its inhibition results in a redirection into an alternative anabolic route, the
pentose phosphate pathway. Neurospora crassa has a simple copy of phosphoglu-
comutase encoding gene (PGM1) in its genome, and the null-mutant showed se-
vere defects in colony morphology. The mutant produced thin and highly
branched hyphae on agar plates, and colony expansion was extremely delayed,
apparently due to an inability to develop fast-growing leading hyphae. The PGM1
mutant did not produce any conidia, and it exhibited a light-induced bending pat-
tern of aerial hyphae and carotenoid pigments. We hypothesize that the lack of an
energy source has caused the defects in the mutant, but supplementation of sodi-
um pyruvate in the media did not recover the wild type phenotype in respect to
colony morphology or conidiation. This suggests that the development of leading
hyphae and conidia might be controlled by glucose-1-phosphate derivatives in the
glycogen pathway or intermediates between glucose-6-phosphate and pyruvate,
not by derivatives from pyruvate metabolism. Poster The Samuel Roberts Noble
Foundation 2010 Sam Noble Parkway Ardmore 73401 United States.

CLAY, KEITH* and RUDGERS, JENNIFER. Tall fescue, endophyte infec-
tion and vegetation change: A 10-year experiment. This experiment addressed how
10 years of secondary succession varied in an unmanaged system where en-
ophyte independent variables were the only treatment. In 2000 a field experiment was established at the Indiana University Research
and Teaching Preserve in Bloomington, Indiana where 16 replicate field plots (30m x
30m each) were created bydisking a former agricultural field (fallow for 4-5
years) and enriching with KY-31 tall fescue seeds at a rate of 45 kg-ha-1. Plots were
arranged in two rows of eight plots in a checkerboard pattern with adjacent
plots receiving different treatments. No herbicides, fertilizing, irrigation, etc. have
been applied. Over time, other plant species naturally colonized plots from the seedank, vegetative fragments, and nearby natural areas. Changes in vegetation occurred in three phases. The first four years there were few
frequencies and fescue dominated both E- and E+ plots. Over the next four years there was a decline in fescue with a concomitant increase in the
abundance of other plant species, but only in the E+ plots. Finally, over the past
two to three years fescue has virtually disappeared in many E- plots, which are
donated by tall fibrous dicots (e.g. Solidago, Verbesina, Vernonio) and trees. NMS ordination of plant community composition suggested that E+ plots
are converging with each other while E- plots are diverging. While the mechanism
or mechanisms leading to these changes is not definitively known, a series of an-
cillary studies have demonstrated differences in competitive abilities, decomposi-
tion rates, arthropod communities, vole (Microtus spp.) predation rates and inva-
sion by trees and noxious weeds. Several experiments suggest that voles represent
keystone herbivores in these grassland systems, and that the loss of fescue from E-
plots is causing novel, vole-driven changes with unknown longer-term conse-
3Rice University 6100 Main St. Houston 77005 United States.

CLEMENT, STEVE* and ELBERSON, LESLIE. Bioprospecting grass-endoh-
sybiota for research and agronomic applications. Bioprospecting here-
means the evaluation and/or acquisition of C3 wild grasses, in ex situ and in situ
situations, harboring diverse strains of fungal endophytes (Epichloë/Neotyphodi-
um complex) for ecological research and agronomic applications. To highlight this
activity, this presentation reviews progress in locating diverse wild grass-endoh-
sybiota (emphasis on fescues, cereal grass relatives, brome grass, wild tim-
othy) in native habitats and in genebank accessions from seed of wild plants in Eu-
rope, North Africa, China, western and central Asia, Argentina, and the United
States. Indeed, public and private sector researchers have found that having a large
pool of 'novel Neotyphodium strains' available is vital for continued success in de-
solving grass cultivars with enhanced pest defensive capabilities and persistence.
Moreover, the inclusion of diverse grass-endophyte symbiotlas in ecological studies
has increased understanding of the importance of endophyte infection to the struc-
ture and function of grass populations and communities. And with potential ex-
plorations of endophyte bioprospecting to the wild relatives of cereal grasses, this
summary summarizes current knowledge (published and unpublished data) of the over-
all effects of diverse grass-endophyte symbiota and their metabolites on the sur-
vival and population growth of ideally important insect pests of wheat and bar-
ley, namely Hannah fly, Russian wheat aphid, bird cherry-oat aphid, rose-grass
aphid, and cereal leaf beetle. This is indispensable information for considering the
use of endophytes and their alkaloids to protect cereals against pests. Finally, this
presentation draws attention to the need to look upon grass endophytes in their
hosts as components of biodiversity, which like other types of generic building ma-
terials must be conserved for research and development. Oral USDA-ARS, Wash-
ington State University 59 Johnson Hall Pullman 99164-6402 United States.

Continued on following page
community has been actively involved in a collaborative project to obtain a high quality genome sequence of R. solani anastomosis group 3 (AG-3), strain Rhs1AP. Sanger, 454 Titanium FLX pyrosequencing, and Illumina (Solexa) methods have generated 2.2 Gb of sequence data that represents approximately 22X coverage of the estimated 86 Mb genome. The fungus has 31 chromosomes ranging in size from 1.85 to 5.25 Mbp and there is evidence of at least five of the chromosomes based on the completed optical restriction map. Single nucleotide polymorphism-mediated genotyping and RT-PCR melt curve analysis are currently being developed to help identify haploid components of the genome. DNA sequence data obtained from haploids derived from single nucleus protoplasts of Rhs1AP will be used in conjunction with cDNA libraries generated from haploid and parental forms to assemble and annotate the genome sequence. Oral 1North Carolina State University 851 Main Campus Drive Raleigh 27606 United States. 2University of Puerto Rico P.O. Box 23360 San Juan 00931-3360 Puerto Rico. 3McGill University Macdonald Campus, 21 111 Lakeshore Road Sainte-Anne-de-Bellevue Quebec H9X 3V9 Canada. 4Leisure Research Centre 13 Holberton Street, PO Box 2282 Toowoomba Queensland 4350 Australia. 5University of Wisconsin 5434 Genetics-Biology Building Madison 53705 United States. 6University of Montana 347 Hitchens Hall Oroko 04469-5722 United States. 7University of North Carolina at Charlotte 2844 Beatties Ford Road Charlotte 28262 United States. 8University of Texas at Austin 1 University Station, Austin 78712 United States. 9University of California Davis 1 University Station, Davis 95616 United States. 10University of Texas at Austin 1 University Station, Austin 78712 United States.

DIAZENE, JOSE C.1, DIANESE, ALEXEI C.2, SOUZA, ERICA S.C.1 and PEREIRA-CARVALHO, RITA C.1. New record of Cercospora apii s. lato on Piper nigrum and Jatropha curcas in the Cerrado. Two different specimens of Cercospora apii s.i were found, one in Jatropha curcas and another in Piper nigrum, both plant species recently introduced into the Cerrado in Brazil. There is now evidence of C. apii-like fungi in both plant species. Both Jatropha and long acicular hyaline conidia highly septate conidia (up tp 25 septa) flatly truncate at the base, on highly geniculate conidiophores. The one on P. nigrum is clearly segregated from the other Cercospora species previously detected on the host: C. piperis-betle [amphigenous fascicles with up to fourteen 30 - 50 x 4 - 5 μm conidiophores; conidia 30-90 x 1-3 μm], and C. pipera [conidiophores 1-3 sept; 10-50 x 2-4 μm; conidia 1-5 septate, 15-75 x 2-3.5 μm]. Similarly, I. curcas is associated with two valid Cercospora species: C. jatrophica and C. jatrophicola. Both are clearly different from C. apii, as C. jatrophica shows significantly smaller conidia [2.5-4 x 40-85 against 2.5-5 x 100-300 μm of C. jatrophica] and conidiophores [4.5-5 x 40-70 against 3-6 x 150-400 μm of C. jatrophica]. Thus none fit in the broad species concept of C. apii defined by Crous and Braun (2003). Culture and DNA sequencing are in progress. Although incomplete this identification and record is important because the fungi are pathogenic and recorded in both hosts. Poster 1Universidade de Brasilia Asa Norte Brasilia 70910-900 Brazil. 2Embrazar Cerrados Rodovia BR 020, Km, 18 Planaltina 73310-970 Brazil.

DIAZENE, JOSE C.1, SANTOS, LEILA T. P. and PEREIRA-CARVALHO, RITA C.1. Cerrado biodiversity: the natural phylloplane mycobiont of Salacia crassifolia. Salacia crassifolia [Celastraceae Hippeastraceae] is a native plant from the Cerrado which shows a broad list of associate fungi, far above the numbers observed even in many species from our rain forests. The leaves are elliptical and relatively small (ca 6 x 2 cm) covered by a smooth waxy layer. Considering the proportion of 6 fungi per plant species adopted by Hawksworth in 1991, and still accepted as reasonable for the mycobiont from temperate regions, the mycobiont diversity present on leaves of S. crassifolia is exceptionally high. Indeed, it is similar to the fungal population on leaves of many Cerradot plant groups, e.g. Mauritia flexuosa [Palmae]. Tabeubia ochracea [Bignoniaceae], and Qualea grandiflora [Vochysiaceae] all three species with over 20 foliicolous species. In our study the phylloplane mycobiont of S. crassifolia already reached 40 fungal species, within 33 genera distributed among ascomycetes (Asterina, Chaetothyrina, Dysrhynchis, Didymella, Lembosia, Linotexis, Meliola, Mycosphaerella, Nectriopsis, Phaeostigme, Phragmeriella, Phyllachora, Schizothirium, Staibia, Stomiopeltis, Ulotriphysella, Ustilago), and 70 genera of basidiomycetes. In this community we have encountered at least 17 different species, 5 of which constitute the most abundant species, i.e., those that have an average of at least two detectable bands of the 6 bands established by Hawksworth (12-15 fungal species), for the 7,000 Cerrado plants, it is expected that between 84,000 and 100,000 fungal species would be present in the Cerrado ecosystem (2.5 million sq. Km, over 20% of the Brazilian territory), where presently less than 1500 species are known. The Salacia fungi studied were documented in this study and the new taxa detected will be submitted for publication. Oral 1Universidade de Brasilia Asa Norte Brasilia 70910-900 Brazil.
Colletotrichum gloeosporioides is a common fruit-rot pathogen of cranberry throughout the growing regions of North America. Reports of C. gloeosporioides from cranberry date to the turn of the 20th century with the work of C.L. Shear. Investigation into the genetic structure of C. gloeosporioides in wild and cultivated populations of cranberry and sympatric hosts reveals greater phylogenetic diversity than has previously been recognized. Phylogenetic analysis of DNA sequence data from ITS1-5.8S-ITS2, beta-tubulin, apr2, and apr2-matG3 resolves three distinct clades that infect cultivated and wild cranberry. The first clade contains the cranberry fruit-rot pathogen common within cultivated cranberry bogs and is resolved as sister to the coffee-berry pathogen, C. kahawae. The second clade is known only from wild cranberry and is closely related to C. nupharicola, a pathogen of Nuphar (pond-lily) and Nymphaea (waterlily). The third clade contains isolates thought to be recently introduced into cultivated cranberry. Preliminary results from pathogenicity tests indicate this third group is responsible for stem canker of cranberry, an emerging disease in cranberry propagation. The phylogenetic results are supported by the presence of fixed differences between Colletotrichum lori between the two clades of C. gloeosporioides sympatric on cultivated cranberry, indicating a lack of gene flow. Phylogenetic inference suggests the stem canker pathogen is closely related to an undersubtropical and tropical species within the C. gloeosporioides complex and currently represents the northermmost record for this clade. Poster 1City University of New York/New York Botanical Garden 200th Street and Southern Boulevard Bronx 10458 United States. 2USDA Systematic Mycology and Microbiology Laboratory 10300 Baltimore Avenue Beltsville 20705 United States. 3P.E. Marucci Center for Blueberry and Cranberry Research and Extension 125a Lake Oswego Road Chatsworth 08019 United States. 4The New York Botanical Garden 200th Street and Southern Boulevard Bronx 10458 United States.

DURALL, DANIEL1*, KLUFTINGER, AMY1 and STANLEY, GRANT1. Population dynamics of Saccharomyces cerevisiae during a guided fermentation. 
Saccharomyces cerevisiae is the yeast primarily responsible for the fermentation of wine. However, different strains of S. cerevisiae exist which may contribute to the fermentative process. In the North American wine industry, grapes are typically inoculated with a specific commercial strain of S. cerevisiae, in a process known as “guided fermentation”. Different yeast strains can have an influence on the sensory attributes of wine, and thus, wineries in North America invest significantly in yeast strains that have a history of use in fermentation. Traditionally, it is thought that the inoculated yeast strain is responsible for the entire fermentation process when guided fermentation is used. To investigate this assumption, using a microsatellite DNA fingerprinting technique to distinguish between different strains, it was tested whether an inoculated low-vigor strain (Lalvin® RC212) re-mained at the final stage of fermentation of a Pinot Noir wine produced at Qualis®
DURDEN, LEKEAH*, BAUCOM, DEANA and CREAMER, REBECCA. 
A study of the endophyte, *Undifilum*, and its interaction with plant pathogenic fungi. 
Oxypolis and Astragalus are toxic leguminous plants commonly referred to as locoweed. Locoweeds contain the fungus, *Undifilum* oxypotrix, which produces the toxic alkaloid salwasonine. The ingestion of this alkaloid creates severe neurological damage to mammals that graze upon it. It is still unknown whether the endophytic presence of this fungus provides any benefits to the plant. Antagonism between *Undifilum* and various fungal pathogens were assayed to understand if *Undifilum* protects its plant host from pathogenic fungi. *Undifilum* oxypotrix samples were isolated from *Oxypolis* sericea and grown on Potato Dextrose Agar (PDA) and Acidic Potato Dextrose Agar (APDA). Known fungal pathogens were individually plated with transfers of *U. oxypotrix* on different sides of the plates and allowed to grow for approximately two weeks, observing the relative interaction with and without the presence of the *Undifilum*. Growth of some pathogenic fungi seemed decreased. Since *Undifilum* is present within the seed, we isolated from the embryos, seed coat and seed coat minus embryo and analyzed members of the polyketide synthase (PKS) gene family. To date, the specific genes involved in the production of lichen compounds have not been characterized. We report the presence of PKS genes in lichen-forming fungi that have not been previously identified. Analysis of the plant transcriptome revealed dramatic changes in expression of host genes involved in pathogen defense, transposon activation, anticyanin biosynthesis and hormone biosynthesis/response. These results highlight the fine balance required to maintain mutualism in a plant-fungal interaction and the power of deep mRNA sequencing to identify candidate sets of genes underlying the symbiosis. Oral 1Massey University Riddett Road Palmerston North 4442 New Zealand. 2Oregon State University Department of Botany and Plant Pathology Corvallis 97331 United States. 3University of Kentucky Department of Plant Pathology Lexington 40546 United States. 4University of Minnesota, St. Paul 55114 United States.

FANKHAUSER, JOHNATHON* and SCHMITT, IMKE. 
Phylogenetic distribution of biosynthetic genes in Lichinales - insights into the evolution of secondary metabolism in lichenized fungi. The majority of lichen-forming fungi synthesize an array of secondary metabolites. Some taxonomic groups, however, are very poor producers, or do not synthesize any typical lichen compounds at all. One such group is the order Lichinales. The Lichinales are phylogenetically not closely related to the Lecanoromycetes, the ascomycete class that contains the bulk of lichen-forming fungi. To gain insights into the evolution of lichen compounds we generated sequences of biosynthetic genes of members of the Lichinales (non-producers) and compared them to those of members of the Lecanoromycetes (producers) in a phylogenetic framework. Since many lichen compounds are synthesized via the acetyl-polyketide pathway, we analyzed members of the polyketide synthase (PKS) gene family. To date, the specific genes involved in the production of lichen compounds have not been characterized. We reported the presence of PKS genes in lichen-forming fungi that do not produce any typical lichen compounds. Poster University of Minnesota, Dept. of Plant Biology 1445 Gortner Ave St Paul 55108 United States.

FANNIN, NEIL*†, LI, HUIHUA, KLOTZ, JAMES† and BUSH, LOWELL†. 
A simple tall fescue seed extraction and partial purification of ergovaline. There are several substances present in the tall fescue/endophyte association (Lolium arundinaceum/Neotyphodium coenophialum) that have biological activity. These include the pyrrolizidine and ergot alkaloids, plus peramine. Of these compounds only the ergot alkaloids have significant mammalian toxicity and the predominant type of ergot alkaloid and ergovaline. As part of developing a repeatable in vivo model for studying effects of endophyte-infected tall fescue in mammals, the diseases they cause, and management practices that can minimize the spread and severity of disease. Our website is being developed to provide science-based information to aid in the understanding and management of the world’s forest Phytophthora species. The website is geared towards forest managers as well as anyone who is interested in learning more about these fascinating pathogens. Forestry Plant Pathology of the World. www.ForestPhytophthoras.org

EICHEN, PEGGY ANN*, KISHORE, DEEPAK, WALDRON, MATTHEW, EVANS, TIM†, FRITSCHE, KEVIN† and SPIERS, DONALD†. 
Effect of subchronic heat stress and ergopeptine alkaloids on the immune system of rats. Research has shown that fescue toxicosis can impact immune function. A study was conducted to assess the combined impact of heat stress and ergopeptine alkaloids on the immune system. Rats received diets containing ergopeptine alkaloids (E+) (~32 ug ergovaline/kg BW/d), no alkaloids (E-), or pair-fed (PF to E+) using the alkaloid-free diet). Each diet group was further divided into temperature treatments of thermoneutrality (TN; 21°C) or heat stress (HS; 33°C). Rats received diet treatments at TN for 1 week followed by 21 days in HS or TN environments. Blood samples were performed intravenously to measure total lymphocytes, neutrophils, and T and B lymphocytes to record core temperature (Tc). Blood samples collected at the end of the study were analyzed using flow cytometry for various lymphocyte percentages (%), which include T cells, NK cells, B cells, and CD8+ and CD4+ T cell subsets. Daily feed intake of E+ rats averaged 2 g below E- in both environments during the last treatment week (P<0.05). Moreover, Tc of E+HS rats was more than 0.7°C above E-HS level at the end of the treatment period (P<0.05). T cell % of total lymphocytes in E+ HS group showed a modest decrease (P<0.05) compared to all the other heat stress and E-TN groups. CD8+ and CD4+ cell % was highest in E-HS, while caloric restriction combined with heat stress reduced the percentage to half that of E-HS (P<0.05). B cell and NK cell % were not different among treatment groups. In summary, we noted several significant effects of heat stress on the T cell compartment of an immune system. Some effects were independent of exposure to ergopeptine alkaloids, and none were a specific consequence of reductions in food intake associated with heat stress or fescue toxicosis. (USDA Agreement No. 58-6227-3-016) Key words: Endophyte, heat stress, caloric restriction, immune system. Poster 1University of Missouri 920 E Campus Dr Columbia 652115300 United States. 2University of Missouri D217 Veterinary Medical Diagnostic Laboratory Columbia 652115300 United States.
malian systems, we developed a simple seed extraction and partial purification protocol for ergovaline/ergovalinine that provided a biologically active product. Tall fescue seed were ground to pass a 2 mm sieve and were carefully packed into a 30 cm x 80 cm column. The bottom of the column contained approximately 4 cm of glass nuggets covered with an expanded metal screen and a Miracloth filter to keep ground seed above the glass nuggets. Approximately 25 kg of seed could be extracted in the column each time. Extraction solution was 80% ethanol and sufficient volume was added to fill void volume (~38 L) over ~ 6 hr. When solvent front migrated to bottom of the column, flow was stopped and seed steeped for at least 12 hr. Column was eluted with 80% ethanol at 2 L hr⁻¹ for 25 hr. Ethanol was removed from the eluate in the dark by evaporation at room temperature. Resulting syrup was freeze-dried. About 90% recovery of alkaloids was achieved with 18-fold increase in concentration. This dried product was extracted with hexane/water (6:1, v/v) and the hexane discarded. The aqueous layer was extracted with chloroform, aqueous layer discarded and the chloroform was removed. Residue from the chloroform was freeze-dried and about 50% of ergovaline was recovered. Similar results were obtained with ergovalinine. The partially purified ergovaline had biological activities in vivo and in vitro bovine bioassays that approximate that of synthetic ergovaline. 

FINCH, SARAH¹*, FLETCHER, LESTER² and BABA, JACOB¹. The evaluation of endophyte toxin residues in sheep fat. To assess whether a toxin or contaminant could pose a threat to human health both toxicological data and an estimate of how much could be ingested as part of the human diet needs to be determined. A toxicological trial in mice has provided data on the toxicology of lolitrem B and epoxy-janthitremes but although the presence of these toxins in animal fat has previously been shown, insufficient information on amounts in food is available to allow risk assessment. The current study tracked the levels of lolitrem B and epoxy-janthitremes in the fat of sheep grazing wild-type and AR37-endophyte infected perennial ryegrass, respectively, over an entire ryegrass staggers season using fat biopsy methods. This research shows that endophyte toxins do not accumulate in sheep fat and are quickly eliminated when pasture toxin levels decrease. This suggests that levels in animal fat are unlikely to reach levels high enough to pose a genuine threat to human health. 

FINCH, SARAH¹*, WILKINS, ALISTAIR², POPAY, ALISON², BABU, JACOB¹, TAPPER, BRIAN¹ and LANE, GEOFF². The isolation and bioactivity of epoxy-janthitremes from AR37 endophyte-infected perennial ryegrass. Despite not producing the common endophyte tremorgen, lolitrem B, AR37 endophyte-infected perennial ryegrass has been associated with sporadic outbreaks of ryegrass staggers. This was thought to be due to the presence of compounds structurally similar to lolitrem B, the epoxy-janthitremes. Research on these compounds has been hindered by their extreme instability but these issues have now been overcome by the careful selection of solvents and the use of an anti-oxidant during the purification process to yield four epoxy-janthitrem compounds. 1D- and 2D- NMR spectroscopy has allowed the chemical structures of these compounds to be determined and a full NMR assignment to be completed. The major epoxy-janthitrem compound has also been tested for effects on mice and insects (porina). Testing in mice showed it to be a low potency tremorgen which induced a prolonged tremor effect. This is the first time that a tremorgen, outside the lolitrem class of compounds, has been found to induce tremor of this duration. Testing in porina showed it to reduce feeding and weight gain. These results suggest that the epoxy-janthitremes are involved in both the staggers syndrome and insecticidal effects observed on AR37 endophyte-infected perennial ryegrass. 

FLETCHER, LESTER¹. Novel endophytes in New Zealand grazing systems - the perfect solution, or a compromise. Abstract: Identification of considerable diversity in Neotyphodium endophytes and their alkaloid profiles presented a potential to exploit these endophytes to improve pastoral production systems. The early selection criteria for potentially useful endophytes was absence of the toxins ergovaline and lolitrem B in ryegrass/endophyte associations and absence of ergovaline in tall fescue/endophyte associations and later also in their ryegrass hosts. A number of strains met these criteria, and currently the most widely used are AR1 and AR37 in ryegrass and AR542 in tall fescue. AR1 has excellent animal health and productive qualities but has some short coming in resistance to insect pests, when compared to standard endophyte controls. AR37 has exceptional agronomic and bio-protective properties but can cause some ryegrass staggers, despite the absence of lolitrem B. Other ryegrass endophyte strains, AR5 and NEA2 are not completely free of toxins but have found a place as significant improvements over wild-type in terms of livestock welfare, but superior to AR1 in terms of insect resistance. AR542 in tall fescue eliminated all problems with fescue toxicosis when crossed with an expanded type dark green screen and a Miracloth filter to keep ground seed above the glass nuggets. Approximately 25 kg of seed could be extracted in the column each time. Extraction solution was 80% ethanol and sufficient volume was added to fill void volume (~38 L) over ~ 6 hr. When solvent front migrated to bottom of the column, flow was stopped and seed steeped for at least 12 hr. Column was eluted with 80% ethanol at 2 L hr⁻¹ for 25 hr. Ethanol was removed from the eluate in the dark by evaporation at room temperature. Resulting syrup was freeze-dried. About 90% recovery of alkaloids was achieved with 18-fold increase in concentration. This dried product was extracted with hexane/water (6:1, v/v) and the hexane discarded. The aqueous layer was extracted with chloroform, aqueous layer discarded and the chloroform was removed. Residue from the chloroform was freeze-dried and about 50% of ergovaline was recovered. Similar results were obtained with ergovalinine. The partially purified ergovaline had biological activities in vivo and in vitro bovine bioassays that approximate that of synthetic ergovaline. 

Poster 1University of Kentucky Dept Plant & Soil Sciences Lexington 40546-0312 United States. ²ARS FAPRU Lexington 40546-0091 United States. 

FLOYD, SIMONA¹*, MACHADO, CAROLINE¹ and SCHRDL, CHRISTOPHER L². Cre/lox system: a practical tool to efficiently eliminate selectable markers in fungal endophytes. The aim of this study was to obtain a nontoxic Neotyphodium coenophialum endophyte free of marker genes that could be used to inoculate popular tall fescue cultivars. Therefore here we describe a new method, based on the Cre/lox system, developed to eliminate the selectable marker gene and generate fungal strains devoid of any foreign genes. N. coenophialum, living in a mutualistic association with tall fescue, can have counteracting agricultural consequences, increasing plant productivity and tolerance to different stresses, yet producing ergot alkaloids associated with livestock toxicity. N. coenophialum e19, harbors dnaW1 and dnaW2, two homologues of a gene that codes for the enzyme diketopiperazine synthase. To address the toxicosis problem, we genetically manipulated N. coenophialum by knocking out the dnaW2 gene encoding dimethylallyltryptophan synthase. Subsequently, we applied the Cre/lox system to eliminate the floxed phosphotransferase (hph) gene (fox²:³:hph:loxP) by transfecting protoplasts with a Cre recombinase expression plasmid, then cultured on media without selection. Marker elimination was achieved for 0.5% of the colonies which allows the reuse of the selectable marker for sequential transformations. This method will reduce concerns related to field release of agronomicaly important grasses harboring manipulated fungal strains. 

Poster ¹University of Kentucky 201F PSB, 1405 Veterans Drive Lexington 40546-0312 United States. ²University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States.

FOLTZ, MATTHEW¹*, PEREZ, KATHRYN and VOLK, THOMAS. Determining the identity of chanterelles in the midwestern United States. Chanterelle mushrooms are highly sought-after choice edibles in many countries around the world because of their delicious taste and fruity odor of apricots. The common golden-yellow chanterelle (Cantharellus cibarius sensu lato) found in many parts of the world was once considered a single species. However, it is now known that this species is a complex of several species with great variation in many ways, both macroscopically and microscopically. Although several cryptic species have recently been identified in the Northwestern United States, the identity of the chanterelles in the Midwestern United States is not well understood. The objectives of this study are to determine how chanterelles from Wisconsin are related to chanterelles from other regions of the United States and Europe and also to determine if the chanterelle currently being called Cantharellus cibarius in the Midwest is an undescribed species. Information from the nuclear large subunit (nLSU) rDNA and mitochondrial small subunit rDNA (mt-SSU-rDNA) is compared between Wisconsin chanterelles and chanterelles from other regions to determine their phylogenetic relationship. Macro- and micro-morphological comparisons are also used to support genetic information. 

Poster University of Wisconsin - La Crosse 1725 State Street La Crosse 54601 United States.

FOOTE, ANDREW¹*, KLOTZ, JAMES², BUSH, LOWELL¹, STRICKLAND, JAMES² and HARMON, DAVID¹. An extract of endophyte infected tall fescue seed induces vasokonstriction of bovine foregut vasculature. An ethanol extract of tall fescue seed was produced to further understand the interactions of toxic compounds that cause fescue toxicosis. We hypothesized that the combination of alkaloids present in the extract would have a greater vasokonstrictive response than individual alkaloids. The objective of this study was to compare the vasokonstrictive response of right ruminal artery and vein to ergovaline (ERV), l-lysergic acid (LSA), and an extract (EXT) adjusted to a measured ERV concentration. Segments of right ruminal artery and vein were collected from the ventral coronary groove of predominately Angus heifers (n=10) shortly after slaughter and placed in a modified Krebs-Henseleit buffer. Vessels were exposed to connective tissue and fat, sliced into 2-3 mm segments and suspended in a multi-myo-
graph chamber with 5 mL of continuously oxygenated Krebs-Henseleit buffer (95% O2/5% CO2; pH 7.4; 37°C). Arteries and veins were equilibrated to 1.0 g and 0.5 g respectively for 90 min following by addition of 120 mM KCI. Increasing concentrations (10-11 to 10-6M) of each compound were added to the respective chamber every 15 min following buffer replacement. Data were obtained as a fraction of the contractile response induced by KCl and were analyzed as a completely randomized design using PROC MIXED of SAS. Contractile response was greater in the artery than vein for ERV and EXT (P<0.05) but not LSA. Increasing concentration of LSA did not affect contractile response in either vessel (P>0.05). The maximum contractile response observed was higher for EXT than ERV for the artery (P<0.05). The greatest numrail veins response to EXT was seen at 10-7M which was greater than ERV at equal concentration (P<0.05) and was similar to 10-6M ERV. These data indicate that the combinatorial effect of alkaloids is greater than individual alkaloids and that ERV is not solely responsible for fescue toxicosis symptoms. 

**Poster**

1University of Kentucky 803 W.P. Garrigus Bldg. Lexington 40546-0215 United States. 2ARS FAPRU Lexington 40546-0091 United States. 3University of Kentucky Dept Plant & Soil Sciences Lexington 40546-0312 United States. 4USDA, ARS-FAPRU N-220 Ag North Building Lexington 40546-0091 United States. 5University of Kentucky 814 W.P. Garrigus Bldg. Lexington 40546-0215 United States.

**FORESTER, NATASHA**1*, **FRASER, KARL**1, **GAGIC, MILAN**1, **JOHNSON, RICHARD**2, **LAMONT, IAIN**2, **LANE, GEOFF**2, **RASMUSSEN, SUSANNE**1 and **LINDA1**1. **Mutualism in a single-race fungal endophyte: the Arms wrestle for iron.** Both mutualistic and pathogenic fungi invade and colonise their host plants to establish successful infections, albeit leading to different outcomes. Recently, we discovered that fungal siderophores are required for maintaining mutualistic grass-endophyte associations which is in stark contrast to pathogenic fungi that are unable to cause infection in their absence. Our research seeks to unravel how fungal siderophores, whereby loss of fungal siderophores can cause a pathogen to become non-pathogenic and a symbiont to become pathogenic, through fundamental studies into the role of siderophores in iron homeostasis during symbiosis. Siderophores are low molecular weight ferric iron chelators that are secreted and are obligatory for obtaining the essential nutrient, iron, from plant hosts. In a project to unravel how grass endophytes provide their hosts with protection from various biotic and abiotic factors, we discovered that absence of a siderophore (epichloëin) from the fungal endophyte Epichloë festucae resulted in stunted Lolium perenne plants which occasionally died. Host endophyte growth was also aberrant in these plants. The symbiotic plants may be able to utilise siderophore sequestered iron based on a unique observation whereby a modified epichloëin product (where the iron has been reduced and removed) was observed only in infected plants and not in culture. We hypothesise that disruption of iron homeostasis in the endophyte-grass symbiont is a factor in the biosynthesis breaking down. 

**Poster**

1AgResearch Grasslands Tennent Drive Palmerston North 4442 New Zealand. 2Otago University, Department of Biochemistry 710 Cumberland Street Otago 9054 New Zealand.

**FRIBOURG, HENRY**1*, **HANNAWAY, DAVID**2 and **WEST, CHARLES**1. **Tall fescue for the Twenty-first Century - the book and online.** Tall Fescue for the Twenty-first Century was published recently by the American Society of Agronomy and the Crop Science Society of America, and is also available in color on the Internet. Tall fescue is the most important cultivated pasture grass in the USA and is increasingly important in other humid temperate regions. Its usual infection by Neotyphodium coenophialum results in many good and bad consequences. The presentation will be an overall view of the topics in the 29 chapters of the book by 59 authors: origin, history, and classification; ecological suitability and adaptation; methods for establishment and management; pests and control methods; utilization, quality and antiquity factors; genetic improvement; seed production and marketing; and turf and conservation uses. 

**Poster**

1Univ of TN 7421 somerset rd Knoxville 37909 United States. 2Oregon State Univ Dept. Crop & Soil Science Corvallis 97331 United States. 3Univ of Arkansas Dept Crop, Soil & Envir Sci Fayetteville 72704 United States.

**GAGIC, MILAN**1*, **FAVILLE, MARTY, KNAPP, KURTIS, MACE, WADE and JOHNSON, RICHARD.** **Endophytic fungi as vehicles for delivery of fibre degrading enzymes.** The development of grass-endophyte associations has transformed pasture agronomy and livestock husbandry in NZ. This interaction has been utilized with the favourable plant traits such as plant persistence and insect deterrence. Due primarily to plant-protective alkaloids that fungal endophytes produce in plants, this interaction has been extensively studied and exploited commercially using selected endophyte strains such as the ryegrass endophyte AR1TM. A commonly perceived risk associated with transgenic plants relates to the dispersal of transgenic pollen. Fungal endophytes may contribute to a solution to this challenge, in that endophyte is not transmitted in pollen. In both Epichloë and Neotyphodium species, fungal hyphae grow intercellularly in the floral meristem and in the ovules of the florets where the seed is infected and the fungus is transmitted vertically to the next generation of the host plant via seed only. Furthermore, various fungi have highly efficient enzymatic systems for lignocellulose degradation which makes fungal endophyte an ideal vehicle for delivering fungal fibrolytic enzymes to the rumen. We propose a novel avenue for improving the rumen function by using genetically engineered fungal endophytes to improve digestibility of perennial ryegrass (Lolium perenne L.) with the aim of increasing voluntary feed intake and energy availability from ingested grass. We have engineered fungal endophytes of ryegrass to express three key enzymes that degrade structural components of grass fibre. Cellulase D (CelD) and xylanase A (XynA) from the rumen anaerobic fungus Neocallimastix patricianum randomly cut out oligosaccharide chains from cellulose and hemicelluloses respectively with ferulic acid esterase A (FaeA), from Aspergillus niger. 

**Poster**

AgResearch Grasslands Tenent Drive Palmerston North 4442 New Zealand.

**GARRIGA, ROCIO**1*, **SALADINI, CARLA**1 and **BAYMAN, PAUL**3. **Mycorrhizal specificity of the invasive orchid Oeceoclades maculata in Puerto Rico.** The terrestrial orchid Oeceoclades maculata is found throughout Puerto Rico and the Caribbean. Originally from Africa, it may be the most common orchid in the world. This success has been attributed to self-pollination, but may also be due to its relationship with mycorrhizal fungi. Low specificity could help the orchid colonize different landscapes. The outer (ERV) and inner (EXT) tubeotrichs mediate the specificity for iron. 

**Poster**

1University of Puerto Rico P.O. Box 23360 San Juan 00931-3360 Puerto Rico. 2University of Puerto Rico O.P. Box 23360 San Juan 00931-3360 Puerto Rico.
a BLAST server containing partial translation elongation-factor 1-alpha (tef) DNA sequences of Fusarium species, which allowed users around the world to use tef DNA sequences to make connections between isolates of interest and known cultures publicly available in culture collections. FUSARIUM-ID (http://isolate.fusarium.org) has now been expanded to include over 1800 isolates of Fusarium, each with sequence data from one or more of thirteen different loci. Each isolate in the database is available from one or more international culture collections. New features include downloadable datasets, tree-building on the fly, and virtual RFLPs. We are currently working to expand FUSARIUM-ID into an online community platform that integrates expertise, data and knowledge resources to support global Fusarium research and education.

Poster presentations

DePARTURE: Biodiversity and Function in Natural Communities

Diversification of the Host Plant Without Impacting Its Neutral Genetic Structure. Our study shows that the endophyte/grass symbiosis contributes to the adaptive potential of the "eastern" population (100% endophyte infection) originating from the wettest site. The population infection patterns are equivalent to those obtained with direct fusions. At least 15 distinct proteins and another 400 are at various stages of the pipeline. We have found that fusions generated using the Gateway system yield localization patterns that are equivalent to those obtained with direct fusions. At least 15 distinct proteins are being identified and examples are presented.

Poster University of Kentucky, Dept. Pathology Plant Science Bldg., 1405 Veteran's Dr. Lexington 40546 United States.

GRAND, LARRY**, GENTRY, DEMONICA1, CODY, BRYAN1, TAYLOR, NICK1, MCCORMICK, MEGHAN1, VERNIA, CAROLINE1 and CUBETA, MARC2. Research and educational use of North Carolina State University mycological herbarium through improved computerization and internet presence. The mycological herbarium at North Carolina State University was established in 1970 and has approximately 8,000 specimens. The collection consists primarily of plant pathogenic and wood decay fungi sampled from ecologically diverse and unique habitats that include the Southern Appalachian mountains, Nags Head Woods, the largest contiguous maritime forest on a barrier island in the eastern US, and one of the two remaining areas of the longleaf pine ecosytem in North Carolina. A user-friendly, internet searchable database with accompanying baseline information is currently being developed to provide educators and scientists with easy access to the collection and is available at the following website http://www.cals.ncsu.edu/plantpath/activities/labs/projects/myherb1. The project involves data capture from existing herbarium records, storage and long term archiving, hosting of the Specify database and website, and participating in the National Biological Information Infrastructure and Global Biodiversity Information Facility. An educational outreach program for high school biology teachers and students mainly from underrepresented and low socioeconomic populations in North Carolina is also being developed. This program is integrally linked to the herbarium database and will focus on the development of a workshop and collaborative, inquiry-based assignments for high school students to foster a better understanding of the biogeography, ecology, and genetic diversity of fungi.
that the endophyte may depress host fitness under restrictive conditions, which has been interpreted as a cost for the host in maintaining the symbiont. Whether this cost may impact the endophyte fitness is unknown. Endophyte fitness is determined by host seed production and the proportion endophyte-infected seeds (transmission rate). While the former has been widely studied, the latter has received very little attention. Here, we explore the relationship between endophyte transmission rate and seed production considering individual spikes and whole plant levels using Loli um multiflorum annual grass and Neotyphodium oc culants as a study model. We analyzed two data sets. The first one includes the transmission rate and seed production per plant of 94 individual plants. Variability in seed production per plant was obtained by subjecting the plants to different resource and stress levels. The second set includes the transmission rate and seed production per spike of 74 individual spikes. Variability in seed production per spike was obtained by subjecting plants to simulated grazing (defoliation and trampling). We found a positive correlation between transmission rate and seed production for both, individual plants (r = 0.27, P = 0.009) and spikes (r = 0.43, P = 0.001) data sets. Transmission rate was highest (>1) and invariant in plants or spikes with high seed production. On the other hand, transmission rate was variable in low seed production plants and spikes. Our results suggest that there could be a threshold of host fitness value (in terms of seed production) below which the endophyte-grass symbiosis could be at risk. Poster IFEVA (CONICET-Facultad de Agronomía/UBA) Av. San Martin 4453 Ciudad. 1Lab. Ecotono, INIBIOMA-CONICET and Centro Regional Universitario Bariloche, Universidad Nacional del Comahue Quintral 1250 S. C. de Bariloche 8400 Argentina.

GUTHRIDGE, KATHRYN*, EKANAYAKE, PIYUMI, FORSTER, JOHN and SPANGENBERG, GERMAN. Global genetic diversity in fungal endophytes of tall fescue. Tall fescue (Lolio n arundinaceum [Schrebr.] Darbysh.) is generally reported to associate with the endophyte Neotyphodium coenophialum. In addition, two other taxonomic groups, FaTG-2 and FaTG-3, morphologically distinct to N. coenophialum have been identified as forming symbiotic associations with tall fescue. To gain an understanding of the naturally occurring variation in tall fescue endophytes, germplasm was collected from the range of natural growth spikes. Our results suggest that there could be a threshold of host fitness value (in terms of seed production) below which the endophyte-grass symbiosis could be at risk. Poster IFEVA (CONICET-Facultad de Agronomía/UBA) Av. San Martin 4453 Ciudad. 1Lab. Ecotono, INIBIOMA-CONICET and Centro Regional Universitario Bariloche, Universidad Nacional del Comahue Quintral 1250 S. C. de Bariloche 8400 Argentina.

GUTHRIDGE, KATHRYN*, LITIPBAYEVA, GALIYA, ROCHEFORT, SI-MONE, FORSTER, JOHN and SPANGENBERG, GERMAN. Anti-fungal properties of pasture grass fungal endophytes. Fungal species of the genus Neotyphodium form endophytic symbioses with agronomically important pasture grass species such as perennial ryegrass (Lolium perenne L.) and tall fescue (Loli um arundinaceum [Schrebr.] Darbysh.). The fungal mycelium grows within the intercellular spaces, especially within the leaf base and leaf sheath, and is asexually propagated through colonisation of seeds. Fungal grass endophytes produce both beneficial (tolerance to abiotic stresses such as drought, deterrence of invertebrate herbivores) and deleterious effects (toxicity to mammalian herbivores) for pasture grass production. Neotyphodium endophytes are largely unexplored in terms of their production of novel antimicrobials. While some Epichloë/Neotyphodium endophytes have been shown to inhibit the growth of plant-pathogenic fungi in vitro, the inhibitory substances produced have not been identified. Endophytes with anti-fungal properties may benefit host plants by preventing pathogenic organisms from
colonying them and causing disease. To determine if endophytes of the genus Neotyphodium produce anti-fungal compounds in vitro and in planta, strains of N. lolii, LpTG-2, N. coenophialum, N. uncinatum and two novel endophytes were tested for the presence of anti-fungal activity against eight fungal species of plant pathogens. The bioassay results showed that endophytes in vitro exhibit variation in anti-fungal activity that does not correlate with known toxin (specifically, lolitrem B, ergovaline and peramine) production. Variation was also observed among genetically distinct strains within N. lolii. Inhibition of fungal growth by endophyte was also demonstrated in plants using plant extracts from endophyte inoculated host plants. Mass spectrometry (LCMS) was used to determine a relationship between anti-fungal activity and the expression of metabolites to identify potential compounds that are active against plant pathogenic fungi. Poster. Victorian Department of Primary Industries 1 Park Drive Bundoolo 3083 Australia.

HAERRI, SIMONE*, GOMES, SHARLENE and NEWMAN, JONATHAN A.1. Controlling for genotype variability: Effective removal of endophyte infection in tillers of tall fescue. The Neotyphodium sp. endophyte - plant symbiosis is not only of applied interest to agriculture, but represents an interesting ecological and evolutionary model system. The system offers, for example, the possibility to study ecological aspects such as the effect of species interactions on the structure and dynamics of systems, or to address evolutionary questions such as genotype-by-environment interactions and the role of symbiosis on speciation. However, for such approaches, it is crucial to be able to experimentally control genetic variation within the system, i.e. to control the endophyte genotype. To control endophyte infection, we create endophyte-infected plants with the same genotype as endophyte-free plants, clonal tillers of 12 different endophyte-infected plant genotypes were treated with different concentrations of the fungicide propiconazole. The goal was to find the concentration that would remove the endophyte from some but not all of the replicates, and also not kill the plant tillers. Additionally, we measured several plant performance parameters to test for the effect of the fungicide on plant growth. After 24 weeks, plants were tested for endophyte infection. We found that the effective removal of the endophytes was dependent on the fungicide concentration and, importantly, also on the plant genotype. At higher concentrations, endophytes were completely removed from all replicates, independent of plant genotype. However, the lowest concentration produced the desired result for most of the plant genotypes by killing the endophytes in only some of the replicates. This concentration also had the weakest effects on plant performance, in contrast to the higher concentrations where plant biomass and number of produced tillers were significantly reduced. The endophyte-infected and the endophyte-free tillers from the lowest concentrations will be used for future experiments investigating the community-wide impact of plant fungal endosymbionts and their role in mediating evolutionary processes. Poster School of Environmental Sciences University of Guelph Guelph, ON N1G 2W1 Canada.

HALL, SARAH L.1*, MCCULLEY, REBECCA1 and PHILLIPS, TIMOTHY D.1. Effects of fungal endophyte symbiosis, prescribed fire, and water availability on tall fescue growth. Prescribed fire (alone or in combination with herbicide) is frequently used to help restore tall fescue pastures to native warm season grassland, with the goals of reducing tall fescue growth/dominance while simultaneously encouraging native grassland species. Tall fescue pastures in Kentucky frequently host Neotyphodium coenophialum, an aboveground fungal endophyte thought to improve the environmental stress tolerance and competitiveness of host plants (E+) over neighboring uninfected plants (E-) and other plant species. To assess how this symbiosis interacts with fire and water availability to determine plant growth, we performed a completely randomized full factorial design with three factors: fire treatment (control), and watering regime (dry vs. wet). Six replicate tall fescue individuals were evaluated in each treatment. Biomass (above and belowground) of tall fescue was uniformly greater in wet vs. dry watering regimes. Within the dry treatment, there was no significant difference in biomass between E+ and E- individuals regardless of burn treatment. Within the wet treatment, biomass was significantly greater for E- compared to E+ for the 1 burn treatment only (p=0.02). Overall, tall fescue growth was enhanced by the 1 burn vs. the 2 burn treatment (p=0.012) for the wet regime, but there was no difference within the dry regime. Our results suggest that fire alone does not significantly reduce tall fescue cover: even the 2 burn treatment did not reduce tall fescue growth below that of the control. Greater E- tall fescue growth following a single fire under a wet watering regime (compared to E+) suggests endophyte infection may have a positive role in allowing E- plants to be more competitive in these conditions. We did not observe expected higher growth in E+ plants over E- under limited water conditions, nor can we explain this finding. Poster. 1Kentucky State University Atwood Research Facility / 400 E. Main St. Frankfort 40601 United States. 2University of Kentucky Ag Science North Lexington 40546-0091 United States. 3University of Kentucky Plant Sciences Bldg. / 1405 Veterans Dr. Lexington 40546-0312 United States.

HALLEN-ADAMS, HEATHER*, GUENTHER, JOHN and TRAIL, FRANCES. The role of lipids in successful overwintering and subsequent perithecium production by Fusarium graminearum. Lipids play numerous vital roles in all known organisms, ranging from their involvement in membrane structure to cell signalling to stress response. In Fusarium graminearum (teleomorph Gibberella zeae), the causal agent of head blight of wheat, barley and other small grains, lipids are crucial for perithecium development. Perithecium initials (the overwintering structures) and subtending hyphae harbor large lipid bodies. We determined fatty acid composition of hyphae during an in vitro sexual development time course using proton NMR and GC-FID. Lipids in the hyphae were primarily in the form of triacylglycerides (TAGs), with C18:1, C18:2 and C16:0 fatty acids predominating. Additionally, we have scrutinized the expression of lipid biosynthesis and degradation genes during sexual development in vitro and in planta using Affymetrix GeneChip microarrays. Both lipid quantification and transcriptomic data show lipids synthesized in the early stages of both plant colonization and in vitro sexual development, and utilized as perithecial development progresses. Poster. Department of Plant Biology Michigan State University East Lansing 48824 United States.

HAN, KU1*, MO, JI-BO2, HOU, XI1, JI, YANLING1 and WANG, ZHIHEW. Prevalence of NRPS genes in China-native Epichloë/Neotyphodium complex. Epichloë/Neotyphodium complex has close association with cool season grasses from Pooidaeae and confer a series of biotic resistance from insect feeding deterrent to disease resistance. NRPS (Non-ribosomal peptide synthetase) genes were detected by non-ribosomal peptide synthetase (NRPSs). According to Johnson et al. (2007), the specific primers designed for 13 different NRPS genes, we detected the NRPS genes in 20 fungal strains isolated from grasses belonging to genera of Agrostis, Brachypodium, Bromus, Calamagrostis, Elymus, Festuca, Roegneria and Poa grown in China. In the result of 12 selected NRPS genes were detected in Chinese native epichloë endophytes. Especially, NRPS6 was observed in all detected epichloë isolates. Except Po6102, all other isolates had NRPS2, NRPS5, NRPS8, NRPS9, CPS1 and AC202 gene partials. lpsA, the gene responsible for synthesizing the peptidyl chain of ergot alkaloid, showed to be absent in all Chinese native endophytes. However, on the contrary to lpsA gene, lbpS gene had discrete distribution in fungal isolates tested. NRPS genes are quite common in Chinese native endophytes while their distribution lacks continuum among all isolates. The distribution of detected NRPS genes indicated difference in strains and geographic origins. *: This work was fully supported by the National Natural Science Foundation of China (No. 30670008 and No. 30970081). Poster College of Life Sciences, Nanjing Agricultural University, Weigang 1 Nanjing 210095 China. 2Nanjing Agricultural University No1,Weigang Nanjing 210095 China.

HEALY, ROSANNE*, BONITO, GREGORY2, GUEVARA, GONZALO1 and MCLAUGHLIN, DAVID1. Spore wall development informs interpretation of spore ornamentation and phylogeny in the truffle genus Pachyphloeus. Pachyphloeus isan ectomycorrhizal truffle genus distributed throughout temperate mostly Fagaceae woods in the Northern Hemisphere. A phylogeny inferred from ITS and LCU15 sequence data placed the genus in the family Pachyphloaceae, although several species were not well supported by this data. The goal of this study was to find phylogenetically informative spore morphology. We examined all taxa in the genus as well as outgroups in families related mostly Fagaceae woods in the Northern Hemisphere. A phylogeny inferred from ITS and LCU15 sequence data placed the genus in the family Pachyphloaceae, although several species were not well supported by this data. We determined the function of spore ornamentation viewed with SEM. We found a general congruence between spore wall ornamentation and inferred lineage. There are at least five different types of spore ornamentation. Implications regarding the evolution of spore character states in the genus are discussed. Poster. University of Minnesota 1445 Gortner Ave., 250 Biological Sciences St. Paul 55108 United States. 2Duke University 136 BioSci Science Drive Durham 27708 United States. 3Instituto Tecnologico de Ciudad Victoria Av. Portes Gil 1301 pte. Ciudad Victoria 87100 Mexico. 4University of Minnesota Plant Biology Department St. Paul 55108 United States.

HELANDER, MARJO*. Invasiveness of endophyte infected tall fescue in Europe and North America. Tall fescue, Festuca arundinacea, is the most widely grown and economically important forage grass in US, while the species origin lies in Eurasia. Furthermore, tall fescue has been used as a model species when examining the relationship between endophytic fungus and its host grass. Generalizations considering mutualism between host and fungus are based on experiments performed with few agonistic isolates. Surprisingly little is known about the effects of endophytes on natural tall fescue

Continued on following page
populations and performance of tall fescue in varying environmental conditions. We performed two identical common garden experiments, one in southwestern Finland and one in Kentucky, USA, between years 2005-2007. Both experiments were conducted with five different tall fescue origins, three wild populations from northern Europe (two islands and mainland) and two cultivars (‘Kentucky-31’ and ‘Retu’) applying nutrients (N), water (W) or their combination (WN). In both experiments, we used naturally endophyte-infected (E+) and endophyte free (E-) plants, and plants from where the endophyte was manipulatively removed (ME-). Cultivar ‘Retu’ is naturally endophyte free. Our results show that endophyte infection increases tall fescue performance in general, but there is high variation in benefits of endophytes to plant performance and reproduction among tall fescue origins under different environmental conditions. 

Poster University of Turku Dept. Biology Turku 20014 Finland.

HERNANDEZ KENDALL, V.*, Aflatoxin production in strains of Aspergillus flavus isolated from various substrates. Aflatoxins are mycotoxins produced by Aspergillus flavus and related species. They are mutagenic, toxic and immunosuppressive. A. flavus is a ubiquitous saprophyte and opportunistic pathogen which has been isolated from various substrates and ecosystems. The purpose of the present investigation is to determine whether isolates from marine substrates and clinical isolates produce aflatoxins in vitro, and whether there is a link between substrates and aflatoxin production. Tested strains were isolated from air, soil, water, and sea fan tissue, in Puerto Rico as well as clinical isolates from patients with fungal infections that were grown at A&M and all marine isolates in 37°C, and all marine clinical isolates did not produce aflatoxins. Results so far demonstrate no specific substrate-aflatoxin relationship. 

Poster University of Puerto Rico Department of Biology Rio Piedras Campus San Juan 00936 Puerto Rico.

HERRERA, CESARI*, SAMUELS, GARY J.; ROSSMAN, AMY Y.; and CHAVERRI, PRISCILA. Phylogenetic relationships of Cosmospora vilior sensu lato and related species. Cosmospora vilior sensu lato is a neotropical fungus that has been characterized by its tuberculate ascospores, occurrence on the surface of the stroma of xylariaceous fungi, and anamorph, Acremonium berkeleyanum, which produces a greenish colony. Cosmospora vilior sensu stricto differs from C. vilior s. l. by occurring on xylariaceous fungi and is only known from the type specimen; its anamorph and culture characters are unknown. Cosmospora vilior has also been reported on other substrata including polyporaceous fungi, bark, and a new record of substrate, bone. The objective of this research was to determine phylogenetic relationships of C. vilior s. l. based on molecular and morphological characters. Phylogenetic relationships were determined using 3,608 characters from six genes (ITS, LSU, rp1, act, tub, tef1) for 38 strains. Cosmospora vilior s. l. is a paraphyletic. Phylogenetic analyses indicate a core clade (C. vilior s. l.) consisting of several lineages occurring on xylariaceous fungi. If Cosmospora vilior is restricted to collections found on xylariaceous fungi, then Cosmospora viliuscula is available for collections that occur on xylariaceous pyrenomycetes. New species and combinations will be proposed. 

Poster University of Maryland, Department of Plant Sciences and Landscape Architecture 2102 Plant Science Building Park 20742 United States. 2USDA-ARS, Systematic Mycology and Microbiology Laboratory 10300 Baltimore Avenue, B-011A, Rm. 301 Beltsville 20705 United States. 3United States Department of Agriculture Systematic Mycology and Microbiology lab 10300 Baltimore Blvd. Beltsville 20705 United States. 4University of Maryland 2112 Plant Science Building College Park 20742 United States.

HERRERO, NOEMI and ZABELGOAZCOA, INIGO. Viruses infecting the entomopathogenic endophyte Tolypocladium cylindrosporum. The associations between fungal viruses and their hosts are similar to plant-endophyte associations. Usually they do not cause obvious symptoms on their hosts. Only a few mycoviruses are known to affect their hosts, causing hypovirulence, disease, or being beneficial. Viruses infecting endophytes may appear to be cryptic because only a small fraction of the tissue of a collection of different species of grass endophytes revealed that at least 25% of the species were infected by viruses. Most of these viruses have double-stranded RNA (dsRNA) genomes. Tolypocladium cylindrosporum is an entomopathogenic fungus which was isolated as an endophyte from two species of grasses, Festuca rubra and Holcus lanatus. This fungus could be also artificially being beneficial. In addition, endophyte mycoviruses appear to be common, a surprising trend with fungal contaminated with non-photobiont bacteria. Close libraries of the 16S (SSU) rRNA gene were constructed from nearly 400 lichen samples (collected in Alaska, North Carolina, and Costa Rica) that are diverse in terms of chemistry, photobiont type, mycobiont, and growth form. Comparative analyses of sequence libraries indicate that major bacterial community differences are correlated most strongly with photobiont type. A large component of this trend is likely due to differing nitrogen requirements in cyanobacterial vs. green-algal lichens. Phylogenetic data also support the notion that different types of lichen

Inoculum 61(4), August 2010 55 

IRNASA - CSIC Cordel de Merinas 40-52 Salamanca 37008 Spain. 2IRNASA - CSIC Cordel de Merinas 40-52 Salamanca 37008 Spain.

HESSE, CEDAR* and SPATAFORA, JOSEPH. High-resolution analysis of microbial community structure from ectomycorrhizal soil using next-generation sequencing technologies. Mat-forming ectomycorrhizal (EM) fungi are known to colonize significant portions of the soils of temperate conifer forests and form beneficial symbioses with forest trees. While it is relatively easy to identify the major mat-forming fungi, little is known about the biotic communities associated with these mats. Previous studies in the H.J. Andrews Experimental Forest (TER, Oregon) identified two common mat-forming genera, Piloderma and Ramaria. This study attempts to describe the fungal community structure within Piloderma and Ramaria EM mats using high-resolution sequencing strategies. Traditional methods for environmental sampling of soil fungi are typically labor intensive, costly, and provide a relatively low resolution picture of fungal communities. In this study two next-generation sequencing platforms, the 454-Titaniu m and Illumina GAII Genome Analyzer, were used to obtain a high-resolution inventory of rDNA sequences from the soils within ectomycorrhizal mats. Presented here are initial comparisons of the two next-generation sequencing methods and their utilization to obtain a high-resolution view of fungal community structure. 

Poster Department of Botany and Plant Pathology, Oregon State University 2082 Cordley Hall Corvallis 97331 United States.

HIROOKA, YURI*, ROSSMAN, AMY Y.; SAMUELS, GARY J.; and CHAVERRI, PRISCILA. Taxonomy and biogeography of Nectria pseudotrichia (Nectriaceae, Hypocreales, Sordariomycetes) based on a multiple-locus phylogeny. Nectria pseudotrichia (Nectriaceae, Hypocreales, Sordariomycetes) is a cosmopolitan fungus in tropical and sub-tropical regions. Morphological characters of N. pseudotrichia and its anamorph are relatively well defined from other Nectria species by having muriform ascospores and a synnematus anamorph. Although N. pseudotrichia has been collected from around the world, the reported morphology of these specimens suggests pheno type heterogeneity based on spore size, perithecial surface, among others. In this study, the morphology and phylogeny of this species were reassessed. Analyses of isolates collected from around the world show the existence of four major phylogenetic lineages that correlate with geography. In most cases, genetic variation among geographic isolates does not equate with apomorphies in visible phenotype. However, the New Zealand isolates were relatively distinctive. Based on morphological and cultural characteristics, the New Zealand isolates were unique in having smooth ascospores, dark purple conidial masses and larger conidia in nature, and some conidia swollen at both ends on SNA. On PDA, the optimal temperature for growth of New Zealand isolates was 25 °C, whereas the other isolates grew optimally between 25-30 °C or 30-35 °C. Morphological differences among the other clades were not observed in specimens or cultures. Although our phylogenetic analyses did not include Australian isolates, specimens from Australia showed morphological characters of true Nectria pseudotrichia. The isolates from New Zealand represent a species distinct from the more widespread, genetically variable N. pseudotrichia. Nectria pseudotrichia represents yet another example of a species complex in the Hypocreales where genetic isolation and speciation apparently precedes the divergence of phenotype. 

Poster 1University of Maryland Plant Sciences Building College Park 20742 United States. 2United States Department of Agriculture Systematic Mycology and Microbiology lab 10300 Baltimore Blvd. Beltsville 20705 United States. 3USDA-ARS, Systematic Mycology and Microbiology Laboratory 10300 Baltimore Avenue, B-011A, Rm. 301 Beltsville 20705 United States. 4University of Maryland 2112 Plant Science Building College Park 20742 United States.

HODKINSON, BRENDAN P.* and LUTZONI, FRANCOIS*. Do lichens harbor their own rhizobia? A large-scale phylogenetic survey of lichen-associated bacteria from the order Rhizobiales. Although common knowledge dictates that the lichen thallus is formed solely by a fungus that develops a symbiotic relationship with an alga and/or cyanobacterium, lichen-associated non-photobiont bacteria are increasingly regarded as significant players in the ecology and physiology of the lichen microbiome. Since many lichens are able to grow on extremely nutrient-poor substrates, it has been suggested that these bacteria may provide some lichen thalli with a substantial source of fixed nitrogen and other crucial nutrients. For this study, community-wide comparative analyses were conducted on lichen-associated bacteria from the order Rhizobiales. Clone libraries of the 16S (SSU) rRNA gene were constructed from nearly 400 lichen samples (collected in Alaska, North Carolina, and Costa Rica) that are diverse in terms of chemistry, photobiont type, mycobiont, and growth form. Comparative analyses of sequence libraries indicate that major bacterial community differences are correlated most strongly with photobiont type. A large component of this trend is likely due to differing nitrogen requirements in cyanobacterial vs. green-algal lichens. Phylogenetic data also support the notion that different types of lichen

Continued on following page
thalli act as specialized niches for specific undescribed lineages of bacteria from the Rhizobiales, suggesting the possibility of co-evolution between certain lichens and their proteobacterial associates. Oral 1Duke University Box 90338 Durham 27708 United States. 1Duke University 125 Science Drive Durham 27708 United States.

HUBBARD, MICHELLE1*, GERMIDA, JIM2 and VUJANOVIC, VLADIMIR1. Fungal endophytes enhance abiotic stress tolerance in wheat in vitro. Fungal endophytes can benefit plant hosts in a variety of ways, including mycorrhizal, mycoheterotrophic and enhanced tolerance to environmental stresses. This study aims to determine if - fungal endophytes from the Saskatchewan Microbial Collection Database (SMCD) - can enhance drought or heat tolerance in wheat in co-culture, and to investigate the ability of the same fungal endophytes to tolerate drought or heat as free-living organisms in vitro. Fungi were grown on agar medium supplemented with 8% polyethylene glycol (PEG) to simulate drought stress. Heat stress was induced in an incubator held at 36 °C. Wheat stress tolerance was measured in terms of percent seed germination at 3 days and seedling fresh weight at 7 days. The stress tolerance of free-living fungal organisms was measured in terms of survival and colony growth rate. Three of the 6 fungal endophytes studied showed potential to improve wheat tolerance for heat and drought in vitro. Oral 1University of Saskatchewan 51 Campus Drive Saskatoon SK S3N 5A8 Canada. 2University of Saskatchewan 204 College Building Saskatoon SK S3N 5A8 Canada.

HUGHES, KAREN1*, PETERSEN, RONALD1 and LICKEY, EDGAR2. Barcoding of agaric fungi in the Great Smoky Mountains National Park: What have we learned? As part of the All Taxon Biodiversity Inventory in the Great Smoky Mountains National Park, representative ITS sequences were generated for 1648 collections. Issues limiting barcoding were contamination of fungal tissue (often contamination of Candra fungi), poor yield, degraded DNA, colored products and multiple indels. Results finding from ITS sequencing included: 1. Identification of cryptic species and cryptic species complexes (Megacollybia, Gymnopus), 2. Identification of biogeographical affinities (Megacollybia, Artomyces, Gymnopus and others), 3. Identification of environmental sequences (some previously misidentified by an inappropriate blast match). 4. Identification of previously unknown putative hybrids between agaric taxa (Strobilomyces and others); 5. Identification of new or unexpected lineages (Composus Gen nov.). 6. Obtaining an estimate of agaric ITS coverage in GenBank. From these studies we can conclude that agaric fungi from the GSMNP have affinities with boreal taxa (a consequence of disjuncts created after the last glacial maximum) and with Central American taxa (a consequence of northward migration following the last glacial maximum), that many “species” are actually species complexes or contain cryptic species, and that about 30% of taxa that we have sequenced are represented in GenBank. Oral 1University of Tennessee 330 Hesler Knoxville 37920 United States. 2Bridgewater College Dept of Biology Bridgewater 22812 United States.

HUGHES, KAREN1*, PETERSEN, RONALD1, LODGE, D. JEAN2 and BERGEMANN, SARAHA1. A driver of fungal biodiversity? The consequences of intertaxon agaric hybridization. Hybridization between varieties and taxa in higher plants has long been known to drive the establishment of new species and increase genetic variability in populations as a consequence of introgressive hybridization or recombination/reassortment in subsequent generations. The identification of apparent hybridization between genetically divergent lineages in agaric fungi (as determined by differences in ITS sequence) in several genera in the Great Smoky Mountains National Park (GSMNP) raises a number of issues. Are hybrid progeny as fit as the parents? Are hybrid progeny propagated sexually or asexually? Can F1 progeny be identified and does recombination and reassortment take place? Finally, is hybridization one driver of the high levels of biodiversity observed in the GSMNP, a region known for unusually high biodiversity? We discuss 4 examples of apparent hybridization and the consequences of this hybridization in nature: Armillaria mellea complex, Gymnopus dicensus complex, Hygrophrye flavescens complex and Amanita citrina var. lavendula. Poster 1University of Tennessee 330 Hesler Knoxville 37920 United States. 2USDA Forest Service Forest Products Lab Luquillo, Puerto Rico 37920 United States. 3Middle Tennessee State Univ Davis Science Bldg Murfreesboro 37132 United States.

HUME, DAVID1*, SCHMID, JAN1, VIJAYAN, PANIMALAR2 and HICKEY, MIKE1. Endophyte viability in stored seed declines at differing rates depending on local climatic conditions. The survival of Neotyphodium endophyte in stored grass seed is a critical component in the supply of quality seed to farmers. From seed harvest to the following spring, endophyte survival is generally maintained in New Zealand (NZ) as a result of low ambient temperature and relative humidity. However, seed carried forward to be sown the following autumn (over 1 year from harvest) is exposed to increasing temperatures and humidities which may compromise both endophyte and seed viability. To examine this effect, endophyte-infected seed was stored from late spring for up to 1 year at three geographic locations, which in order of increasing temperature and humidity, were: central NZ, northern NZ and south-east Queensland, Australia. Seed from each location was assessed monthly for endophyte and seed viability. Seed viability showed little, if any, decline over the period of sampling, but endophyte viability declined at all locations over time. These declines fitted that of a logistic relationship, that is, not much decline at first, then a rapidly increasing decline, followed by a plateau, as the proportion of seeds with viable endophyte approached zero. This decline occurred at an earlier stage and was more rapid in Queensland, was least in central NZ, and intermediate in northern NZ. This corresponded closely with the differing temperatures and relative humidities of these locations. Poster 1AgResearch Limited Tennent Drive Palmerston North 4442 New Zealand. 2Massey University Riddet Road Palmerston North 4410 New Zealand. 3AgResearch Tennent Drive Palmerston North 4474 New Zealand.

HUSTAD, VINCENT1* and MILLER, ANDREW2. Preliminary phylogenetic studies in the Geoglossomycetes (Fungi: Ascomycota). The class Geoglossomycetes encompasses a widespread and diverse group of fungi found on every continent except Antarctica. Commonly referred to as earth-tongues due to their morphology and terrestrial habitat, these fungi have long been a subject of mycological interest. This study represents the first attempt to intensively investigate phylogenetic relationships within the Geoglossomycetes. Sequences from over 30 taxa in Geoglossum, Trichoglossum, and Sarcocelotia in the class Geoglossomycetes were obtained from material collected in eastern North America and Western Europe. Maximum parsimony, maximum likelihood, and Bayesian analyses were conducted using nuclear ribosomal sequences of the entire internal transcribed spacer (ITS) and partial 28S large subunit (LSU). Bootstrap and posterior probability support values confirm previous findings that the Geoglossomycetes form a monophyletic clade. However, some genera within the class appear to be paraphyletic and may need to be recircumscribed. Further research is needed to more broadly sample the class Geoglossomycetes complete the phylogeny of this widespread group of fungi. Poster 1University of Illinois at Urbana-Champaign 505 S. Goodwin, Ave. Urbana 61801 United States. 2Illinois Natural History Survey 1816 S. Oak St. Champaign 61820 United States.

IANNONE, LEOPOLDO JAVIER1*, YOUNG, CAROLYN2, ROSSI, MARIA SUSANA1 and SCHARLD, CHRISTOPHER L1. Multigene phylogeny and alkaloid gene profiling of epichloë endophytes from Argentina. Asexual epichloë-endophytes have been detected in more than 30 grass species native to Argentina, but only the endophytes from 10 host species have been characterized at a molecular level. In this work we developed specific primers for sequencing the calmodulin A gene (calA) in order to perform phylogenetic analyses of epichloë endophytes from 19 different hosts from Argentina. The resulting phylogenies were compared with those obtained using previously described markers tubB and tefA. The endophytes were also characterized by diagnostic PCR for the detection of some of the genes involved in the biosynthesis of lolines (lolC), ergot alkaloids (dwww) and lolitrem B (Itns genes). The CalA phylogeny was consistent with tubA and tefA phylogenies, confirming the hybrid origin of most of the endophytes and revealing the existence of a wide diversity of different host-endophyte associations. Three different lineages were recognized, the previously known hybrid species N. tembladerae and N. pampeana and a new species, Neotyphodium cabralii, which only included isolates from Phleum alpinum. This diversity was also detected in the alkaloid gene profiles of the endophytes. The lolC gene was not detected in the endophytes characterized as N. cabralii, but its presence in N. pampeana, N. cabralii, and endophytes from Poa lanigera and P. spiciformis in indicating that these endophytes might produce some kind of loline. Screening for Itm genes indicated that cluster 3 is lost in the endophytes from Argentina, and cluster 1 is lost in N. pampeana and N. cabralii. Lolitrem clusters 1 and 2 gene compositions were very variable among Neotyphodium tembladerae strains, and dwww was not detected in any of the endophytes studied. Thus, the endophytes from Argentina do not produce ergot alkaloids or lolitrem B, but precursors of lolitrem B might be produced by N. tembladerae from different hosts. Poster 1PROPLAME-PRHIDEB-CONICET; DIQ & DBBE-UBA Av Int Guairales 2160 Pab2 Lab 69 Buenos Aires C1428EGA Argentina. 2Samuel Roberts Noble Foundation 2510 Sam Noble Parkway Ardmore 73401 United States. 3IFBINE-CONICET-FCEyN-UBA Av Guairales 2160 Pab2 Buenos Aires C1428EGA Argentina. 4University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States.

IANNONE, LEOPOLDO JAVIER1*. Endophytes of native grasses from South America. Biodiversity and ecology. Whereas the symbiosis between assexual epichloë-endophytes and agronomic grasses is considered to be mutualistic, few is known about these symbioses in wild grasses. In Argentina, these endophytes have carried detected in 37 native grass species. Although sexual stages have not been found in South America, morphological characterization and phylogenetic research is needed to more broadly sample the class Geoglossomycetes complete the phylogeny of this widespread group of fungi.
logenetic analyses have revealed the existence of a high diversity of hybrid endophytes in this country, where grasses harboring endophytes have been found in all kinds of environments from tropical forest to cold deserts. Whereas some endophytes seem to be strictly associated to one host species in a particular environment, Neotyphodium emerikohai presents an extraordinarily wide environmental host range from USA to Argentina. In those host species, inhabiting different environments, the incidence of endophytes is highly variable among populations and in most of the cases is clearly associated with environmental conditions. Although endophytes can be easily lost at seed level, some host like Bromus auleticus, an excellent forage grass, presents a very high endophyte incidence. In this host, the high fungal incidence could be explained by the beneficial effects conferred by the endophyte, as enhanced growth and resistance to pathogen fungi. Preliminary analyses indicate that some endophytes could produce lollitrem B or ergot alkaloids. These results suggest the existence of a diversity of endophytes that could not be detected with the markers used up to now and that many of these grasses and their endophytes could be used in forage breeding programs. Although our knowledge on endophytes of native grasses is increasing, more research is needed in order to understand the role of the endophytes in native hosts, as well as their diversity in different countries from South America. This knowledge will allow us to understanding the origin and evolutionary strategies of asexual endophytes. Oral PROPLAME-PRHIDE-B-CONCEIT, DIQ & DBBE-UBA Av Int Guairales 2160 Pab Lab 69 Buenos Aires CI425E6 Argentina.

ISIKHUEMHEN, OMOANGHE1*, ADENIKEUN, CLEMENTINA O2, OHIMAIN, ELIJAH 1 and ANIKE, FELICIA1. Mating studies and improved strain selection in the edible tropical fungus, Lentinus squarrosulus Mont. Lentinus squarrosulus Mont. tropical edible fungus that is distributed across Sub-Saharan Africa and most parts of Asia. Intrastock mating study was performed using single spore isolates (ss) from a wild strain (MBFBF 201). Mycelia growth and morphology characterization indicated that milled corn straw agar (CSA) medium best supports mycelia growth compared to two other media: potato dextrose agar (PDA) and yeast peptone soluble starch agar (YPSS). The results from ss pairings and analysis confirmed a tetrapolar mating system for L. squarrosulus. Further characterization of the resulting dikaryons indicated that the growth rate of the parent monokaryons does not affect the growth rate of the resulting dikaryon. Primordial formation in the resulting dikaryons with the fastest growth rate was 12 days after inoculation. Under similar conditions, MBFBF 201 and another wild strain, MBFBF 269, produced primordia after 28 and 32 days, respectively, indicating that intrastock breeding could be an effective method for obtaining improved strains of L. squarrosulus. Poster 3North Carolina A&T State University 1601 East Market St Greensboro 27411 United States. 4Department of Botany & Microbiology, University of Ibadan, Ibadan Nigeria. “Biological Sciences Department, Nger Delta University Wilberforce Island Nigeria. JAMES, TIMOTHY Y.1*, SCHLOEGEL, LISA M.2, SAKTHIKUMAR, SHARADHA1, LONGCORE, JOYCE E.1 and CUOMO, CHRISTINA A.1. Rare recombination and the origin and spread of the amphibian chytrid fungus, Batrachochytrium dendrobatidis (Bd). Mycosis pandemic. The incidence of chytridiosis has increased within the first 2 weeks of treatment with imazapic and continued to decrease throughout the 12 week experiment. EV’s were reduced from 1000 to 1200 ppb. LA’s were reduced from 300 to 15 ppb and the PA’s were reduced from 150 ppm to 12 ppm. After 12 weeks the controls contained 1.9, 2.1 and 957 ppm LA’s, 88 lines from 15 different sites. The collection was planted at the Red River Farm (Oklahoma) in October 2008 in 5x5 sward plots in 2 randomized complete block design with two replications. The tall fescue material was evaluated for field persistence, morphological and summer dormancy characteristics, endophyte infection status and alkaloid profiles. Multiple tillers of the top ten most persistent lines were screened for endophyte infection status using an endophyte-specific high throughput PCR screen. Alkaloid gene profiling and SSR marker analysis was used to identify differences between the isolates in each line to determine the suitability of using this material for livestock grazing. Tall fescue lines that possess useful traits will be incorporated into the Noble Foundation cool season grass breeding program. Poster The Samuel Roberts Noble Foundation 2510 Sam Noble Parkway Ardmore 73401 United States.

JEWEIL, KELSEA1*, SNIDER, STEPHEN2 and KELLER, NANCY1. Ralstonia solanacearum alters reproductive module and spatial arrangement of Aspergillus flavus. Aspergillus flavus, a fungal crop pathogen and producer of toxic secondary metabolites such as aflatoxin, responds to the presence of the bacterial plant pathogen Ralstonia solanacearum, and vice versa. In solid co-culture R. solanacearum strains GM11000 and UW376 both inhibit asexual spore production in A. flavus WT NRLR3537 and induce sclerotia formation in some A. flavus strains deficient in oxypalin production. In turn the bacteria produce a strong coral red pigment in their colonies. Closed-container volatile experiments without physical culture contact have shown that A. flavus produces unidentified compound(s) that suppress the production of background pigmentation (melanization) and extracellular polysaccharides (EPS) in both GM11000 and UW376, with both bacteria continue to block conidia production in A. flavus. R. solanacearum has a native quorum sensing (QS) system using the oxypalin (a signaling fatty acid derived from A. flavus) and recently being tested is 3-OH PAME, and 3-OH PAME is responsible for any of the observed changes in A. flavus growth and reproduction. Culture extracts containing the novel red pigment are being analyzed for structural elucidation, and a quantitative system has been developed to report the localized induction of sclerotia formation in A. flavus by R. solanacearum. Poster University of Wisconsin-Madison 1550 Linden Dr. Madison 53706 United States. 2Department of Botany & Microbiology, University of Wisconsin-Madison 1101 University Ave Madison 53706 United States.

JI, HUIHUA1, FANNIN, NEIL, YANG, WENBIN, SCOERGENDORFER, ANGELA and BUSH, LOWELL. Longevity of ergot alkaloids in herbicide killed L. arundinaceum /N. coenophialum. In the past several years there has been much interest in removal of Neotyphodium coenophialum infected tall fescue from horse pastures. This has been accomplished by either complete killing of the seed and establishment of a new desired seed or by selective removal of the tall fescue from the stand. With selective killing of Lolium arundinaceum /Neotyphodium coenophialum plants within the pasture, the loss of ergot alkaloids from the standing herbage becomes significant to the question of when to allow reentry of grazing animals. The objective of these experiments was to determine the degradation of lysodol (LA’s), ergovaline, ergovaline (EVO’s), and the pyrrolizidine (PA’s) alkaloids in dying plants. Plants were established in pots in greenhouse but grown outside after herbicide treatments. Experiments were split plot design with treatment as the main blocks. Imazapic and glyphosate were the herbicides used with imazapic the selective herbicide. LA’s and EVO’s decreased within the first 2 weeks of treatment with imazapic and continued to decrease throughout the 12 week experiment. EV’S were reduced from 1000 to 1200 ppb. LA’s were reduced from 300 to 15 ppb and the PA’s were reduced from 150 ppm to 12 ppm. After 12 weeks the controls contained 1.9, 2.1 and 957 ppm LA’s, EVO’s and PA’s respectively. The glyphosate experiment was only 4 weeks duration and the concentrations of LA’s and EVO’s remained above 200 ppb. Weight of herbage in each herbicide treated pot remained nearly the same throughout each experiment but the plants in the controls continued to grow. Significant amounts of EVO’s remained after 4 to 8 weeks in these experiments indicating that pregnant mares should not graze killed forage for at least 10 weeks after treatment. Poster University of Kentucky Dept Plant & Soil Sciences Lexington 40546-0312 United States.

JI, YANLING1*, PAN, JIEYOU 2 and WANG, ZHIWEI1. IAA production of Neotyphodium sinicum EHA-1- Roegneria kamoji Complex. Endophytic fungi-grass symbiosis base on either endophyte can synthesize or induce the host plant to produce various kinds of secondary metabolites. These secondary metabolites, such as alkaloids and plant hormones usually benefit to plant survival, growth and reproduction. We detected IAA concentrations of culture filtrates, cell free macerates of Neotyphodium sinicum EHA-1 by ELISA and HPLC, and important that indole-3-acetic acid (IAA) accumulation, so in culture media. N. sinicum EHA-1 synthesizing IAA even no trypsin (Trp), precursor
of IAA was added exogenously into the culture. These indicated this isolate can produce plant hormone de novo. In Tp presence, conditions, highest concentration of 47.08 mg/g dry mycelium was recorded in IAA production tests. When IAA was extracted from aerial tissue of Roegneria karrooji Ei and EF plants and analyzed by HPLC; higher concentration of IAA was detected in EF plants compared with that of EF plants. This phenomenon was recognized on plants in period of heading stage and flowering stage respectively. These suggested that IAA biosynthesis in fungal cells may have a certain contribution in total IAA level within Chinese Roegneria-Neotyphodium symbiont. Poster 1Nanjing Agricultural University No1, Weigang Nanjing 210095 China. 2College of Life Sciences, Nanjing Agricultural University Weigang 1 Nanjing 210095 China.

JOHNSON, JAY1*, BRYANT, JENNY, SCHARF, BRAD, KISHORE, DEEPAN, COATE, ERICH, EICHER, PEGGY ANN and SPIERS, DONALD. Geographical regional differences in Bos taurus cattle responses to fescue toxicosis and heat stress. Cattle raised for generations on endophyte-infected tall fescue (E+) may have an acquired tolerance to fescue toxicosis. This can be tested using the same cattle breed from different US regions where tall fescue (Festuca arundinacea) is present (Missouri) or absent (Oklahoma). Angus steers from Missouri (MO ANG; n=10; 513.6 ± 13.6 Kg BW) and Oklahoma (OK ANG; n=10; 552.8 ± 12.0 Kg BW) were used to represent these different groups. Animals were fed a diet containing either E+ (30 µg ergovaline/Kg BW/day) or uninfected (E-; 0 µg ergovaline/Kg BW/ day) tall fescue seed in the Brody Environmental Center at the University of Missouri. A low treatment dose was selected to reduce a possibly fatal hypersensitive response of OK ANG to the toxin, and facilitate discrimination of sensitivity differences in the fescue toxicosis response. Steers were maintained at 19-22°C (TN) through Day 8, followed by 2 weeks of cycling heat stress (HS, 26-36°C). Diet treatment began on Day 2 and continued until the end of the study. Feed intake (FI) along with skin and rectal temperatures were measured on both E- and E+ cattle. A novel fumonisin B1 (FB1) variant was eventually confirmed in three groups at any ambient temperature. FI change from pretreatment level at TN was (p<0.05) greater for E+ (-2.1 Kg) compared to E- animals (-0.3 Kg). During HS, both groups exhibited a significant (p<0.05) FI reduction with OK ANG averaging a 3.43 Kg greater reduction compared to MO ANG (p<0.05). In addition, E+ cattle averaged a 3.3 Kg greater decrease in FI compared to E- animals (p<0.05). Although there appear to be large differences in feed intake response to heat stress that are related to region of origin, there are no differences in the thermoregulation response to fescue toxicosis. (USDA Agreement No. 58-62273-6-016). Keywords: heat stress, fescue toxicosis, adaptation Poster University of Missouri 920 E Campus Dr Columbia 652113500 United States.

JOHNSON, JENNIFER1*, AIKEN, GLEN2, PHILLIPS, TIM3 and BARRETT, MICHAEL1. Grazing evaluation of a novel endophyte tall fescue developed for the upper transition zone. An endophyte (Neotyphodium coenophialum) infects tall fescue [Folium arundinacea (Schreber) Darbysh.] that imparts tolerances to moisture, heat, and grazing, but also produces ergot alkaloids that are toxic to grazing cattle. Novel endophytes have been developed that do not produce toxic ergot alkaloids. A 2-yr grazing experiment evaluated steer performance and forage productivity of KY31 infected with AR584 novel endophyte (AR584) as compared to KY31 wild-type endophyte (KY31), endophyte-free KYFA9301 (EPF9301) and ‘Jesup’ fescue infected with AR542 novel endophyte (MaxQ). Fescue-endophyte combinations were assigned to 1.0-ha pastures in a randomized complete block design with three replications. Pastures were continuously grazed from 6 May to 23 July in 2008 and from 2 April to 25 June in 2009. Rectal temperatures were recorded and jugular blood was collected for assaying serum prolactin. Stocking rates were varied to maintain similar forage masses (2500 ± 250 Kg DM ha-1). Average daily gain was lowest (P < 0.01) for KY31 (0.80 ± 0.05 kg d-1), and was similar (P = 0.10) among EPF9301 (0.88 ± 0.05 kg d-1), NE9301 (0.81 ± 0.08 kg d-1) and MaxQ (0.84 ± 0.04 kg d-1). Rectal temperatures were elevated (P < 0.05) in steers grazing KY31 as compared to EPF9301. Forage productivity of KY31 infected with AR584 novel endophyte can improve weight gain and alleviate toxicosis, and provide higher carrying capacities than KY31. Poster 1 ‘Red-cockaded Woodpecker and Heartwood Infection’ Symposium, 26-27 June 2010 at the University of Missouri. 2National High Plains Grasslands Research and Development Center, 1725 Natomas Rd, N220 Ag Science North, University of Missouri 920 E Campus Dr Columbia 652113500 United States.

JOHNSON, LINDA1*, KOULMAN, ALBERT2, LANE, GEOFF3, FRASER, KARLI4, VOISEY, CHRISTINE4 and JOHNSON, RICHARD4. Multiple cyclic oligopeptides are synthesised by epichloë endophytes via a single ribosomally encoded gene, gigA. Epichloë endophytes live symptomlessly within the intercellular spaces of cool-season grasses, and confer a number of biotic and abiotic advantages to their hosts. We describe the characterisation of a novel endophyte gene (designated gigA for grass induced gene), which is expressed only in plants, is the most abundantly expressed fungal transcript in endophyte infected grasses and which directly encodes a novel family of secreted post-translationally modified cyclic oligopeptides (COPs). The GigA protein contains an N-terminal signal sequence and imperfect 27 amino acid repeats which we propose are processed by a kexin protease to yield multiple COPs of 8 or 9 amino acids. Deletion of gigA, and re-introduction of the mutant into the host plant, leads to complete loss of COP production, altered hyphal ultrastructure and an increase in fungal biomass. This is the first report of multiple cyclic peptides being ribosomally encoded from a single gene and we are interested in both the mechanism of cyclisation and the function of these COPs in endophyte-grass symbioses. Poster 1AgResearch Grasslands Tennent Drive Palmerston North 4442 New Zealand. 2MRC Human Nutrition Research Fulbourn Road Cambridge CB1 9NL United Kingdom. 3AgResearch Tennent Drive Palmerston North 4442 New Zealand.

JUSINO, MICHELLE6* and WALTERS, JEFFREY. Exploring the Relationships Between Red-cockaded Woodpeckers and Heartwood Infesting Fungi. We are interested in the relationship between heartwood infesting fungi, such as red heart fungus (Phellinus pinii) and red-cockaded woodpeckers (Picoides borealis). Red-cockaded woodpeckers are cooperatively breeding birds that live in the southern United States. A low treatment dose of fumonisin B1 (FB1) and cyclopiazonic acid ( CPA) was administered to red heart fungus infected trees containing naturally excavated red-cockaded woodpecker cavities to those containing natural and provisioned cavity starts. We will present preliminary data from samples from the heartwood of trees containing naturally excavated red-cockaded woodpecker cavities, naturally excavated cavity starts (i.e., entrance tunnel only), and provisioned cavity starts (control trees) from our experimental sample, which was collected from fifteen red-cockaded woodpecker clusters (i.e., the set of cavities belonging to one family group). These samples were collected with a specially designed sampling tool, which will also be described. We extracted DNA from each of these samples separately and performed polymerase chain reactions with universal fungal primers. The results will show how fungal infection rates differ between trees selected for complete excavation by red-cockaded woodpeckers compare to those with incomplete excavations (starts) and those with no woodpecker activity (controls). A significant difference in fungal infection rates between complete cavities and cavity starts could lend support to the hypothesis that red-cockaded woodpeckers facilitate the transmission of heartwood infesting fungi via their cavity starts. Poster University of Missouri 920 E Campus Dr Columbia 652113500 United States.

KANG, YAN4*, JI, YANLING2 and WANG, ZHIWEI5. Morphological Diversity of Neotyphodium sinicum in Chinese native Roegneria plants. Neotyphodium sinicum compose natural symbionts with asymptomatic Roegneria spp. native to China. In Fujian, Jiangsu, Shanghai, Anhui, Hubei, Shandong, Shanxi, Hebei, Jilin, we collected 2243 asymptomatic Roegneria plants, 46.0% were detected to be endophytes infected. Morphological characteristics of 40 Neotyphodium isolates obtained from Roegneria plants of different provinces in China were investigated. On PDA plates, colonies white, cottony, grow rapidly with a radius of 7.5-6.7 mm/21d. The colonies were divided into 5 types. Type A: The colony has potuberance in the middle, circular, smooth, and regular edge, like a cap. Type B: The colony has no potuberance in middle, circular, smooth and regular edge. Type C: They are slightly brain-like, draped surface and have regular edge. Type D: They have brain-like surface and irregular edge. Type E: Colony has a small potuberance in the middle, irregular, smooth surface and regular edge. Only one isolate belong to Type E. Conidia hyaline, reniform to elliptical, 4.7-7.3 μm × 2.6-3.2 μm. Conidigenous cells discrete, arising solitary from the aerial mycelium, septated at the base or middle, hyaline, smooth, 16.2-24.5 × 1.9-2.7 μm. There are high variable among conidia size. Conidigenous cells were solitary and arose perpendicularly from the hyphae with a small head at tip. There is no relationship between size of conidia and colony genets and colony types. Neotyphodium-Roegneria symbiont have a wide distribution in most areas of China. Morphological characteristics of the endophytic fungus obtained from this symbiont grown in China exhibit abundant diversity, indicating an early appearance of this species. Molecular phylogenetic evidences indicated that N. sinicum should be an interspecific hybrid between members belonging to ETC and EBY, the E. bromicoleae endophytes and its closest relative in future. *: This study was fully supported by NSFC of China (No. 30070019 and No. 508 Inoculum 61(4), August 2010
Kerrigan, Julia* and Yadagiri, Kirthi Kiran. Ultrastructure, life cycle, and pathology of Labyrinthula terrestris, causal agent of rapid blight on turfgrasses. For rapid blight disease, the causal agent is a marine net slime mold. This is the first species in the genus that is pathogenic to vegetation and causes rapid blight disease. The causal agent is a marine net slime mold. This is the first species in the genus that is pathogenic to vegetation and causes rapid blight disease.
on host inflences. Conversely, E. fuscata E2368 forms associations with meadow fescue (L. pratense) and tall fescue (L. arundinaceum) which are generally mutualistic, although stroma are occasionally formed on some inflences, and it is largely transmitted vertically through seed. Contrasting the genome sequences of these two epichloë endophytes with such different lifestyles, using in silico methods, will provide insight into genome adaption and candidate regions for future studies. Our intention is to build on this comparative genomic analysis resource by adding the genomes of other endophytes as they become available, providing a framework for rapidly assimilating genome similarities and differences and to support larger scale evolutionary studies. *Oral* 1AgResearch Institute, Puddle Alley, Mosgiel Dunedin 9053 New Zealand. 2Samuel Roberts Noble Foundation 2510 Sam Noble Parkway Ardmore 73401 United States. 3AgResearch Grasslands, Tenent Drive Palmerston North 4442 New Zealand. 4AgResearch Thomas Building, 3A Symonds St Auckland 1010 New Zealand. 5University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States. 6University of Kentucky Department of Plant Pathology, Animal and Food Sciences, University of Kentucky 806 W.P. Garrigus Building Lexington 40546 United States. 7University of Kentucky 814 W.P. Garrigus Bldg Lexington 40546-0215 United States. 8University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States. 9Samuel Roberts Noble Foundation 201F Plant Sciences Bldg Lexington 40546 United States. 10University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States. 11AgResearch Inoculum 61(4), August 2010

KIM, SUHN* and HARRINGTON, THOMAS C. A new species of *Lep- togramphus* and other Ophiostomatales from the exotic bark beetle, *Hylurgus ligniperda*, in California. The root- and stem-feeding bark beetle *Hylurgus ligniperda* is native to Europe but was discovered in Los Angeles, California in 2003. This bark beetle is a common vector of Ophiostomatales, which are potent- ial pests of the blue-mitts of conifer tree hosts. In this study, Ophiostomatales were isolated on a cycloheximide-amended medium from 118 adult *H. ligniperda* collected from infested pine logs at two sites in California. In total, eight species of Ophiostomatales were identified, and seven species that were occasionally isolated were unidentified. The most frequently isolated species were *Ophiostoma* sps and *Grossmannia galeiforme*, which were isolated from 31% and 23% of the samples, respectively. The taxa included in this study (isolated from 9% of the beetles), *O. quereri* (8%), and *Leptographium tereforme* sp. nov. (6%). *Grossmannia miehli*, L. serpens, three *Sporothrix* species, *O. flue- cosum*, O. stenoceras, two unidentified *Hyalorhinocladiella* sp., and a sterile fun- gus, were each isolated from less than 5% of the beetles. Most of the identified species were already known in the USA and have been found in association with *H. ligniperda* in other countries. However, the new species, L. tereforme and G. galeiforme were recorded from the USA for the first time, and this is the first re- port of L. serpens from western North America. *Poster* Department of Plant Pathology, Iowa State University 351 Bessey Hall Ames 50010 United States.

KOONTZ, ANNE*, BUSH, LOWELL2, KLOTZ, JAMES3, MCLEOD, KYLE4 and HAMILTON, DAVE. Efficiency of a fescue seed extract in inducing toxico- sis in cattle. Tall fescue (Lolium arundinaceum) toxicosis is often com- plicated by a reduction in intake. This study was conducted to develop a repeatable model that would prevent a reduction in intake altering the quantity of alkaloids present in the animal over the course of the experiment. A tall fescue seed extract was used in a crossover experiment to determine its ability to induce fescue toxicosis. This experiment utilized four growing Holstein steers (BW = 337±23kg) surgically fitted with ruminal cannulas. Steers were maintained on a diet of endophyte free fescue hay fed ad libitum throughout the experiment. En- dophyte infected (E+; 5.33 ppm ergovaline) and uninfected (E-; 0.00 ppm ergo- valine) KY-31 tall fescue seed was extracted with ethanol, concentrated and lyophilized. Ergovaline concentration of the final extract was 101.75 ppm. Extract was packaged in cellulose paper and ruminally dosed twice daily at 4.4 mg ergo- valinic/kg BW. Animals were given a two week washout period between treat- ments. Physiological indicators were measured over 7d at 22°C (d1-3) and 32°C (d4-7). During E+ treatment rate of intake was reduced at 22°C (P < 0.05) and total feed intake was reduced at 32°C (P < 0.05). Core body temperature was low- ered at 22°C and elevated at 32°C during E+ dosing (P < 0.05). Skin temperature over the ribs was unaffected by endophyte treatment. Steers dosed with E+ seed had higher respiration rates at 32°C (P < 0.01), and depressed heart rates at both temperatures (P < 0.0001). At 22°C both systolic and diastolic blood pressures were elevated (P < 0.05) with E+ treatment. These physiological alterations are consistent with those reported for cattle grazing or consuming seed from endo- phyte infected *Poster* 1Department of Animal and Food Sciences, University of Kentucky 812 W.P. Garrigus Building Lexington 40546 United States. 2University of Kentucky 806 W.P. Garrigus Building Lexington 40546 United States. 3University of Kentucky 814 W.P. Garrigus Bldg Lexington 40546-0215 United States.

KRAUSS, JOCHEM*. Aphids in the world of endophytic fungus infected grass species. Endophytic funghi of cool season grass species are well known to deter herbivores from damaging agricultural grass hosts. Phloem sucking aphids have been shown to have disadvantages feeding on endophyte infected grass hosts. However, few studies compared effects of different endophyte species or strains on aphids. It is also unknown, whether responses of aphids differ in laboratory and field experiments. In laboratory experiments we showed that the wild strain *Neos- tophodium coenophialum* in Festuca arundinacea affects population growths of different aphid species negativetly than the strain AR542 or the endophytic fungi N. lolii in Loliure perenne. Nevertheless all endophytic fungi had strong negative effects on population growth under laboratory conditions. Under field conditions other constraints are often more important in the regulation of aphid abundances. *Oral* University of Bayreuth, Population Ecology Group, Animal Ecology 1 Uni- versitätsstrasse 30 Bayreuth 95445 Germany.

KROPP, BRADLEY* and ALBEE-SCOTT, STEVEN2. Some ectomycor- rhizal fungi from the Samoan Islands with molecular evidence for a South Temperate origin of one taxon. Ectomycorrhizal fungi have rarely if ever been reported from the islands of the South Pacific. Yet, some ectomycorrhizal fungi associated with native vegetation were recently collected in the Samoan Islands. One of these, an undescribed species of *Inocybe*, “Inocybe taurensis”, was associ- ated with the ectomycorrhizal tree *Pisonia* grandis in littoral forest on the remote island of Ta’u. In addition, an unidentified species of *Hebeloma* was also collect- ed in native montane forest on the island of Tutuala. Based on an analysis of nLSU, rpb1, and rp2 beta sequence data at least one of these fungi, the *Inocybe* species, appears to have a South Temperate origin. Some introduced hosts are present on these islands but they are uncommon. Since these ectomycorrhizal fungi were associated with native forest they are potentially indigenous. Explana- tions for the unexpected presence of ectomycorrhizal fungi in the Samoan Archi- pes are given. *Poster* 255±0.7mg rice seed extract from Samoan Islands. 1University of Hawai`i at Manoa, 446 South King St Honolulu 96822 United States. 2University of Hawai`i at Manoa, 446 South King St Honolulu 96822 United States.

KROPP, BRADLEY* and THOMAS, ELIZABETH2. Role of abiotic stress in the infection of Dyers Woad by a rust fungus and implications for biocontrol. Dyer’s woad (*Isatis tinctoria*) is a noxious weed of the western United States. The rust pathogen, *Puccinia thlaspeos* is a potential biocontrol agent of this weed. Al- though the general disease etiology of this fungus is well studied, little is known about how environmental stresses affect infection. This study examined the effect of varying levels of different abiotic stresses on the infection rate. Plants facing moderate to severe levels of oxidative stress had increased protection against the rust pathogen but similar levels of salinity, osmotic, dehydration, and cold stress did not affect infection. However, with the exception of oxidative stress, plants facing mild and sub-lethal levels of these stresses had significantly lowered in- fection rates. Mild abiotic stress appears to help the plants develop tolerance to the rust pathogen, thereby affecting its efficacy as a biocontrol agent. *Poster* 1Biolo- gy Department, Utah State University 5305 Old Main Hill Logan 84322 United States. 2North Carolina State University 851 Main Campus Drive Raleigh 27606 United States.

KUMAR, LETICIA*, HEALY, ROSANNE1, SMITH, MATTHEW2 and MCLAUGHLIN, DAVID2. A New Species of *Hydnocystis* (Pyrenomataceae, *Pezizales*) from Minnesota. Phylogenetic analyses of the LSU and ITS nuclear ribosomal DNA of a recently collected truffle from Southeastern Minnesota sug- gest a new species for the genus *Hydnocystis* and the first record of this genus in North America. Morphological characters differentiating the Minnesota species from the other two species in the genus, *H. piligera* (Europe, Russia, China) and *H. japonica* (Japan), are: 1) a lack of discrete paraphyses, having instead a pros- enchyomatous tissue between the ascii, 2) a more robust hypothecium, and 3) sparse- ness of excipular hairs. These divergent traits in combination with phylogenetic analyses support the Minnesota sample as a distinct *Hydnocystis* species. *Poster* 1University of Minnesota 1445 Gortner Ave., 250 Biological Sciences St. Paul 55108 United States. 2Duke University Department of Biology Durham 27708 United States. 3University of Minnesota Plant Biology Department St. Paul 55108 United States.

KURTZMAN, CLETUS*. Barcoding the yeasts: Which genes? Old style yeast identification, as many know, is an onerous process requiring determination of growth reactions on 60-100 different media. Once completed, there is still a high degree of uncertainty about species identity. With the determination of sequences for domains 1 and 2 (D1/D2) of the nuclear large subunit rRNA gene for all known ascomycetous yeasts in 1998 and all known basidiomycetous yeasts in 2000, yeast taxonomists quickly adopted these databases for species identification. Results of this change were the doubling of known yeasts in the past decade and the development of commercial diagnostic systems using these databases.
which continue to expand with the description of new species. Consequently, the D1/D2 gene sequence has become the barcode for yeasts. After a decade of use, is D1/D2 still the best choice for a yeast barcoding system? Data from D1/D2, ITS, mitochondrial small subunit rRNA, translation elongation factor 1-α, and actin gene sequences will be presented to examine whether there are several phylogenetic lineages. From the results, if a single gene sequence is to be used, D1/D2 is probably the best choice because it is easily sequenced and there already exists a very large database in GenBank. However, D1/D2, or any other single gene sequence, will not reveal the presence of hybrids, and D1/D2 sequences do not always resolve closely related species, a deficiency shared by certain other genes. From these comparisons, the recommendation for species identification is to use a multigene system of which D1/D2 is a member. Oral L. National Center for Agricultural Utilization Research, US Department of Agriculture, Agricultural Research Service 1815 N University Street Peoria 61604 United States.

LI, CHUNJIE1*, WANG, ZHENGFENG2 and NAN, ZHIBIAO1. Effects of Neotyphodium endophyte on wild barley growth under salt stress conditions. Wild barley (Hordeum brevisubulatum) is widely distributed in alkalline pasture grasslands and widely cultivated in northern China. Neotyphodium endophytes have been found in seeds and leaf sheaths in all H. brevisubulatum samples from Hexi corridor, Gansu province, China. The effects Neotyphodium endophyte infection on seed germination, vegetative and reproductive growth of H. brevisubulatum under NaCl stress conditions were investigated. The results showed that seed germination rate, coleoptile and root lengths of endophytein- (E+) and endophyte-free (E-) seeds were much higher than those of endophytein-free (E-) seeds when the NaCl concentration reached 200, and 300 mM, but there were no observable differences in NaCl concentrations of 100, or 400 mM. E+ plants produced relatively more tillers, with a higher ratio of reproductive tillers, and higher shoot dry weights and ripe infructescences per plant than E- plants under salt stress. There were larger differences between E+ and E- plants in the length of ripe infructescences, seeds per infructescence and seed yields per plant under salt stress conditions. However, there were no differences in dry weight of vegetative tillers per plant and thousand-ker-di weight of seeds between E+ and E- plants under salt stress. These findings suggest that the endophyte may play an important role in plant tolerance to salinity. Poster 1College of Pastoral Agriculture Science and Technology, Lanzhou University Jiayuguan Xilu 768 Lanzhou 730020 China. 2Baiyin Agricultural Science Research Institute Baiyin city Baiyin 730900 China.

LIN, CHING-HSIU*, YANG, SIWY LING and CHUNG, KUANG-REN. Signaling transduction pathways involved in cellular resistance to reactive oxygen species and multidrugs and required for pathogenicity in Alternaria. Citrus brown spot disease is caused by the necrotrophic fungus Alternaria alternata, whose pathogenic capability has been thought to rely on the production and action of host-selective ACT toxin with a core 9,10-epoxy-8-hydroxy-9-methyldecatetraenoic acid structure. The pathogen induces rapid lipid peroxidation and accumulation of hydrogen peroxide (H2O2) in citrus, indicative of host defensive response. Our studies are aimed at understanding the fungal response to host-generated reactive oxidative species (ROS) and at determining if circuitment of plant defenses is also likely to be important for the disease process. We functionally determined a redox-responsive transcriptional regulator (AaAPI), a two-component histidine kinase (AaHSK1), three MAP kinases (AaFS3, AaSLT2 and AaNOXR), and a two-component regulator (AaNRPS/PKS amphi gene, AaNRPS/PKS amphi gene) for fungal virulence/pathogenicity in citrus. AaAPI and AaHOG1 function independently for oxidative stress response. AaHOG1 also confers cellular resistance to salt, but not to sugar osmolytes. AaHSK1 is the primary regulator for cellular resistance to sugar or for sensitivity to dicabromoxide or phenylpyrrole fungi-cides. AaFS3 and AaSLT2 are required for condiation and attributable to salt sensitivity. AaNOXR, likely regulating expression of the AaAPI and AaHOG1 genes, is responsible for production of superoxide and H2O2. Fungal mutants impaired in any of the reported genes are hypersensitive to 2-chloro-5-hydroxypiridine, 2,3,5-triiodobenzoic acid (TIBA), and many pyridine- or benzene-containing compounds. This common phenotype is probably, at least in part, due to a synergetic modulation of membrane transporters belonging to the major facilitator superfamily (MFS). Interactions among these pathways occur at transcriptional and post-translational levels, leading to proper regulations for a wide diversity of biological functions. Oral 1University of Florida 700 Experiment Station Rd Lake Alfred 33850 United States.

LIU, JINGE1*, MANN, LESLEY2, HESSE, ULJANA1, SUGAWARA, KOYA3 and SCHARDL, CHRISTOPHER L3. Expression of small secreted protein genes of the systemic grass endophyte, Epichloë festucae, during benign seed transmission and stroma formation. Epichloë festucae is a model species for symbioses of endophytes with cool season grasses. E. festucae colonizes all above-ground plant organs, growing by intercalary hyphal extension in elongating grass leaves. During the reproductive phase of growth, the fungus exhibits a dual nature: retaining its benign endophytic growth and its mycorrhizal identity, or forming an external mycelial "seal" (stroma). In order to identify the genes in-
LOEHR, STEPHANIE M.1*, and ROYCE, DANIEL J.1. Corn Stover Substrate for Agaricus bisporus Production. The value of the mushrooms (Agaricus bisporus) produced in the U.S. in the 2008-09 season was $957 million. Commercially grown mushrooms are produced on a traditional composted substrate consisting of various mixtures of hay, cottonseed hulls, straw, bearded horse manure, poultry manure, seed meals, and gypsum. A two-phase composting process occurs to produce the selective substrate for Agaricus growth. This method of composting is cost-effective, consuming and malodorous. Elimination of the phase I composting process may help to alleviate some of these concerns, as well as possibly increasing profits of mushroom farmers. We have attempted to eliminate phase I composting by subjecting milled corn stover (Zea mays) to phase II composting only to produce a selective substrate. Using this substrate, we have achieved mushroom yields comparable to mushroom yields grown using traditional two-phase composted substrate. Factors influencing yield and biological efficiency of mushrooms grown on this substrate include particle size of substrate, supplementing at casing with delayed-release nutrient supplements, temperature during phase II composting and supplementing prior to phase II composting. Data from specific crops will be presented. Growers may benefit from the use of this minimally composted substrate by reducing material and labor costs and dry matter loss. By optimizing environmental impacts of mushroom substrate preparation. Oral The Pennsylvania State University 305 Buckhout Lab University Park 16802 United States. 2The Pennsylvania State University 316 Buckhout Lab University Park 16802 United States.

LOVELY, C. BEN *, SHAW, GREGORY E. and PERRYN, MICHAEL H. Regulation of Morphogenesis in Response to Low Ammonium in Ustilago maydis. The common pathogenic fungus Ustilago maydis undergoes the dimorphic transition from a yeast-like saprobic growth form to a hyphal growth form in response to successful mating and subsequent host cues. In addition, U. maydis can also undergo haploid filament formation in response to several environmental cues including low ammonium conditions and growth in lipids or acid pH. On solid media deficient in ammonium (SLAD), U. maydis produces a filamentous colony morphology, while in liquid low ammonium media the cells do not form filaments. The PAK-like Ste20p homologue, Smul, is required for a normal response to pheromone via up-regulation of mfa expression. Disrupting smul reduced this up-regulation of mfa, while mutation of mfa with the effect restored mfa expression in the a2 mating background. Disruption of smul also leads to a decrease in the filamentous response on solid SLAD media, whereas overexpression of smul increases filament production in the same conditions. Yeast two hybrid analysis identified the conserved protein-arginine methyltransferase, Hsl7, as a potential interacter of Smul. Disruption of hsl7, causes cell elongation and an increase in the filamentous response to solid SLAD. Interestingly, simultaneous disruption of hsl7 and overexpression of smul leads to a hypha-like filamentous response on solid SLAD. In addition, the double mutant strain also forms filaments in liquid SLAD, while neither single mutant displays this phenotype. A similar filamentous response in both solid and liquid SLAD was also observed in strains lacking another PAK-like protein kinase involved in cytokinesis, Cla4. These observations provide an interesting line of investigation into the overall control filamentous response to environmental cues in U. maydis. Oral University of Louisville Department of Biology, Belknap LS139 Louisville 40208 United States. 2University of Louisville Department of Biology, Belknap LS139 Louisville 40208 United States. 3University of Louisville Department of Biology, Belknap LS139 Louisville 40208 United States.

LOUIMA, DANIEL L.1*, EBERHART, JOYCE1 and ABBOTT, RICHARD2. Effects of fungal spore inoculum on the survival, growth, and ectomycorrhiza diversity of out-planted Douglas-fir seedlings. Inoculating bare-root conifer stock with spores of ectomycorrhizal fungi (EMF) has been advertised to improve growth and survival; and has never been rigorously tested on 2-0 bare-root Douglas-fir out-planted on sites subjected to operational forest management. We evaluated the effectiveness of EMF spore inoculum to increase survival and growth. We also compared EMF spore inoculum to that obtained from a different ecoregion. Inoculated seedlings were assigned to 3 ground treatment types: 1) “Burn” – areas where slash piles were burned, 2) “Loader” – logged areas of the harvest unit exclusive of temporary roads and burned slash piles, and 3) “Road” - decommissioned roads that had been subsoiled to reduce soil compaction. Each of these ground treatment categories was planted with 100 clusters of seedlings for a total of 300 clusters. Each cluster contained one seedling from each of 3 fungal inoculum treatments: 1) local inoculum, 2) off-site inoculum, and 3) no EMF spore inoculum control. Mortality was greatest in the first year and differed among all disturbance treatments and all fungal treatments. The local inoculum was associated with higher seedling mortality. In the second growing season, mortality was not different among the fungal treatments but was greater in the Loader treatment than the other disturbance treatments; leader growth was not different among fungal treatments. This allows for a more rapid identification of compounds that have been affected by environmental impacts. Current chemistry instruments/techniques have allowed deeper investigation into the pathways of the target metabolites, allowing routine identification and semi-quantification of the indole diterpenes and ergot alkaloids that make up the licoribem B and ergoline pathways, respectively. Collaborations with molecular biologists have lead to a greater understanding of the gene clusters associated with these pathways, and the identification of gene function. Investigations at the molecular level have also improved understanding of additional endophyte pathways, and led to the identification of new endophyte metabolite classes. Current chemistry techniques are significantly more sensitive (and informative) than those employed historically. This allows for a more rapid identification of compounds that have been affected by gene knock-outs. These more sensitive techniques can also be employed in the investigation of novel bioactivity, be that insect resistance or animal toxicity. Historically, techniques have not been available for the in planta detection of high potency, very low level toxins. Significant pre-concentration steps were required before the toxins could be detected and identified. With currently available techniques, the analysis of crude samples can reveal sufficient information to identify candidate compounds. The traditional chemistry techniques still have their place, as they are generally low-tech, low-cost, and suitable for high-throughput analyses. These techniques are ideally suited to large-scale projects focused on few metabolites. The merits and application of each of the above techniques will be discussed, with examples from recent research. Oral AgResearch Tennent Drive Palmerston North 4422 New Zealand.

MACE, WADE1*, SCHWENDEL, HEIKE2, HUME, DAVID2 and HICKEY, MIKE. Seasonal expression of endophyte and plant alkaloids for selected endophytes in two tall fescue cultivars. Over a 12 month period alkaloid production was monitored in four tall fescue host/endophyte associations, namely; Jesup infected with endemic Kentucky31 endophyte, Jesup/AR542, Jesup/AR584 and Flecha/AR542. The endophyte alkaloids measured were ergovaline, lolines (N-acetyl norsoline, N-formyl loline and N-acetyl loline), peramine and cyclic-oligopeptides. The plant alkaloid thesinine was also measured. This is the first study to report the expression of the cyclic-oligopeptides and tall fescue expression of theesine. The expression of the alkaloids did not appear to be in uni-
son, with peramine peaking later than lolines and cyclic-oligopeptides. Flecha also showed significantly higher expression of all of the endophyte alkaloids compared to Jesup. Particular attention was paid to distribution of the alkaloids between the leaf and pseudostem sections of the tiller, as previous studies have shown that alkaloid expression is differentially distributed in the Continental (cultivar Jesup) and Mediterranean type (cultivar Flecha) tall fescues. This plant section showed that the higher expression of alkaloids in Flecha was driven by the leaf expression, as both cultivars produced the same levels of alkaloids in the pseudostem. Poster 1 AgResearch Tenny Drive Palmerston North 4424 New Zealand.

MALINOWSKI, DARIUSZ*, WEST, CHARLES† and BELESKY, DAVID P.†. The role of endophytes in summer-dormant tall fescue. Summer-dormant types of tall fescue (Lolium arundinaceum) originated in the Mediterranean Basin and, in contrast to continental counterparts, have developed a mechanism of summer drought avoidance. Changing climate and repeated, devastating droughts, has led to increased use of summer-dormant types of cool-season perennial grasses in C3-C4 transitional zones. Summer-dormant tall fescue accessions may harbor natural Neotyphodium coenophialum fungal endophytes. The involvement of native endophytes with summer-dormant tall fescue tolerance of abiotic and biotic stresses is not well understood. Improved cultivars of summer-dormant tall fescue are often re-infected with novel endophyte strains, which may have unknown consequences for relatively short-term economic returns from improved pasture productivity. This project focuses on endophyte variances in tall fescue accessions compared to endophyte associations with continental-origin tall fescue. We focus on responses to drought and mineral stress, selected aspects of plant physiology, competitive interactions with other plant species, long-term persistence under defoliation stress, and tall fescue forage nutritive value. Data suggest that endophytes elicit similar responses in the rhizosphere of summer-dormant and summer-active tall fescue with respect to root growth, root mass development and nitrogen uptake compared to summer-active tall fescue, endophytes do not contribute to drought stress tolerance (i.e., no differences in carbon isotope discrimination between endophyte-infected and endophyte-free plants) and long-term persistence of summer-dormant tall fescue, although endophyte infection can affect expression of summer dormancy in some tall fescue accessions. The ecological role of endophytes in summer-dormant tall fescue may primarily relate to increased tolerance to biotic stresses, especially herbivory, in that the endophyte may reduce the severity and frequency of grazing by sheep and goats, very important ruminants in the Mediterranean Basin. Oral 1 Texas AgrilLife HYW 70 Vernon 76385 United States. 2Univ of Arkansas Dept Crop, Soil & Environ Sci Fayetteville 72704 United States. 3USDA-ARS, Appalachian Farming Systems Research Center 1224 Airport Road Beaver 25813 United States.

MALTZ, MIA* and TERRY, NORMAN†. Role of AM fungi in the phyto-restoreation of boron contaminated soils. Previous studies have explored the role of commercial AM products for facilitating host plant establishment in arid environments. It is well known that mutualistic associations between arbuscular mycorrhizal (AM) fungi and their host plants are especially important in degraded and contaminated environments. High toxic boron contamination in residual soil horizons and in the aquifers, continues to limit establishment of plants in arid environments. The objective of this research is to test the influence of AM inoculation on the boron tolerance of a grass, Puccinellia distans, exposed to increasing concentrations of boron supplied in a standard horticultural potting soil. Different methods of AM inoculation were tested by incorporating AM spores or extraradical hyphae from fungal inoculants, including Glomus mossae, Glomus intraradices, and Glomus morbicum inoculants. Plant biomass accumulation was used as a means of quantifying changes in plant boron tolerance as a result of varying intensity and method of application of inoculants. Oral 1 Sonoma State University 1801 E. Cotati Ave. Rohnert Park 94928 United States. 2University of California, Berkeley 111 Koshland Hall Berkeley 94720 United States.

MARINO CORDENAS, YOBANA†, TRIFILIO MARTINEZ, MARELLA1 and BAYMAN, PAUL2. Colonization and degradation of coffee seeds (Coffea arabica) by endophytic fungi: a novel approach for control of the coffee berry borer. Fungi are particularly efficient at degrading the major plants polymers, cellulose and lignin, because, they secrete extracellular enzymes to breakdown these complex molecules that other organisms unable to degrade. Endophytic fungi can be latent saprotrophs when the tissues die and some of them are often re-infected with novel endophyte strains, which may have unknown consequences for relatively short-term economic returns from improved pasture productivity. This project focuses on endophyte variances in coffee accessions compared to endophyte associations with continental-origin coffee. The species tested were Xyliaria hystopoxylon, Xyliaria guareca, Xyliaria sp, Xyliariaceae sp., Polyporus and Pestalotiopsis. Significant differences were found in the percentages of internal and external colonization. The losses in weight of coffee seeds caused by the fungi ranged from 0 - 3.3% but differences were not significant. The goal of this project is to identify species of fungi that can accelerate the natural decomposition of coffee beans that remain on the ground and plants after the harvest. This would ensure they don't become infection sources of the coffee berry borer (Hypothenemus hampei), a major pest of coffee. Fungi that are efficient decomposers of coffee beans, without causing adverse changes in agronomic system function, could be a novel method of cultural control of this pest in Puerto Rico. Poster 1 University of Puerto Rico-Rio Piedras Avenida Ponce de Leon San Juan 00917-3360 Puerto Rico. 2University of Puerto Rico P.O. Box 23360 San Juan 00915-3360 Puerto Rico.

MARTIN, W. WALLACE*. A new aquatic member of the Zygomycoctea with affinities to Mortierella. An unusual fungus was isolated from a moribund adult midge collected from a local pond. The fungus grows vegetatively on a variety of common media but produces reproductive structures only when hemp seeds or dead midge larvae are employed as a food source. Hyphaeaggregate into the food source to produce an extensive floating network of anamorphosing thick-walled hyphae. The network is typically one in which the hyphal mesh divides the water surface into nearly isodiametric squares or simple polygons. As development continues clusters of rounded vesicles are produced at the interstices of the hyphal network. Clusters typically consist of 15-30 rounded, interconnected hyphal vesicles which function as "floats" from which a series of smaller branching hyphae emerge. Hyphal vesicles are observed to become tangled in the smaller hyphae and in some cases are penetrated and killed by the hyphal. Some clusters also function as bases for 1-3 simple sporangioles, 0.3-0.5 mm long, which produce rounded, many-spored sporangia. A columnella is lacking. Large floating aggregations of several hundred rounded vesicles are produced around the periphery of older water cultures. Disarticulated vesicles reveal that they contain a living aggregate of single or larger vesicles whose contents are filled with refractive contents surrounded by a sheath of smaller vesicles. When vesicle aggregations are dried for several months and subsequently immersed in water, they produce a number of thin branching hyphae. No zygospores have been observed. A preliminary study comparing the 18S rDNA of this fungus with other members of the Zygomyctea has revealed that it is most closely related to the genus Mortierella. Poster Randolph-Macon College P.O. Box 1949 Ashland 23005 United States.

MATTHEWS, JAMES‡, XUE, YAN‡, LIAO, SHENGFÄ‡ and BOLING, JAMES. Alteration of bovine gene expression and protein function by ergot alkaloids. The objective of our endophyte toxicosis research program has been to determine the potential effects of toxic endophyte-infected tall fescue consumption on expression and function of proteins critical for nutrient metabolism by cattle. We have evaluated the effect of endophyte exposure on (1) liver expression profiles using a grazing steer model, (2) function of nucleoside transporters using Madin-Darby Bovine Kidney (MDBK) cultured cells, and (3) function of vesicular glutamate transporters (VGLUT) using neuronal synaptic vesicles isolated from steer cerebral tissue. Growing steers exposed to a summer-long (> 90 days) treatment of the endophyte infected (80%) and non-infected (20%) summer-dormant tall fescue pastures (n=10) vs a low toxic endophyte (LE; 0.023 μg/g ergot alkaloids) tall fescue pasture (n=10) displayed classic phenotype and clinical characteristics of toxicosis, including decreased average daily gain, serum alkaline phosphatase, alanine aminotransferase, aspartate aminotransferase, and lactate dehydrogenase. Concomitantly, immunoblot analysis found that hepatic contents of aspartate aminotransferase and cystolic phosphoenolpyruvate carboxykinase were higher in HE steers. Microarray analysis of the same liver samples revealed increased (P<0.01) expression of genes for proteins involved in mitochondrial shunting of amino acid carbons into pyruvate (alanine aminotransferase 2) and ATP (oxidative phosphorylation pathway) synthesis. Whole-cell nucleoside transport analysis with MDBK cells revealed that ergovaline and bromocryptine inhibited (80%) nucleoside transporter 1 activity, with bromocryptine acting in a non-competitive manner. Functional analysis of glutamate uptake by synaptic vesicles revealed that four naturally-occurring ergopeptides are potent inhibitors of VGLUT activity, including a non-competitive mechanism of action by ergovaline. Thus, novel putative mechanisms for ergot alkaloid-induced fescue toxicosis have been identified; livers of steers grazing HE pastures have enhanced potential for glucogenic and ATP synthetic capacity whereas nucleoside transporters are unable to use a central shunt gluconeogenic neurotransmission and peripheral tissue function may be impaired by specific ergopeptides. Oral 1University of Kentucky 213 WP Garriss Building Lexington 40546-0215 United States. 2University of Kentucky 214 WP Garriss Building Lexington 40546-0215 United States. 3University of Kentucky 207 WP Garriss Building Lexington 40546-0215 United States. 4University of Kentucky 207 WP Garriss Building Lexington 40546-0215 United States.

MCARDO, PATRICIA*, CORDES, CARLOS, LAUDOMIO JAVIER† and NOVAS, MARIA VICTORIA†. Biodiversity of foliar endophytes in the native grass Poa
bonariensis. Most of the studies on endophytes of grasses have been focused on the systemic vertically/horizontally transmitted epichloid-endophytes. These endophytes have been proved to protect their hosts against pathogens and to suppress fungal growth in culture. However, little is known about the total biodiversity of foliar endophytes and its relationships with vegetative-transmitted and epichloid-endophytes. In this work we studied the biodiversity of horizontally transmitted endophytes of Poa bonariensis, a perennial grass native to Argentina, and its association with the presence of Neotyphodium endophytes. To achieve this, we randomly collected plants of P. bonariensis without disease symptoms from a natural population that present Neotyphodium infected (E+) and Neotyphodium free (E-) plants. The presence of Neotyphodium was checked in all collected plants, and 20 E+ and 20 E- plants were chosen for biodiversity analyses. Thirty surface-disinfected leaf fragments of each plant were plated on malt extract agar medium. The isolates obtained were subjected to different treatments to induce sporulation. Sporulating isolates were morphologically identified to species level. The non-sporulating isolates were sorted out into different morphotypes, according to their cultural characteristics, and a random sample from each morphotype was selected for molecular identification based on the ITS sequences. The identification was performed by alignment with sequences from GenBank database using BLAST and phylogenetic analyses with Mr. Bayes 3.1. The abundance and diversity of endophytes between E+ and E- plants was compared using the Shannon diversity index (H). A total of 524 isolates were obtained. Although only isolated from E+ plants, Neotyphodium was the most abundant endophyte in this population, followed by Alternaria, Cladosporium, Drechslera, Stagonospora and Acremonium, and other taxa like Curvularia, Paeclomycetes, Phoma, Radulidium, Sporormiella and Peniophora were also isolated. E+ plants presented a significantly higher quantity and biodiversity of foliar endophytes in E+ than in E- plants. Poster 2PROPLAME-PRHIDEB-CONICET, DBBE-UBA Av Guiraldes 2160 Cdad Universidad Paraguay 2160 Buenos Aires C1428EGA Argentina. 3PROPLAME-PRHIDEB-CONICET, DBBE-UBA Av Guiraldes 2160 Cdad Universidad Paraguay 2160 Buenos Aires C1428EGA Argentina. 4PROPLAME-PRHIDEB-CONICET, DBBE-UBA Av Guiraldes 2160 Pab 2 - Lab 69 Buenos Aires C1428EGA Argentina.

McCULLY, REBECCA1*, MCNEAR, JR., DAVID2 and IQBAL, JAVED3. Effects of endophyte symbiosis on belowground processes. Aboveground fungal endophyte symbionts of tall fescue are known to alter the physiology of individual plants, as well as effect changes in plant and herbivore community structure and ecosystem function; however, the response of belowground communities and processes to these aboveground endophytes remains largely unexplored. Using a regional sampling approach, we evaluated the hypothesis that endophyte-infected (E+) tall fescue pastures have larger soil carbon pools and altered soil microbial communities than adjacent endophyte-free (E-) stands. We sampled paired E+ and E- tall fescue pastures at nine locations throughout the southeastern United States and found support for the hypothesis, at least with regard to soil C: E+ stands had ~7% more soil C than E- (p < 0.001). These alterations to the total soil C pool were also reflected in the active and slow (or particulate) organic matter fractions; however, neither total microbial biomass nor microbial community composition were significantly altered by fungal endophyte presence. To further explore a potential mechanism for these observed alterations in soil C pools, we assessed differences in root exudates (the total organic C production from roots of plants grown hydroponically) between E+ and E- tall fescue individuals that encompassed several plant and fungal endophyte genotypes. We found large plant and endophyte genotype effects on root exudate production (e.g., KY 31 tall fescue had lower total organic C root exudate production than the other plant genotypes evaluated to date, and there was a trend for the wild-type endophyte to have lower levels of root exudates than novel endophytes). Aboveground fungal endophytes can have significant impacts on belowground processes, but more work is needed to understand the mechanistic basis of these observed effects. Oral 1University of Kentucky Ag Science North Lexington 40546-0901 United States. 2Dept. of Plant & Soil Sciences, University of Kentucky N-222 Ag Sci North Lexington 40546-0901 United States. 3University of Kentucky N-122S Ag Sci North Lexington 40546-0901 United States.

METHIVEN, ANDREW* and MILLER, ANDREW. Evolutionary relationships of the gomphoid genus Clavariadelphus: One genus or two? The genus Clavariadelphus includes a group of club-shaped basidiomes most commonly collected in late summer and fall in northern, boreal, coniferous forests throughout North America. A monograph of Clavariadelphus in North America divided the genus into two subgenera: subgenus Clavariadelphus with species that are ectomycorrhizal with coniferous or deciduous trees, broadly ellipsoid basidiospores (length-width ratio < 2.5), and little or no hyphae at the base of the basidiomes; and, subgenus Ligulas with species that function ecologically as litter decomposers in coniferous forests, narrowly ellipsoid basidiospores (length-width ratio ~ 2.5), and various amounts of hyphae which bind the substrate to the base of the basidiomes. While some mycologists have argued that these two subgena are distinct enough to be recognized as separate genera, questions about the range of variation in morphological characters, chemical spot tests and cultural characters have precluded recognition of the two groups as segregate genera. We hypothesize that the genus Clavariadelphus is polyphyletic and, in order to adhere to a natural system of classification, needs to be subdivided into two monophyletic groups and its relationships ribosomal genes, the large subunit (LSU) and the internal transcribed spacer (ITS), which are commonly used to segregate species (ITS) and higher taxonomic units (genera and families; LSU), were amplified, sequenced and analyzed in a phylogenetic context to determine if Clavariadelphus should be segregated into two genera. Based on ITS and LSU sequences, Subgenus Ligulas is well-supported as a monophyletic group that is distinct from and basal to Subgenus Clavariadelphus. Since the type species of the genus, C. paniculata, belongs to Subgenus Clavariadelphus, a new genus will be proposed for the taxa included in Subgenus Ligulas. Poster 1Eastern Illinois University Department of Biological Sciences Charleston 61920 United States. 2Illinois Natural History Survey 1816 S. Oak St. Champaign 61820 United States.

MILLER, ANDREW*, HUHNDORF, SABINE M.1, RAJA, HUZefa2, MAR-VANOVA, LUDMILA1 and SHEARER, CAROL1. Barcoding the Dothideomycetes and Sordariomycetes. The Dothideomycetes and Sordariomycetes with nearly 30,000 species combined represent one of the largest groups in the Ascomycota. Although these fungi play important roles as endophytes, parasites and saprobes throughout all ecosystems, a small percentage of these species have been barcoded and, of these, few are associated with an authoritatively identified identified barcoding data set. As part of a project to identify species on these fungi, we are working in a coordinated fashion to generate barcodes for as many diverse taxa as possible as part of the specimen documentation. Our standard barcode consists of nuclear ribosomal DNA encompassing not only the entire internal transcribed spacer (ITS) region but also the first two variable domains of the 28S large subunit (LSU). To date, nearly 400 barcode sequences have been generated for over 200 species. All taxa are associated with a voucher specimen deposited in F. ILL, and/or ILLS, and many taxa possess online image, description and locality data. Examples of intra- and interspecific ITS variation in species from both the Dothideomycetes and Sordariomycetes will be discussed along with comparisons between ITS and the recently introduced Mcm7 protein-coding gene, which shows potential as an additional or alternative barcode marker. Oral 1Systematic Mycology & Microbiology Laboratory, USDA National Arboretum 1816 S. Oak St. Champaign 61820 United States. 2Botany Department, The Field Museum 1400 South Lake Shore Drive Chicago 60605 United States. 3University of Illinois 505 South Goodwin Avenue, 265 Morrill Hall Urbana 61801 United States. 4Czech Collection of Microorganisms, Masaryk University Brno CZ-602 00 Brno CZ-602 00 Czech Republic.

MINNIS, ANDREW M.1*, ROSSMAN, AMY Y.2, FARR, DAVID F.1 and OLSEN, RICHARD T.1. Microfungi on Nyssa. Nyssa (Cornaceae) is a small genus of trees found in swamps or alluvial soils and into uplands. Collectively known as gums or tupelos, the black gum, N. sylvatica, is the most commonly cultivated species for ornamental and urban tree use due to beautiful red fall color. The USDA-ARS National Arboretum has an active breeding program to develop improved species for ornamental and urban tree use due to beautiful red fall color. The USDA-ARS National Arboretum has an active breeding program to develop improved species for ornamental and urban tree use due to beautiful red fall color. The USDA-ARS National Arboretum has an active breeding program to develop improved species for ornamental and urban tree use due to beautiful red fall color. The USDA-ARS National Arboretum has an active breeding program to develop improved species for ornamental and urban tree use due to beautiful red fall color. The USDA-ARS National Arboretum has an active breeding program to develop improved species for ornamental and urban tree use due to beautiful red fall color. The USDA-ARS National Arboretum has an active breeding program to develop improved species for ornamental and urban tree use due to beautiful red fall color. The USDA-ARS National Arboretum has an active breeding program to develop improved species for ornamental and urban tree use due to beautiful red fall color. The USDA-ARS National Arboretum has an active breeding program to develop improved species for ornamental and urban tree use due to beautiful red fall color.

MOLINA, RANDY*1, TRAPPE, JAMES M. 2, LUOMA, DANIEL L. 1, CAZARES, EFREN3, PILZ, DAVID1, SMITH, JANE4, CASTELLANO, MICHAEL1, MILLER, STEVEN 5, and TRAPPE, MATTHEW J. 3. Diversity, Ecology, and Conservation of Truffle Fungi in Forests of the Pacific Northwest. Forests of the Pacific Northwest (PNW) have been an epicenter for the evolution of belowground-fruiting truffle fungi with over 350 species and 55 genera currently identified. Most truffle species are ectomycorrhizal symbionts. Approximately 120 plant species from 19 families and 41 genera are documented as ectomycorrhizal hosts in the PNW, with members of the Pinaceae, Fagaceae, Betulaceae, and Salicaceae acting as the major tree hosts. This rich assemblage of ectomycorrhizal hosts, together with diverse forest habitat and climatic conditions, has created a unique confluence of biological and environmental conditions for the explosive evolution and diversity of truffle species in the PNW. Truffle fungi have evolved numerous times from diverse lineages of aboveground fruiting Ascomycota, Basidiomycota, and Zygomycota. In addition to performing myriad ecosystem functions typical of ectomycorrhizal fungi, truffle fruit-bodies serve as a major food source for many forest-dwelling mammals; 47 mammals and one bird have been recorded as eating truffles. A few truffle species are commercially harvested for gourmet consumption in regional restaurants, and a new industry is emerging for this special forest product. This presentation summarizes five decades of truffle research by the Corvallis Forest Mycology program and emphasizes the historical development of truffle science by mycologists over the last 100 years, truffle diversity and importance in forest ecosystems, and management principles to sustain this valuable fungal resource. Oral 1US Forest Service, Pacific Northwest Research Station 629 SW Main, Suite 400 Portland 97205 United States. 2Oregon State University, Dept Forest Ecosystems and Society 321 Richardson Hall Corvallis 97331 United States. 3US Forest Service, Lassen National Forest 2550 Riverside Dr. Susanville 96130 United States. 4US Forest Service, Pacific Northwest Research Station 3200 SW Jefferson Way Corvallis 97331 United States. 5Department of Botany, University of Wyoming 114 Aven Nelson Building Laramie 82071 United States.

MOORE, NEIL*, ARNAOUDOV'A, ELISSAVETA2, HARRIS, DANIEL1, JAROMCZYK, JERZY3 and SCHARDL, CHRISTOPHER L1. The Epichloë festucae genome browser. We provide a tour of the web site for the Epichloë festucae Genome Project. This site, based on the GBrowse generic genome browser from the Generic Model Organism Database (GMOD) project, integrates and visualizes the large amount of data we have collected describing the E. festucae genome. Data from various alignment, prediction, and analysis programs are represented as tracks in GBrowse. The user can view any subset of tracks in any region of the genome, with GBrowse displaying the location and other properties of features in that region. Clicking on a feature launches a custom script which displays more detailed, program-specific information about the feature. We will demonstrate tracks generated from the following programs: Exonerate maps ESTs, gene models, and other transcripts onto the genome. The exonere feature page displays the full alignment, as well as the query sequence and relevant portions of the genome sequence in color-coded FASTA format. BLAST aligns transcriptome and genome sequences against the NCBI GenBank and Protein database. The feature page displays the alignment, linking to the corresponding database entry for the sequence. FGENEsh predicts genes and protein sequences. The FGENEsh feature page displays the predicted protein sequence, as well as more detailed information on exons and other predicted features. MAKER applies a number of alignment and de novo analysis tools to predict genes. The MAKER feature page displays the hierarchy of sub-features, as well as a color-coded predicted transcript sequence in FASTA format. InterProScan applies a wide variety of algorithms to scan for protein domains and families. The InterProScan feature page displays the identified signatures, with links to descriptions of those signatures and proteins in the InterPro web database. Other features of the site include a link to download FASTA files for all features in a given track, in a particular region of the genome; a full-text feature search providing links to the genome region containing the desired feature; and many more. Oral 1University of Kentucky, Department of Biology, Richardson Hall Corvallis 97331 United States. 2Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada, 1391 Sandford Street London, Ontario N5V 4T3 Canada. 3University of Kentucky Department of Plant Pathology, 1151 Richmond Street London, Ontario N6A 3K7 Canada. 4New Mexico State University 1Department of Biology, 5Department of Plant Pathology Las Cruces, NM 88003 USA.

NAGABHYRU, PADMAJA*, SCHRADL, CHRISTOPHER L1, BACON, CHARLES2 and DINKINS, RANDY1. Tall fescue endophyte effects on drought stress tolerance. Tall fescue plants symbiotic with the endophytic fungus, Neotyphodium coenophialum (E+), have better survivability and persistence under stressful conditions, especially under drought stress, than plants lacking the endophyte (E-). To understand more about the enhanced drought tolerance conferred by endophytic fungi, we generated E- clones by treating endophyte-infected tall fescue plants with a fungicide to generate E- clones. Then we conducted time course studies in which water was withheld from 0 to 5 days, and investigated endophyte effects on changes in levels of sugars, sugar alcohols, and amino acids, as well as some major fungal metabolites. Upon rewatering, survival and retitling were significantly greater for E- than E- plants starting from day 2 or 3 of the treatment. In each experiment, plants with first clone pair, fire glucose and fructose levels were higher in both shoots and roots of E- plants within 24 hrs after withholding water and were 2-3 fold higher in E- plants. Drought stress caused increase in most of the amino acids in both E- and E- plants. At day 1 after withholding water, proline had increased 6-7 fold in E- vs. a 2-3 fold increase in E-. Loline alkaloids and mannitol, which are endophyte metabolites, also significantly increased with drought stress. Results in experiment 2, with same clone pair were very similar, except for a one-day relative delay in effects on tiller survival and metabolites, probably due to weather conditions. In the second clone pair, effects of endophyte on survival and retitling were also observed, but of lesser magnitude than with the first clone pair. Overall, the results indicated that endophyte effects on free sugars and certain amino acids in shoot and root were evident within two days of the onset of drought stress, but the particular effects depended and environment (variation between experiments) and perhaps on genotype. Thus, we had concluded that endophyte aids in survival and recovery of plants from drought, and may act in part by inducing rapid accumulation of these compatible solutes, soon after imposition of stress. Oral 1University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States. 2USDA, ARS, Russell Research Center College Station Rd. Athens 30604 United States. 3USDA ARS 1100 S Limeston Agricultural Building N Lexington 40546 United States.

NALIM, AMEENA*, SANOGO, SOUM1 and BOSLAND, PAUL2. Genotypic characterization of Phytophthora capsici races from chile pepper in New Mexico. Phytophthora capsici, a soft-borne microorganism, and a devastating pathogen of chile peppers (Capsicum annuum L.) and many other vegetable crops worldwide, was first reported in New Mexico. There are no commercial chile pepper cultivars resistant to P. capsici. It is important to characterize the variability of populations of P. capsici to better control and manage this pathogen, and for breeding resistant chile pepper cultivars. Physiological races of P. capsici have been characterized based on a set of recombinant inbred lines of NM chile pepper. There is evidence of 2 mating types in the field, which could lead to new races not detected. Time durability of host resistance. Inoculation of two resistant inbred lines with P. capsici and the characterization of races can be difficult and time consuming. Our goal was to distinguish races of P. capsici using molecular markers. To establish a uniform classification of races, DNA-based molecular markers, such as specific DNA fingerprints were sought to identify each race. The internal transcribed spacers (ITS) and the intergenic rDNA spacer (IGS) regions have been useful for species identification but have not been used in intra-specific studies of Phytophthora species. The specific objectives of this study were (1) the development of PCR-based DNA fingerprinting methods to distinguish races of P. capsici and (2) sequencing of multiple loci to compare the phylogenetic relatedness of these races. Several primer pairs were used to amplify the ITS and IGS regions and sequenced. PCR products were digested using several different restriction enzymes. Our results indicate low intraspecific variation in the ITS region of isolates from NM chile pepper. There was a significant correlation between RFLP fingerprints and races. Oral 1New Mexico State University Department of Plant Pathology Las Cruces, NM 88045 USA. 2New Mexico State University, Agricultural Sciences Center, Las Cruces, NM 88003 USA.
to eventually elucidate the roles of mycophilic bacteria. The community assemblage corresponding to each fungal species and discuss the specificity of bacterial associates within Bishop pine (*Pinus muricata*). Our results show that mycorrhizal colonisation of host plants. Here, we tested the hypothesis that mycorrhizal colonisation in turn adversely affects N. lolii endophyte concentrations and that the competitive interaction between the two endosymbionts is affected by resource supply. Specifically, we report how competition between Glomus (*G. mosseae* - GM, *G. intraradices* - GI) mycorrhizal fungi and N. lolii (common strain - CS, AR1) foliar endophytic strains is affected by P supply, and water soluble carbohydrate (WSC) content in two contrasting Loliyum perenne cultivars: a high sugar grass (HSG), AberDart, and a conventional (control) grass, Fennema. Endophyte and mycorrhiza concentrations were estimated by quantitative polymerase chain reaction (qPCR). The presence of Glomus mycorrhiza reduced the concentrations of foliar endophytes and their alkaloids in leaf blades and pseudostems, the reduction depended on P supply, bygrass cultivar (notably Loliyum WSC content), and endophyte strain. Conversely, foliar endophyte infection reduced mycorrhizal colonisation rates and concentrations in the roots of the control cultivar Fennema, though not in the high sugar cultivar, AberDart. High molecular weight WSCs were significantly higher in AberDart-HSG blades, but lower in the roots of this cultivar compared to Fennema. Neither GM nor N. lolii infection had an effect per se on the yield of root or blade compared to mycorrhiza-free (M) and endophyte-free (E-) plants, respectively; though yield of roots and blades was reduced by GI infection and at low P. Competitive interactions between foliar endophytes (valuable for plant protection) and mycorrhizal endosymbionts (valuable for P acquisition) as seen in this study are of critical concern especially in areas of high pest prevalence and low P availability, through reduced plant yield and/or work stress in plants grown from E- populations. In E+ and GI endosymbionts and for elucidating the physiological/ metabolic basis for the interactions between endosymbionts, to ensure sustained plant performance and fitness, in natural as well as in agricultural contexts. Oral 1University of Guelph School of Environmental Sciences Guelph N1G 2W1 Canada. 2AgResearch Grasslands P.B. 11008 Palmerston North N/A New Zealand. 3AgResearch Grasslands P.B. 11008 Palmerston North N/A New Zealand. 4Molecular Solutions 4216 N. Castle Ave. Portland OR 97229 United States. 5AgResearch & Agri-Food Canada 960 Carling Avenue, Central Experimental Farm Ottawa K1A 0C6 Canada.

Norvell, Lorelei L.1*, Exeter, Ronald L.2, Gordon, Matthew3 and Redhead, Scott A.2. Species concepts in a molecular age: the *Phaeocryptopus* species complex. Two steps forward—one step back. The taxonomic community has come to recognize that when it becomes too difficult to identify a specimen using traditional means, it may not be the fault of the key, but of the species concept. Current research by a “taxonomic-genomic” consortium seeks to discover where molecular biology is more efficient and where morphology is more cost-effective in diagnosing species in *Phaeocryptopus* (Agaricomycetes, Hymenogastreae), a genus of agarics surveyed for by US governmental agencies to help determine federal management of Pacific Northwest forests. The *Phaeocryptopus* genus was first shown useful in 1998 when RFLP profiles obtained from 160 North American *Phaeocryptopus* species supported 26 named and unnamed morphospecies. Collection and morphological research during the past decade and a half has produced ten new species, a monograph, and keys to 25 species endemic to Oregon, California, Washington, Idaho, and British Columbia. Sequence analyses of the ITS region from type and recently collected US and Canadian specimens during 2009 and 2010 reveal nesting of newly named species (e.g., *P. rutobutilina, P. tibialuxifanum*) while helping to resolve the identity of rare specimens that were collected without important fresh notes. On-going morphological analyses are helping to ascertain how much ITS sequence variation should be expected among closely related taxa and are testing whether as-yet undescribed species implied by our recent DNA sequence analyses can be readily identified in the field. Our conclusions should prove useful to ecological studies using environmental DNA sequences to determine species diversity and contribute over 300 new *Phaeocryptopus* sequences to GenBank, thereby contributing to a reliable global phylogeny for the genus. Poster 1PNW Mycology Service 6720 NW Skyline Blvd. Portland 97229-1309 United States. 2Bureau of Land Management, Salem District Office 1717 Fabry SE Salem 97306 United States. 3Molecular Solutions 4216 N. Castle Ave. Portland 97227 United States. 4AgResearch & Agri-Food Canada 960 Carling Avenue, Central Experimental Farm Ottawa K1A 0C6 Canada.

Novas, Maria Victoria1*, Iannone, Leonardo Javier2, Viganole, Maria Victoria1 and Scervino, Martin2. Positive association between *Neotyphodium* endophyte and arbuscular mycorrhiza fungus: a widespread trait in native grasses. The potential impact of foliar endophytes on below-ground process, in particular on arbuscular mycorrhiza fungus (AMF), has already been established in native grasses, from type and recently collected US and Canadian specimens during 2009 and 2010 reveal nesting of newly named species (e.g., *P. rutobutilina, P. tibialuxifanum*) while helping to resolve the identity of rare specimens that were collected without important fresh notes. On-going morphological analyses are helping to ascertain how much ITS sequence variation should be expected among closely related taxa and are testing whether as-yet undescribed species implied by our recent DNA sequence analyses can be readily identified in the field. Our conclusions should prove useful to ecological studies using environmental DNA sequences to determine species diversity and contribute over 300 new *Phaeocryptopus* sequences to GenBank, thereby contributing to a reliable global phylogeny for the genus. Poster 1PNW Mycology Service 6720 NW Skyline Blvd. Portland 97229-1309 United States. 2Bureau of Land Management, Salem District Office 1717 Fabry SE Salem 97306 United States. 3Molecular Solutions 4216 N. Castle Ave. Portland 97227 United States. 4AgResearch & Agri-Food Canada 960 Carling Avenue, Central Experimental Farm Ottawa K1A 0C6 Canada.

O’Connell, Richard*, Takahara, Hiroyuki and Kleemann, Jochen. Tête à tête inside a plant cell: insights into fungal biotrophy from the *Colletotrichum-Arabidopsis* pathosystem. The hemibiotrophic ascomycete *Colletotrichum higginsianum* causes anthracnose disease on many brassica crops, as well as Arabidopsis thaliana, providing a model pathosystem in which pathogen and host genomes are available and both partners can be genetically manipulated. After initial penetration by melanized appressorium, the fungus grows biotrophically inside living epidermal cells, producing bulbous biotrophic hyphae that invade and expand the host plasma membrane and develop a specialized...
intercontact with host cells. We assume that appressorium and biotrophic hyphae secrete effector proteins, during and after penetration, that permit the fungus to evade or disarm host defense responses, maintain host cell viability and remodel the host cytoplasm. As a first step towards the discovery of secreted effectors in C. higginsianum, we generated expressed sequence tags from appressorium and biotrophic hyphae isolated from infected leaves by fluorescence-activated cell sorting. Biocomputational prediction tools were then used to identify genes encoding small, soluble secreted proteins of unknown function. Expression profiling showed that many candidate effector genes are plant-induced and highly stage-specific. Localization in planta, either by immunolabelling or the ectopic expression of fluorescent fusion proteins in C. higginsianum, revealed that several effectors accumulate at the biotrophic plant-fungal interface. We present evidence that some secreted effectors may function in counter-defense, potentially masking fungal cell wall components from detection by plant PAMP receptors, while others suppress elicitor-induced plant cell death when transiently expressed in N. benthamiana leaves. A further effector candidate containing a predicted nuclear localization signal was found to target the plant nucleus when expressed in planta as a GFP fusion protein. Oral Max Planek Institute for Plant Breeding Research Carl-von-Linne-Weg 10 Cologne 50933 Germany.

OBERHOFER, MARTINA and LEUCHTMANN, ADRIAN. Diversity of hybrid and non-hybrid Epichloë endophytes in a native woodland grass species across Europe. Assexual Neotyphodium endophytes are either haploid species of sexual origin or are heterozygous hybrids. As a result, there is a need to question hypotheses that have used presumed hybridizations between sexual and asexual parental strains. Hybrid strains are dominating in many natural host grass populations suggesting that they have a selective advantage. Benefits resulting from hybridization may be the large choice of adaptive genes or a remedy for accumulating deleterious mutations. Here we examined the European woodland grass species Hordelymus europaeus, which is known to be host of both, hybrid and non-hybrid endophytes. These endophytes are asexually and strictly seed transmitted. We collected samples from 33 populations along a pan European transect ranging from Italy to Sweden. Endophytes were isolated and screened for the presence of hybrid and non-hybrid strains using allozyme analysis. Non-hybrid strains were then subjected to direct sequencing of the intron rich genes for β-tubulin (tubB) and translation elongation factor 1-α (tefA), while hybrid strains were cloned into M13 plasmids and different alleles of the two genes sequenced separately. Sequences were compared to reference sequences from GenBank by maximum likelihood analysis. We will present newly discovered hybrid strains and discuss their putative parentale Epichloë species. Furthermore, we found evidence of a presumed host jump of a sexual Epichloë species from Brachypodium sylvaticum to H. europaeus. The different hybrid strains varied considerably in their distribution areas suggesting that they are of different age and have arisen independently. Oral ETH Zürich, Institute of Integrative Biology Universitaetstrasse 16 Zürich 8092 Switzerland.

OLARTE, RODRIGO*, HORN, BRUCE, MONACELL, JAMES, STONE, ERIC and CARBONE, IGNAZIO. Direct genetic evidence to support the presence of sexual recombination within the life cycle of Aspergillus flavus. Aspergillus flavus is the major producer of aflatoxins, which are cancer-causing secondary metabolites. In the United States, mycotoxins have been estimated to cause agricultural losses totaling upwards of $1.4 billion annually, with aflatoxin contamination in peanut exported worldwide potentially accounting for as much as $450 million. We recently described Petromyces flavus, the sexual state of A. flavus, from cross between strains of the opposite mating type. Sexually compatible strains when crossed with one another varied greatly in their degree of fertility. We demonstrated that sexual reproduction in A. flavus is heterothallic and occurs between individuals belonging to different vegetative compatibility groups, which suggests that the vegetative compatibility system is not a barrier to gene flow. In the present study, we genetically examined the F1 offspring from several successful crosses between strains of the aflatoxin gene cluster on chromosome V in the linked loci on different chromosomes were analyzed to quantify gene flow. We present the first direct genetic evidence to support the occurrence of sexual recombination between compatible strains of A. flavus through the meiotic processes of independent assortment and crossing-over, both of which are likely to contribute to the maintenance and regeneration of the aflatoxigenic phenotype. Crossing-over can repair deleterious mutations in the aflatoxin cluster in recombinants that may not be sexually induced or are heterozygous hybrid strains that have escaped from natural hybridization. Our experimental results are consistent with recent indirect inference of recombination in nature. The locations of the crossover breakpoints within the aflatoxin cluster of the recombinant F1 progeny from our mating studies corroborate with those deduced from the genetic analysis of natural populations. Implications of recombination on mycotoxicity heritability are currently under investigation. Oral Department of Plant Pathology North Carolina State University 851 Main Campus Dr., Room 271, Partners III Raleigh 27606 United States. National Peanut Research Laboratory 1011 Forrester Dr, S.E. Dawson 38942 United States. 2Bioinformatics Research Center, North Carolina State University 840 Main Campus Dr., 1500 Partners II Raleigh 27606 United States. 3Department of Genetics, North Carolina State University 840 Main Campus Dr., 1517 Partners II Raleigh 27606 United States.

OSMUNDSON, TODD*, BERGEMANN, SARAH and GARBELLOTTO, MATTEO. Fungal discovery and diversity patterns in a model tropical ecosystem: the Moorea Biocore Project. The Moorea Biocore Project has the goal of developing a fully-characterized tropical island model ecosystem through intensive biotic surveys and generation of DNA barcode libraries for all groups of non-microbial organisms, including fungi as both a component of the macroflora and a test case for the inclusion of microbes. To characterize fungal diversity and species composition as comprehensively as possible, standard inventory techniques have been combined with environmental DNA sampling across a land-use gradient from agricultural plantations to endemic plant communities. An estimated 200-300 macrofungal species have been collected, and the generation and analysis of over 10,000 environmental rDNA (ITS + partial LSU) sequences are currently in progress. Preliminary results indicate high diversity. For example, a leaf DNA clone library from 3 plant species yielded a Cha1 richness estimate of 132 OTUs (97% similarity level) with a mean 69.3% of OTUs unique to each host, and a wood library from one of these hosts generated an estimate of 36 fungal OTUs, with no OTU overlap with the corresponding leaf library. One of the most comprehensive fungal diversity studies for a tropical ecosystem to-date, this project provides unique estimates of fungal biodiversity and methods and techniques for characterization of fungal communities, sources of taxonomic and substrate biases, and informatics challenges - these questions, in addition to project-specific progress and issues, will be addressed. Oral University of California - Berkeley 137 Mulford Hall Berkeley 94720 United States. Middle Tennessee State Univ Davis Science Bldg Murfreesboro 37132 United States.

PADDASEE, MAHAAJABEEN and AIME, M. CATHERINE. Placing orphan anamorphic smut genera in good homes: a phylotgetic reevaluation of Tilletiopsis and Malassezia. In May 2009 a novel anamorphic smut (MCA3729) was isolated via the ballistospore-fall method from salt-irrusted grass infected with the rust fungus Puccinia emaculata on a beach on Galveston Island, Texas. On the basis of phylogenetic analyses of six loci—two nuclear ribosomal (large and small subunit) and four protein-coding (ATP-dependent RNA helicase, ribosomal RNA assembly protein, elongation factor 1-alpha, and RNA polymerase II)—the isolate is placed within Ustilaginomycota (smut fungi) and their allies) with high support values. Ribosomal sequence data place MCA3729 as sister to but distinct from the anamorphic species Tilletiopsis pallecens, which is confirmed by assimilation tests. Additionally, DNA data show that T. pallecens is unrelated to the generic type of Tilletiopsis, T. washintonensis, and together with MCA3729 form a new genus and lineage that is sister to the Exobasidiomycetes and the Ustilaginomycetes. The data also suggest that the lipophilic yeast genus Malassezia could be included within the Ustilaginomycetes. The potential impact on the systematics of Ustilaginomycota will be discussed as will the implications for understanding morphological evolution of smuts and their allies. Poster Louisiana State University AgCenter 302 Life Sciences Building Baton Rouge 70803 United States.

PANACCIONE, DANIEL*, COYLE, CHRISTINE, SCHARDL, CHRISTOPHER L, CHENG, JOHNATHAN and O’CONNOR, SARAH. Early steps and branch point of ergot alkaloid pathways in fungi. Different structural classes of ergot alkaloids are produced by several fungi in the Clavicipitaceae, including certain Neotyphodium species that grow endophytically in grasses and ergot fungi of the genus Claviceps, produce lysergic acid derivatives and also accumulate simpler clavine ergot alkaloids. Distantly related fungi in the Trichocomaceae, such as the human pathogen Aspergillus fumigatus, produce a separate series of clavine alkaloids that differ from clavine alkaloids produced by Clavicipitaceae fungi in saturation of the last assembled of four rings in the ergoline ring system. DNA sequence comparisons and knockout analyses of several genes common to fungi in both lineages indicated that ergot alkaloid producers from the two families share early steps of the ergot alkaloid pathway before diverging at some point after the synthesis of the tricyclic intermediate chanoclavine-I. Gene disruption, complementation, and augmentation studies with esaA, a gene encoding a flavin-dependent oxidoreductase of the “old yellow enzyme” class, demonstrated that the branch point of the ergot alkaloid pathways of the two lineages. Disruption of esaA in A. fumigatus led to accumulation of chanoclavine-I and chanoclavine-I-aldehyde. Complementation of the A. fumigatus esaA mutant with a wild-type allele from the same fungus restored the wild-type profile of tetracyclic ergot alkaloids, demonstrating that the product of esaA is required for closure of the fourth ergoline ring. Augmentation of the A. fumigatus esaA mutant with a homologue of esaA from C. purpurea resulted in accumulation of ergot alkaloids typical of clavicipitaceae fungi includ-

Continued on following page
ing agroclavine and setoclavine/isodesoclavine. The data indicate that functional differences in the cysA-encoded old yellow enzymes of A. fumigatus and C. purpureus result in divergence of their respective ergot alkaloid pathways. Oral 1West Virginia University 1090 Agricultural Sciences Building Morgantown 26506 United States. 2University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States. 3Massachusetts Institute of Technology 77 Massachusetts Avenue Cambridge 02139 United States.

PEAY, KABIR1, AMEND, ANTHONY1 and BRUNS, THOMAS D.2*. Aerial spore dispersal of EM fungi: the best dispersers usually, but do not always, win in the race to colonize seedlings. Prior work that treated groups of post-flowering pines as "host islands" showed that species richness of ectomycorrhizal fungi fit an island biogeographic model. However, the species composition of EM fungi on these islands was found to be "nested", with a subset of fungi found on islands of all sizes and distances. We hypothesized that this nested pattern was driven by differences in dispersal ability among species. We tested this hypothesis by using 454 sequencing and q-PCR to catalogue and quantify spores deposited in rainwater from locations ranging <10 to >5000 m from forest borders and by using uncolonized seedlings to bait for fungi at these same locations. We found that ectomycorrhizal fungi with the greatest spore dispersal generally colonized the greatest number of seedlings. However, the exceptions to this pattern were interesting as they revealed evidence that competitive interactions may limit prevalence of Suillus pungens, the best disperser in our system, in areas near the forest border, where spores of other species are abundant. In addition, the >200,000 sequences acquired by pyrosequencing showed that a huge diversity of spores can be trapped in rainwater, identified by sequence, and used to detect the dispersal of EM fungi that never colonize seedlings. Oral 1Dept. Plant & Microbial Biol. Univ. Cal. Berkeley 111 Koshland Hall Berkeley 94720-3102 United States. 2Dept. Plant & Microbial Biol. Univ. Cal. Berkeley 111 Koshland Hall Berkeley 94720-3102 United States. 3UC Berkeley 321 Koshland Hall Berkeley 94720 United States.

PEKAREK, ELIZABETH* and VILGALYS, RYTAS.1 Selection on rates of mitotic recombination in Aspergillus. While mitotic recombination was discovered in Aspergillus fifty-years ago, its role in natural population has often been dismissed as insignificant or untestable. Yet, recent experimental work has shown an adaptive advantage for A. nidulans individuals which have completed a parasexual cycle. In this study we look at the variation in rates of mitotic recombination in A. niger under different environmental stressors in order to determine if the fungal parasexual cycle is a potential mechanism for maintaining the adaptive advantages of genetic recombination within an asexual species. Poster 1Duke University Department of Biology Durham 27708 United States. 2Duke University 139 Biological Sciences Building Durham 27708 United States.

PESCITELLI, STEPHANI1* and METHVEN, ANDREW2. Biodegradation of paper waste by three edible mushroom species. We used cultures of three mushroom species-Hypsizygus ulmarius, Pleurotus ostreatus, Pleurotus eryngii-to inoculate synthetic logs made of different ratios of sterilized sawdust and paper waste by three edible mushroom species-Hypsizygus ulmarius, Pleurotus ostreatus, Pleurotus eryngii. We compared the dry weight of the resulting fruiting bodies or mushrooms to inoculate synthetic logs made of different ratios of sterilized sawdust and paper waste by three edible mushroom species. We found to garden soil.

POULDE, RAVIN*, HERRERA, JOSE and NEBEL, KATHERINE. Characterization of Coprophilous Fungal Communities Using Molecular Techniques. Dung as a substrate, provides a favorable environment for the establishment and maintenance of diverse fungal communities, which are commonly described as coprophilous fungi. We sought to characterize and compare the coprophilous fungal communities from four different herbivores collected at two separate sites: pronghorn (Antilocapra americana) and domesticated cow (Bos taurus) from Sevilleta National Wildlife Refuge, NM, and bison (Bison bison) and black-tailed prairie dog (Cynomys ludovicianus) from Wind Cave National Park, South Dakota. The data were analyzed using standard phylogenetic reconstruction methods (e.g., maximum likelihood). We will discuss the results of this study, the implications of these findings, and the utility of these types of data for fungal systematics.

PRESLEY, GERALD* and METHVEN, ANDREW. Production of edible mushrooms from a corn ethanol waste product. In an attempt to turn to a sustainable fuel source, ethanol from corn has become a more widely produced and used in many applications including automobile fuel. The process extracts the sugars from the corn in order to ferment it into ethanol, leaving behind solid wastes. These solid wastes are currently used as livestock feed. Considering the severely negative environmental impacts of the livestock industry and the fact that the 10% surtax of this waste product, alternative methods of use of this waste product are needed. This problem can be solved using edible fungi. Fungi consume dead organic material as a food source, and are perfect for the job of decomposing the waste product from corn ethanol production. Using edible fungi will give an edible product in the end and also a nutrient rich fertilizer from the materials that are not converted into mushrooms. Two edible species, Pleurotus ostreatus and Hypsizygus ulmarius will be used to decompose the corn ethanol waste product and produce edible mushrooms. The fungi will decompose the waste with varying effects on seedling above-ground biomass, tiller number at eight weeks after planting, and emergence through brick grit will be discussed. Poster 1University of Kentucky Plant Sciences Blvd. / 1405 Veterans Dr. Lexington 40546-0312 United States. 2 USDA ARS 110 S Limestone Agricultural Building N Lexington 40546 United States.

PORTER, TERESIITA*, HESE, CEDAR, YODER, RYAN2, ROBBERTSE, BARBARA1, VILGALYS, RYTAS2 and SPATAFORA, JOSEPH1. Mining genome and transcriptome data for fungal phylogenetic analyses. The amount of genomic data for fungi is increasing at a rapid and exponential rate, and fungal genomes provide novel tools for sequencing and annotating genomes. The use of this information to reconstruct the relationships among fungi is currently limited and in need of further development. As an example, we present methods to infer relationships among traditional fungal pathogens and their host pathogen interactions. Oral 1West Virginia University 1090 Agricultural Sciences Building Morgantown 26506 United States. 2Massachusetts Institute of Technology 77 Massachusetts Avenue Cambridge 02139 United States.

68 Inoculum 61(4), August 2010

Continued on following page
supplements added to the substrate mixture. The dry mass of the mushrooms produced will be compared with the dry mass of the starting organic material to determine biological efficiency. This will be compared to the biological efficiency of the waste’s current use as livestock feed. **Poster** Eastern Illinois University Department of Biological Sciences Charleston 61920 United States.

**RABINOVICH, MAIA, AT, JATINDER, KAUR, GUTHRIDGE, KATHRYN, SAWBRIDGE, TIM and SPANGENBERG, GERMAN. Comparative ge- nomics in the perennial ryegrass fungal endophyte Neotyphodium loli.** Multiple strains of the prevalent fungal endophyte of perennial ryegrass, Neotypho- dium loli, were subjected to Genome Survey Sequencing (GSS) using 454 pyrosequencing technology to gain a better understanding of the genetics underlying the biology of this asexual endosymbiont. Endophyte strains were selected based on exhibiting differing alkaloid profiles and relatively high levels of genetic diversity, as initially determined by metabolic profiling and Simple Sequence Repeat (SSR) molecular marker analysis respectively. The assembly of sequence reads for N. loli strain Standard Toxic (ST) resulted in 3,876 contigs (0.5 to 94.3 kb), covering 25.5 Mb of the c. 29 Mb N. loli nuclear genome. A comparative analysis among the nuclear sequences for the various strains identified large-scale deletion events, some of which are associated with metabolic diversity. At the nucleotide level, 178 intraspecific Single Nucleotide Polymorphisms (SNPs) were identified in a subset of large ST contigs, averaging 1 SNP every 2.5 kb. The N. loli ST sequence was also compared to the publicly available genome assemblies of the sexual relative Epichloë festucae and the dikot host plant genome E2256 (http://www.genome.oe.edu/fungi.html). A number of insertions/ deletions ranging from 0.5 to 37.6 kb were identified in each genome, some of which harbour entire genes or gene clusters. In addition to the nuclear genome, the complete mitochondrial DNA sequence (c. 88 kb) was determined for each N. loli strain and compared to the E. festucae mitochondrial genome. **Oral** Victorian Department of Primary Industries 1 Park Drive Bundoora 3083 Australia.

**RABINOVICH, MAIA, AT, JATINDER, KAUR, LOEFFEN, ERNA, GUTHRIDGE, KATHRYN, SAWBRIDGE, TIM and SPANGENBERG, GERMAN.** Genome survey sequencing of novel pasture grass fungal endo- phytes. Both beneficial and detrimental agronomic properties result from the as- sociation between Neotyphodium fungal species and temperate pasture grasses, including improved tolerance to water and nutrient stress and resistance to invertebrate pests. Invertebrate resistance is provided by specific metabolites produced by the endophyte, in particular loline alkaloids and peramine. Other metabolites produced by the endophyte, such as lolitrem and ergot alkaloids, are toxic to grazing animals and reduce herbivore feeding. Novel endophyte strains that lack either or both of the toxins detrimental to animal welfare have been identified. Genome survey sequencing (GSS) was performed for these novel endophyte genotypes using the Roche GS FLX Titanium platform. Two novel endophyte strains (NEA11 and NEA12) identified from perennial ryegrass (Lolium perenne L.) with desirable alkaloid profiles were targeted, along with Standard Toxic (ST) endophyte strain. Substantial recovery of nuclear and organelle DNA sequences was achieved for all genotypes. The mitochondrial genome sequences for NEA11 and NEA12 were determined as c. 88.7 kb in size respectively, through comparison with the known mitochondrial genomes of Neotyphodium loli standard toxic (ST) (c. 88.7 kb) and the putative sexual progenitor taxon Epichloë festucae E2368 strain (c. 69.9 kb). The novel endophyte, NEA11, an LpTG-2 taxon endophyte, has a mitochondrial genome sequence tentatively class- ified as N. loli. The mitochondrial genome of the NEA12 novel endophyte is distinct from both N. loli and E. festucae, and may represent a novel taxon within the Neotyphodium- Epichloë complex. **Poster** Victorian Department of Pri- mary Industries 1 Park Drive Bundoora 3083 Australia. 2Barenbrug Holland B.V. 6679 AD Oosterhout Nijmegen . Netherlands.

**RAJA, HUZEFIA, SHEARER, CAROL, HUSTAD, VINCENT, MAR- VARANO, LUDMILA and MILLER, ANDREW.** Testing the phylogenetic utility of Mcm7 in the Ascomycota. A variety of protein-coding genes such as RNA polymerase (RPP1 and RPB2), tubulins (α and β), ATP synthase (ATP6), and translation elongation factor EF-1α (TEF1α) have been used to produce well resolved and highly supported fungal phylogenies. Many of these genes, however, have been shown to underperform when estimating “true” evolutionary relationships. A new single-copy protein-coding gene, Mcm7, which codes for a li- cenosing factor required for DNA replication and may be responsible for the growth of Mcm7 phylogenies recently has been shown to outcompete other genes in estimating phylogenies. A previous study tested the utility of Mcm7 at higher taxonomic levels (class and above) focusing primarily on lichenized fungi within the Ascomycota. This study tests the utility of Mcm7 for estimating phylogenies at lower taxonomic ranks (class and below) and focuses on non-lichenized ascomycetes within the Pezi- tozymycota. Congruence, robustness and resolving power of Mcm7 phylogenies will be compared with those from 28S large-subunit rDNA. Preliminary results suggest Mcm7 is easily amplified and sequenced with >80% amplification and se- quencing success for numerous taxa throughout several orders in the Ascomycota. **Poster** University of Illinois 505 South Goodwin Avenue, 265 Morrill Hall Urbana 61801 United States. 2Czech Collection of Microorganisms, Masaryk University Brno CZ-602 00 Brno CZ-602 00 Czech Republic. 3Illinois Natural History Survey 1816 S. Oak St. Champaign 61820 United States.

**RAMIREZ CAMEJO, LA, ZULUAGA MONTERO, A 1, ZUARAZO ESCUEDO, MT 1, HERNANDEZ KENDALL, V, 1, DAVILA GONZALEZ, MM 1 and BAYMAN, PAUL 2.** Substrate specificity and phylogeography of Asp- ergillus flavus, with focus on marine and clinical strains. Aspergillus flavus is an opportunistic fungal pathogen of humans, animals and plants, known for aflatoxin production and worldwide distribution. Recently we have found that A. flavus is common in both healthy and diseased sea fans (Gorgonia ventailina) in waters around Puerto Rico. However the source of inoculum is not clear. Also, it is un- clear whether A. flavus strains demonstrate substrate specificity. Furthermore, few phylogeographic studies have focused on marine fungi. In this study, we compared A. flavus strains isolated from healthy and diseased tissue of sea fans in Puerto Rico, and strains isolated from other substrates and sites to determine whether all clades are equally associated with diseased sea fans, whether there is an association between substrate and phylogeny, and whether genetic distance correlates with geographic distance. DNA was extracted and parts of four genes were sequenced. Eight Amplified Fragment Length Polymorphism (AFLP com- binations) were used to fingerprint. Phylogenetic relationships were estimated using neighbor-joining and maximum likelihood methods. No significant dif- ferences were seen between strains from diseased and healthy tissue, and both groups were equally polymorphic, suggesting that disease does not depend on the presence of certain strains. The data show no correlation between substrate speci- ficity and phylogeographic distribution. A. flavus strains appear to be generalists. Improved resolution of genetic identity of A. flavus strains can help us understand the diversity of opportunistic pathogens. **Poster** University of Puerto Rico Department of Biology Rio Piedras Campus San Juan 00936 Puerto Rico. **Oral** University of Puerto Rico P.O. Box 23360 San Juan 00931-3360 Puerto Rico.

**RAO, SUIJAYA, ALDERMAN, STEPHEN, KATER, JEFF and HOFFMAN, GEORGE.** Bugs, slugs and exotic Epichloë typhina: Close encounters of the Oregon kind. Epichloë typhina is an endophytic fungal pathogen of a wide range of cool season grass species that causes partial or complete suppression of seed head development in its grass host, resulting in a disease known as choke. It is na- tive to Europe and was inadvertently introduced into seed production fields of Dacltylis glomerata in the Willamette Valley in western Oregon where it causes significant losses in seed yield. It is heterothallic and requires transfer of sperma- tia from one mating type to another prior to development of perithecia and pro- duction of ascospores which when dispersed cause new infections. In areas of en- demism, E. typhina is involved in a mutualistic interaction with flies of the genus Botanophila spp. in which adult flies transfer spermatozoa while the fungal stoma provides food for developing fly larvae. Laboratory and field studies in Oregon have indicated that although flies are involved in fertilization of stromata, other organisms such as slugs and mechanisms such as ascospore fertilization may also be involved. These questions are still open. More than 95% complete fertilization of stromata, and for the rapid development and spread of choke that has been observed in Oregon. The progression of choke dis- ease over the years and through a season, spatial distribution in fields, and inter- actions of E. typhina with Botanophila flies and slugs in D. glomerata seed pro- duction fields in Oregon will be discussed. **Oral** Oregon State University 2017 ALS Corvallis 97331 United States. USDA ARS NSFPRC 3450 SW Campus Way Corvallis 97331 United States.

**RATEKIN, ANGELA* and VOLK, THOMAS.** Blastomyces, Histoplasma, Coccidioidomycosis. Some would say the sound of it is something quite atro- cious: An Educational Overview of Medical Mycology. Medical Mycology is a relatively short history when one considers the current level of concern and importance. John Rippon, who literally wrote the book on medical mycology, stated, “Until the 1950’s one could still easily separate out the several species of concern to the medical mycologist from the rest of the fungal organisms and simply ignore the rest.” The massive increase in fungal infections is due to the in- crease in immunocompromised patients resulting from organ transplantation, ag- gressive cancer therapies, HIV/AIDS, corticosteroid therapies, and simply the use of stronger antibiotics, which leads to a state of unbalanced normal flora. Today’s Medical Mycologist must be well versed in the types of disease/infections including mycemia, mycotoxicosis, and mycosis, and especially important mycoses. Because of newly developed antifungal drugs that are narrower in use, specific identification of infecting agents needs to be completed in today’s labs, including the wide variety of opportunistic organisms and the true pathogens. My- cosis can range from a superficial cutaneous, subcutaneous infection all the way to a deep or systemic infection, depending on the organism. From the fungal per- Continued on following page
supplement with/without Mycofix® Plus (5 g/ha/day). During the 3 and 5 month studies, the range of ergovaline and lolitrem B concentrations in ryegrass was 0.3 - 1.1 and 0.6 - 1.6 mg/kg DM respectively. Slight signs of ill-thrift and heat stress, but not staggers, were observed in sheep. Lambs receiving the deacti-vated Mycofix® Plus group were in better condition and showed differences in germination and/or growth. Endophyte growth behavior in locoweed infected with an endophyte fungus, Undifilum oxytropis which can induce toxico-sis was done across 60 pastures from the Bay of Plenty and Waikato provinces of New Zealand. These ranged in age from recently renewed (<1 year old) to well established (>5 years old). Endophyte blt immunosassays were performed on 100 randomly selected tillers from each paddock. A 30cm section for foliar insects and 10 square samples for subterranean pests were taken for each paddock. The endophyte/cultivar sown and the pasture re-renewal practice were determined from farmer interviews. Endophyte levels in in locoweed of an endophyte fungus, Undifilum oxytropis which can induce toxico-sis was done across 60 pastures from the Bay of Plenty and Waikato provinces of New Zealand. These ranged in age from recently renewed (<1 year old) to well established (>5 years old). Endophyte blt immunosassays were performed on 100 randomly selected tillers from each paddock. A 30cm section for foliar insects and 10 square samples for subterranean pests were taken for each paddock. The endophyte/cultivar sown and the pasture re-renewal practice were determined from farmer interviews. Endophyte levels in 80% of renovated pastures were suitably high (>70%) while 15% were shown to have low (<50%) endophyte levels. Sowing of seed during an extended dry spell was suggested as a possible contributing factor to low infection rates. Endophyte type was shown to influence pasture insect pest populations. High populations of Black Beetle were found in pastures with wild type and AR1 endophytes compared to NEA2 and AR37. Also, high Argentine Stem Weevil populations were found in pastures containing NEA2 compared to AR37 endophytes. In most pasture renewal scenarios, pasture were pastured in 84% of an extended dry spell. Individual successful establishment of novel endophyte pastures is achieved. Assuming correct endophyte choice for regional pastures, farmers can receive the benefits shown in small-scale research trials with respect to the reduction of invertebrate grazing pressure. Poster AgResearch East St, Private Bag 3123 Hamilton 3123 New Zealand.

REYNA, ROXANNA**, COOKE, PETER2 and CREAMER, REBECCA1. Verification and observation of endophyte growth behavior in locoweed plant tissue in culture medium and in plant tissues. Grazing locoweed Oxytropis and Astragalus by livestock can cause the toxicosis known as locoism. Locoweed contain the indolizidine alkaloid, swainsonine, which is the principal agent responsible for the disease. Transmission electron microscope was made to relate endophyte infection with effects on the locoweed host. A comparison of endophyte growth patterns within plant tissue and in culture medium using transmission electron microscope and scanning electron microscopy was done. Plant grown with and without endophyte presence did not show differences in germination and/or growth. Endophyte growth behavior in culture medium showed sporulation, thickened hyphae, condensed structures, and extensive branches. Transmission electron microscopy revealed strong binding of gold labeling to chitin. Poster New Mexico State University Box 30003, MSC 3517 Denver, CO 80201. EPPWAS Las Cruces, New Mexico State University Box 30003, MSC 3517, EMS Las Cruces 88003 United States.

RAUDABAUGH, DANIEL* and OVERTON, BARRIE. Water Stress Tolerance of Endophytes Isolated from Bryophytes with Notes on Evaluating Optimal Biomass Production at Different Matric Potentials. Water stress influences water availability for soil and wood inhabiting fungi because the more negative the matric potential, the harder the substrate holds onto water, making it less available for microbial growth. The objectives of this study are to isolate epi- phytic and endophytic fungi from bryophytes and assay their tolerance to osmot- ic and matric-induced water stresses, then evaluate the soil matric potential found at the bryophyte soil interface and isolate terrestrial (soil) fungi to compare opti- mal matric potential of soil fungi to that of endophytes. Twelve fungal endophytes were isolated from species of liverworts (Bazzania trilobata and Conocephalum conicum) and two moss species (Mnium punctatum and Polytrichum commune) from three habitats in central Pennsylvania. Mnium punctatum (desic- cation-tolerant) and C. conicum (desiccation-intolerant) were collected from hy- dric habitats, B. trilobata (desiccation-tolerant) was collected in a mesic habitat, and P. commune (desiccation-tolerant) was collected from a xeric habitat. All epi- phytes and bryophyte endophytes show differences in germination and/or growth on NaCl modified media from ca. -0.47 to -28.94 MPa. Conidia from isolate LHU 61 germinated on matrical-modified media from ca. -0.47 to -14.6 MPa, while colonies from transplanted from ca. -0.47 to -37.92 MPa. In contrast, isolate LHU 61 germinated on matrical-modified media. Osmotic induced stress with NaCl displayed significant varia-
tion for both endophyte groups. Results for matrically modified media suggest that phytic and endophytic isolates were assayed for their ability to grow on NaCl-modified media at the bryophyte soil interface and isolate terrestrial (soil) fungi to compare optimal Biomass Production at Different Matric Potentials. Osmotic induced stress with NaCl displayed significant varia-
tion for both endophyte groups. Results for matrically modified media suggest that phytic and endophytic isolates were assayed for their ability to grow on NaCl-modified media at the bryophyte soil interface and isolate terrestrial (soil) fungi to compare optimal Biomass Production at Different Matric Potentials. Osmotic induced stress with NaCl displayed significant varia-
tion for both endophyte groups. Results for matrically modified media suggest that phytic and endophytic isolates were assayed for their ability to grow on NaCl-modified media at the bryophyte soil interface and isolate terrestrial (soil) fungi to compare optimal Biomass Production at Different Matric Potentials. Osmotic induced stress with NaCl displayed significant varia-
tion for both endophyte groups. Results for matrically modified media suggest that phytic and endophytic isolates were assayed for their ability to grow on NaCl-modified media at the bryophyte soil interface and isolate terrestrial (soil) fungi to compare optimal Biomass Production at Different Matric Potentials. Osmotic induced stress with NaCl displayed significant varia-
tion for both endophyte groups. Results for matrically modified media suggest that phytic and endophytic isolates were assayed for their ability to grow on NaCl-modified media at the bryophyte soil interface and isolate terrestrial (soil) fungi to compare optimal Biomass Production at Different Matric Potentials. Osmotic induced stress with NaCl displayed significant varia-
tion for both endophyte groups. Results for matrically modified media suggest that phytic and endophytic isolates were assayed for their ability to grow on NaCl-modified media at the bryophyte soil interface and isolate terrestrial (soil) fungi to compare optimal Biomass Production at Different Matric Potentials.
REYNOLDS, HANNAH* and VILGALYS, RYTAS2. Mysterious hosts and secret parasites: which Elaphomyces species are parasitized by Elaphocordyceps? The genus Elaphocordyceps includes several mycoparasites derived from a large lineage of parasites of insect larvae. The mycoparasitic Elaphocordyceps parasitize the false truffle Elaphomyces, a genus with over 40 described species and dozens of undescribed species. Elaphomyces taxonomy depends heavily on spore characters such as color, size and ornamentation, and on the internal structure of the peridium, but many parasitized Elaphomyces have discolored peridia and produce no spores. The hosts, therefore, typically cannot be identified using morphology because they are degraded or have not developed properly. We observed that some specimens of Elaphomyces that have not produced Elaphocordyceps fruiting bodies have yielded Elaphocordyceps sequences using general fungal primers. ITS primers specific to the host and the parasite were designed in order to identify the host and parasite species for visibly parasitized specimens. Additionally, Elaphocordyceps primers were used to detect infection in asymptomatic Elaphomyces. We will discuss the geographical and phylogenetic diversity of this host-parasite association, the infection rate of Elaphomyces populations, and describe the range of symptoms of the parasitism. Oral 1Duke University Box 90338 Durham 27708 United States. 2Duke University 139 Biological Sciences Building Durham 27708 United States.

RIVERA, YAZMIN*, PITCHER, KATHLEEN2 and KRETZER, ANNETTE1. Population genetic structure of the ectomycorrhizal basidiomycete Suillus spraguei and fragmented forests in the northeastern U.S. The northeastern United States is one of the only seven large, nonfragmented forest regions of the contiguous United States. Sporocarps were collected from eight sites in the Adirondack Park and compared to sporocarps collected from seven sites in fragmented areas of New York, Pennsylvania and Massachusetts using seven previously developed microsatellite markers. Both allelic richness and expected heterozygosities were not significantly different between fragmented and non-fragmented populations. Except for one site, none to little genetic differentiation was detected with FST ranging from 0.0 to 0.04 within fragmented and non-fragmented forests, and 0 to 0.05 among them. Moderate genetic differentiation was detected only for one site in a fragmented area of New York (FST= 0.04 to 0.12). Overall, our analysis revealed a broad panmictic population with no isolation by distance over 600 km and no detectable effect of forest fragmentation for this species. These results suggest high levels of gene flow between sites and possibly a lack of time for genetic differentiation by genetic drift due to a large effective population size. Exploring the effects of forest fragmentation on less common ectomycorrhizal species could reveal different patterns of genetic structuring. Poster SUNY ESF 1 Forestry Drive Syracuse 13210 United States. *NC State 510 Thomas Hall Raleigh 27695-7616 United States.

ROBIDEAU, GREGG P.*, DE COCK, ARTHUR W.A.M.2, COFFEY, MICHAEL D.3, VOGLMAYR, HERMANN4, GACHON, CLAIRE M.M., RISTAINO, JEAN B.6, HU, JULIA1, BONANTS, PETER J.M.3, CHITTY, DAVID2, RINTOUL, TARA1, BALA, KANAKC, EGGERTSON, QUINN4 and LEVESQUE, C. ANDRE2. DNA barcoding using cytochrome c oxidase I (COI): A valuable addition to oomycete molecular taxonomy. Many oomycete species are pathogens of plants and animals and the devastating speed with which they are able to spread makes rapid identification crucial to implementation of control strategies. DNA-based identification can be done quickly and easily by a non-specialist if there is an adequate database of reference strains. The use of DNA for oomycete species identification is well established, but DNA barcoding with cytochrome c oxidase subunit I (COI) is a relatively new approach that has yet to be assessed over a significant sample of oomycete genera. We have sequenced COI from over 1200 isolates representing 23 genera. A comparison to internal transcribed spacer (ITS) sequences from the same isolates showed that COI identification is a practical option; complementary because it uses the mitoch-

Inoculum 61(4), August 2010 71

Continued on following page
may have implications for plant productivity and insect herbivory. Our study suggests that projected increases in plant resource allocation are also expected to impact the ways in which plants interact with symbiotic partners which in turn may affect plant-herbivore dynamics. Here we examined the effects of three levels of CO2 (ambient, 800ppm and 1000ppm) on the interaction between tall fescue (Schedonorus phoenix) and its fungal endophyte Neotyphodium coenophialum. Since plant interactions with symbiotic partners which in turn may affect plant-herbivore dynamics are required for virulence. Here, we investigated the regulatory roles of the HAP complex, components of which are downstream targets of Sir1. Microarray analysis showed that, as in other fungi, Hap proteins modulated the expression of genes encoding iron- and iron-storage proteins in response to iron availability. Interestingly, HapX showed both positive and negative regulatory roles in C. neoformans. In particular, HapX induced a subset of genes encoding siderophore transporters, under iron-limiting conditions, suggesting a role for HapX in iron acquisition via siderophore transport. However, deletion of HAP resulted in only a minor influence on virulence in a mouse model of infection. Taken together, these results suggest that HapX may be an important regulator for iron sensing/uptake in the environment as opposed to in host tissue. Oral 1Michael Smith Laboratories, University of British Columbia 2185 East Mall Vancouver, BC V6T1Z2 Canada. 2Department of Biotechnology, Chung-Ang University 72-1 Naeri, Dongjak-gu, Seoul, Republic of Korea. 3Institute of Molecular Biosciences, University of British Columbia 6556 Agricultural Road Vancouver, BC V6T1Z2 Canada.

SAIKIA, SANJAY1*, TAKEMOTO, DAIGO2, TAPPER, BRIAN3, LANE, GEOFF3 and SCOTT, BARRY4. Functional analysis of indole-diterpene gene clusters in Lolium B biosynthetic pathway in the grass endosymbiont Epichloe festucae. Epichloe festucae in association with Lolium perenne synthesizes a range of secondary metabolites, including the indole-diterpene (ID) lolitre B, that confer bioprotective benefits to the grass host. Earlier, we have identified a complex LTM (lolirom) locus comprised of three clusters of genes for the biosynthesis of lolitrem B. The clusters comprise three (lmtM, C and 15), five (lmtQ, F, S, C and 20) and two (lmtE and J) genes, respectively. Lmt C, M and B are proposed to be required for the synthesis of paspaline. In this study, we investigated the function of the other ltm gene products by analyzing products that accumulate in symbiota containing deletion mutants of E. festucae and by feeding putative ID intermediates to Penicillium patellii containing copies of these genes under the control of a native ID biosynthetic gene promoter. Deletion analysis suggests that LmT E and J catalyze prenylation and oxidation steps for the formation of the A- and B-rings of lolitrem B, LmT and K catalyse prenylation and oxidation steps for formation of ring-I, Lmt catalyzes demethylation of C-12 and hydroxylation of C-10; and LmtQ catalyzes hydroxylation of C-13. Feeding studies demonstrate that LmtP catalyzes reactions similar to those catalyzed by Paspa and converts paspaline to β-PC-M6 and 13-desoxypaspaline. However, LmtQ, unlike Paspa, appears unable to utilize 13-desoxypaspaline as a substrate. Poster Michael Smith Laboratories, University of British Columbia 2185 East Mall Vancouver, BC V6T1Z2 Canada. 2Graduate School of Bioagricultural Sciences, Nagoya University Plant Pathology Laboratory Nagoya 464-8601 Japan. 3AgResearch Tennent Drive Palmerston North 4442 New Zealand. 4Institute of Molecular Biosciences, Massey University Riddet Road, Turitea Campus Palmerston North 4442 New Zealand.

SAIKO, KARU1. Defensive mutualism between endophytic fungi and plants? Fungal endophytes attracted attention when livestock toxicoses in USA and New Zealand in the mid-20th century were demonstrated to be attributable to mycoxoxins (Baon et al. 1977). Since then “endophyte” quickly became synonymous with “mutualist”, and the primary driving selective force behind the mutualism was, and still is, considered defense against herbivores (Chay 2009). Statistical perusal of the endophyte literature (99 published studies on 36 plant, 62 herbivore and 17 predator or parasitoid taxons), however, revealed that the reasons for the strong mutualistic stamp of endophytes are largely historical and system-based (Saikonen et al. 2010). First, defensive mutualism appears to be more commonly detected in systemic and vertically transmitted grass endophytes compared to horizontally transmitted endophytes. Second, although endophytes slightly increase grass resistance to herbivores, most of the conceptual framework for endophyte-plant-herbivore interactions has been based upon studies of two, economically important and non-native grass species, tall fescue and perennial ryegrass, and generalist invertebrate pests. Third, the tenth articles of 22 separate experiments providing data of higher trophic levels failed to reveal neither negative nor positive cascading effects of endophyte infection on natural enemies of herbivores. Fourth, the grass endophyte literature is also heavily biased toward short-term laboratory and greenhouse experiments and optimized growing conditions.

Poster 1Michael Smith Laboratories, University of British Columbia 2185 East Mall Vancouver, BC V6T1Z2 Canada. 2Department of Biotechnology, Chung-Ang University 72-1 Naeri, Dongjak-gu, Seoul, Republic of Korea. 3Institute of Molecular Biosciences, University of British Columbia 6556 Agricultural Road Vancouver, BC V6T1Z2 Canada.

RUSH, TOMAS* and AIME, M. CATHERINE. Placement of the yeast genus Moniliella in the Ustilaginomycotina and description of a new species. An unusual yeast was isolated from a jar of dill pickles that was not refrigerated for more than three weeks following Hurricane Gustav (August 2008) in Louisiana. The isolate was identified as an undescribed species of Moniliella (=Tri- chosporonoides). The phylogenetic position of Moniliella has been problematic. Originally described as an anamorphic ascomycete in the Moniliellales, the genus was transferred to the Trichosporaceae (e.g., jelly fungi) in the Basid- iomycota. Using DNA sequence data from four gene regions [three nuclear ribosomal DNA loci-large subunit, internal transcribed spacer region (ITS), and small subunit-and elongation factor 1-α], we determined that Moniliella belongs to the Ustilaginomycotina, the subphylum of Basidiomycota that includes phytopathogenic smut fungi with haploid yeast phases, within class Ustilaginomycetes. Phylo- genetic analyses of the ITS show that the new species isolated from pickles is congruent with the other species of Moniliella-M. maddia, M. nigrescens, M. spathulata, M. megachilensis, M. oedocophalis, and M. fonsecae-but distinct. In addition to phylogenetic data, physiological data, assimilation tests, and culture and microscopic characters were collected to diagnose, fully describe, and illustrate this new species. Keywords:arthrospores, basidiomycetaceae yeast, fermentation, osmotic pressure, Trichosporonoides Poster Louisiana State University 302 Life Science Building Baton Rouge 70803 United States.

RYAN, GERALDINE D.*, RYAN, JONATHAN A.2. The effect of elevated atmospheric carbon dioxide on grass-endophyte-aphid interactions. Atmospheric carbon dioxide concentrations are predicted to rise to between 550 and 1000ppm from the current ambient level of 390ppm by the year 2100. CO2-induced changes in plant physiology have been shown to alter the synthesis of insect herbicides through changes in the production of carbohydrates, proteins and amino acids and allocation of resources to plant defensive chemistry. Changes in plant resource allocation are also expected to impact the ways in which plants interact with symbiotic partners which in turn may affect plant-herbivore dynamics. Here we examined the effects of three levels of CO2 (ambient, 8000 and 10000ppm) on the interaction between tall fescue (Schedonorus phoenix) and its fungal endophyte Neotyphodium coenophialum. Since plant physiological response to CO2 has been shown to depend on nitrogen availability, we also examined the effects of a low and high nitrogen treatment on grass-endophyte interactions under enriched CO2. Herbivore response was examined by measuring the abundance of Rhopalosiphum padi - an aphid known to be nega-

SALTZMAN, IAN A.*, Smut Fungi Spores as Contaminants in Grass Seed Produced in the Pacific Northwest. The Pacific Northwestern (PNW) U.S. produces most of the world’s cool season grass seed and exports more than 7 million kg of seed annually. China is one of the major markets for PNW grass seed, and shipments of Kentucky bluegrass (Poa pratensis) seed have been rejected by quarantine officials because of the presence of smut teliospores (Tilletia sp.). The objective of this study was to survey and characterize smut fungi associated with one of the major markets for Kentucky bluegrass, bentgrass (Agrostis spp.), and fescue (Festuca spp.) and discuss the impact of these spores on the production of grass seed. A total of 1055 seed samples produced between 2005 and 2007 were assayed using a wet sieving technique. Spores and debris retained on a 20 µm diameter mesh sieve were counted and characterized microscopically. Among the different types of seed samples examined, 9–32% contained teliospores. Two types of teliospores were present in every species—yellow to protoblastoid and reticulate. Preliminary results show that the diversity in geographic range and hosts suggests the existence of more than one species. The objective of this study was to apply phylogenetic sequence analysis to this diversity in order to determine whether there are geographic and/or host specific lineages. Multilocus phylogenetic and morphological analyses of twenty five strains were used to address the objective. The results of the phylogenetic analysis indicates that strains identified as the morphologically defined species N. veuillotiana fall into five groups which are geographically defined but independent of host. Neocentria veuillotiana was originally described from France. One French strain clusters with one strain collected in the Azores Islands to constitute a European clade. This clade is sister to a large clade that comprises strains collected in Eastern North America; this clade includes two strains isolated from a canker on Fagus Connecticut. A third clade includes one strain from Japan and one strain from Eastern North America. Two additional clades, respectively from Costa Rica on ‘wood’ and the Netherlands on Tsuga, represent lineages that are significantly removed from N. veuillotiana clade. These preliminary results indicate that N. veuillotiana is a species complex. The isolation of N. veuillotiana from a cankered Fagus is the first time that this species has been associated with a plant disease Oral University of Maryland College Park 2112 Plant Sciences Building College Park 20742 United States. Oralsda-ARS, Systematics and Genomics, Microbiology Laboratory, 17500 Bayshore Blvd, 30011A, Rm 301 Beltville 20705 United States. United States Department of Agriculture Systematic Mycology and Microbiology lab 10300 Baltimore Blvd. Beltville 20705 United States.

SALICHOS, LEONIDAS* and ROKAS, ANTONIS*. Simple is better: ortholog prediction algorithms in a yeast model clade. Accurate identification of orthologous genes is crucial for in silico studies and for functional analysis of organisms. Several al-

SAIN, DIVYA* and STAJICH, JASON. Evolution of fungal cell wall genes from Chytridiomyctoa to Dikarya. The cell wall is the principle interaction between the fungus and its environment. The rigid walls must be able to withstand stress, changes in temperature and pressure, while still being flexible and capable of remodeling as part of growth. The evolution from aquatic flagellated forms of the ancestral fungi to the varying forms of multicellular and hyphal growth required changes in how cell walls are synthesized and remodeled. We have reconstructed the evolution history of the genes for biosynthesis, remodeling, and modifications of fungal cell walls to trace the patterns of gene family evolution including among the major lineages of fungi including Chytridiomyctoa, Blastocladiomyctoa, Mucoromycotina, and Ascomycete and Basidiomycete fungi from available genome sequences. We have found patterns of diversification and loss among the different species of these lineages. The diversity of cell wall carbohydrate degrading enzymes such as chitinases, chitin deacetylases and glucanases. Many of these diversifications occurred early in fungal evolution but we also note lineage-specific changes like expansions of chitin synthases within Chytrid lineages. Our work also characterized the composition of chitin and GPI anchored proteins to examine how classes of cell surface or cell wall attached proteins evolve together. We presented a phylogeny of many of the major lineages of fungi derived from a large cell wall evolution using comparative genomic approaches to reconstruct when diversification and simplification of gene families occurred and how these patterns relate to evolution of morphological characteristics. Oral University of California, Riverside 900 University Ave Riverside 92521 United States.

SALGADO-SALAZAR, CATALINA*, SAMUELS, GARY J., ROSSMAN, AMY Y., and CHAVERRI, PRISCILA1. Advances in systematics and taxonomy of Nectria-related fungi: Neocentria veuillotiana species complex. Neocentria veuillotiana is a common, cosmopolitan species, with specimens identified from temperate and tropical regions. It is found on hardwood trees and conifers and characterized by its perithelial morphology and by its Cylindroc-
SCHARDL, CHRISTOPHER L.* and SCOTT, BARRY2. Recommendations for gene nomenclature for Epichloë species and related Clavicipitaceae. With the recent sequencing of the Epichloë festucae genome (www.endophyte.uky.edu) and ongoing annotation of genes, we propose the following standard for naming genes in this group. The proposed standard is based on a common format for Aspergillus nidulans and many other fungi and bacteria. Each gene should be designated by four italic letters, with the first three letters in lower case, and the fourth in upper case. (If a nidulans has an obvious ortholog named by this format, the same name would be preferred for Epichloë and related genera.) Where there are functionally equivalent homologs at multiple loci these paralogs can be distinguished by a numeral (non-italic) following the last letter. Thus, the dimethylallyltryptophan synthase (DMATS) gene in E. festucae is designated dmaW, and the two paralogs of this gene in Neotyphodium coenophialum are designated dmaW1 and dmaW2. To distinguish alleles, letters, numerals and symbols can follow a hyphen appended to the gene designation. Thus, a deletion mutant of dmaW1 can be designated dmaW1-Δ1. Gene translation products can be designated in roman script with the first letter capitalized. Thus, DmaW is an acyl-CoA synthetase for Erg W, and Mat2S is a AAA+ ATPase enzyme. In publications where homologs from multiple species are discussed, the source species for each homolog can be designated by a hyphenated prefix, such as Cpu-dmaW and Cpu-dmaW for the dmaW homologs from Claviceps purpurea and C. paspali, respectively. These prefixes are not part of the gene name, and should be used only when needed to disambiguate in context. Multigene loci can be named with three or more letters, all capitalized and in italicized form (e.g., the loliolene biosynthesis gene locus, LTLM). Mating type idiomorphs should be named MTa and MTB, for mat1 and mat2 specificities, with the genes at each idiomorph designated mtat, mtbb, and mtc for the MTA idiomorph, and mtht for the MTB idiomorph. A detailed rationale for these proposed naming conventions will be presented in our poster.

Poster 1University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States. 2Institute of Molecular Biosciences, Massey University Palmerston North 4442 New Zealand.

74 Inoculum 61(4), August 2010

SCHARDL, CHRISTOPHER L.*. Diversity of bioprotective alkaloids produced by Epichloë and Neotyphodium. The epichloae (Epichloë species and their anamorphs, the Neotyphodium species) are clavicipitaceous endophytes of cool-season grasses (Poaceae, subfam. Pooideae), and many are known to synthesize one to several different classes of bioprotective alkaloids that are active against invertebrate and, in some cases, vertebrate herbivores. The ergot alkaloids are derived from tryptophan, a prenyl group, and an N-methyl group from S-adenosylmethionine, and many contain additional moieties derived from one or three hydrophobic amino acids. The ergot alkaloid synthesis (EAS) gene cluster in Epichloë festucae contains 11 genes known or suspected to determine steps in the biosynthetic pathway. The indoleterpenes (e.g., lolitrem and janthitrems) are derived from indole-glycerol, a geranylgeranyl group and, often, additional prenyl groups. A cluster of 10 LTLM genes are associated with lolitrem biosynthesis. Peramine is a modified cyclopeptide likely derived from arginine and proline or a proline precursor, plus an N-methyl group. A single gene, perA, has been identified that encodes a multi-enzyme peptide potentially catalyzing all steps in peramine biosynthesis. The lolines are derived from acid-labile prenyl groups, plus an N-acetylated, N-methylated, or N-formylated. A cluster of 11 genes at the loline (LOL) locus includes at least nine for known or likely biosynthetic enzymes. Although some epichloae produce none of these alkaloids, many produce various combinations. For example, Neotyphodium coenophialum, an endophyte of Lolium arundinaceum, produces lolines, peramine, and ergot alkaloids; N. loli in L. perenne produces lolines, peramine, and lolitrem; and N. uncinatum in L. pratense produces lolines. Considerable chemodiversity exists within sexual Epichloë species. For example, strains of E. festucae have been identified that produce any of the four alkaloid classes. The occurrence of alkaloid genes is often rare in the sexual species. For example, LOL genes have been identified in a few isolates from eight of the 11 Epichloë species. Though sparse distribution is some-
The barcode of Life database (BOLD) now accepts ITS sequences as fungal barcodes, a formal proposal is required for GenBank to designate fungal submissions with sequence database (RefSeq Targeted Loci), which will overlap with barcoding and facilitate flagging of ex-ante and authoritative isolates in similar search. Mycologists have been slow to embrace barcoding, which has been dominated by zoologists but recently saw increased interest from botanists. In our presentation, we will speculate on reasons for this. Mycologists should contribute in either an ad hoc or coordinated fashion to barcode databases, remembering the primary users of fungal barcodes are likely to be nonmycologists wishing to include fungi in their studies. Mycologists could also attempt to assemble larger, database work-like projects like those successfully implemented by other biologists. As examples of barcoding in action, symposium speakers will present data on ITS and additional barcoding markers, and their applications in field studies. Oral NCBI, NIH, GenBank 45 Center Drive Bethesda 20892 United States. 3University of Virginia 120 Buckhout Laboratory University Park 16802 United States.

SEITZMAN, BRIAN*, HIBBETT, DAVID*, HOBBIE, ERIK*, QUIMETTE, ANDREW and MIMON, RACHEL. Evolution of nutritional strategies of Hyphophyaceae (Basidiomycota: Agaricales) inferred from stable isotope and molecular analyses. The family Hyphophyaceae (Basidiomycota: Agaricales) includes a genus known to be ectomycorrhizal (Hyphophyllum), genera assumed, but not demonstrated, to be mycorrhizal (Hamaitcus and Camarophyllus) and those that are saprotrophic (Hyphophyllum) which forms green algae or cyanobacteria (Lichenomphalia, Dictyomena, Acantholichen and others). To date, there has been no confirmation of the nutritional strategies of genera other than Hyphophyllum. In this study, we combine molecular phylogenetics with analyses of stable isotopes to understand the diversity and evolution of nutritional strategies in Hyphophyaceae. The isotopic profiles of genera of uncertain nutritional mode are different from those of others. Additional isolates need to be sequenced in other families, which, coupled with phylogenetic analysis, elucidate several changes in strategy over the course of this family’s evolution. Poster 137. Clark University 950 Main Street, Biology Department Worcester 01610 United States. 2University of New Hampshire 8 College Rd. Durham 03824 United States.

SHAW, GREGORY E.*, LOVELY, C. BEN and PERLIN, MICHAEL H. Mutant Type Specific Signaling in Ustilago maydis. The phytopathogenic fungus U. maydis undergoes a dimorphic transition in which cell fusion and pathogenic development must occur for U. maydis to complete its lifecycle. Both cell fusion and pathogenicity are controlled by two loci, the a and c loci, encoding a pheromone and pheromone receptor, and the b locus, controlling pathogenic development. Mating of two cells of opposite mating type requires activation of the a locus via signal transduction through the mitogen-activated protein kinase (MAPK) pathway. The PAK-like Ste20p homologue, Smu1, is required for a normal response to pheromone via up-regulation of mfa expression. Deleting smu1 reduced this up-regulation of mfa expression, with the effect more pronounced in the a2 mating background. A similar mating type specific defect also occurs with deletion of another PAK-like protein kinase involved in cytokinesis, Cla4. However, the effect was more pronounced in the a1 mating background. New evidence suggests that these mating type dependent defects in smu1 and cla4 deletion mutants extend to cell lengths as well. However, here only the cla4 a2 mutant increases in cell length, while the smu1 a2 mutant significantly decreases in length when compared to wild type. Also, yeast two hybrid analysis identified two potential Smu1p interactors, Rho1 and Has1, both of which exhibit mating type specific effects. Data suggest that while Rho1 is required for viability, when overexpressed it also reduces the response to pheromone dramatically in the a2 mating background. Disruption of has1 causes cell elongation independent of mating background, yet when disrupted in a strain concomitantly overexpressing smu1 cell separation defects are observed in the a2 mating-type background. Thus, mating type dependent effects provide an interesting line of investigation into the overall control of mating type morphogenesis, and pathogenicity in U. maydis. Poster 138. University of Louisville Department of Biology, Bellkop-LST 139 Louisville 40208 United States.

SHORT, DYLAN* and GEISER, DAVID. A comparison of human pathogenic and environmental Fusarium species. Fusarium species can be opportunistic human pathogens, causing both life-threatening, invasive infections and sight-threatening infections. Recent work has shown that several Fusarium species are often inhabitants of the indoor environment, particularly forming biofilms in plumbing fixtures. To compare biofilm-associated Fusarium with those derived from human infections, we isolated Fusarium species from sink drains across the Mid-Atlantic and Southeastern U.S., and used multilocus sequence typing (MLST) to compare haplotypes from plumbing, human and other sources. The majority of isolates recovered belonged to known phylogenetic species within three Fusarium species complexes known to inhabit plumbing and to cause human infections. At least one putative new species in the Fusarium dimerum species complex was discovered. Furthermore, we conducted population genetics analyses of the single most common Fusarium solani human pathogen, a currently unnamed species belonging to the Fusarium solani species complex, known provisionally as FSSC 2. This species appears to be the most common Fusarium species in the sink drain environment, yet it was rare among the isolates recovered. A nine-locus MLST scheme was developed for FSSC 2, utilizing previously characterized loci (translation elongation factor 1-alpha, ribosomal RNA gene regions, and the second largest RNA Polymerase B gene) as well as six new sequence based molecular markers designed specifically for FSSC 2. This MLST scheme revealed a significantly higher incidence of Fusarium species in FSSC 2, and probable frequent recombination. Oral University of Pennsylvania State University 120 Buckhout Laboratory University Park 16802 United States.

SILLIKER, MARGARET*, HENDRICKSON, PETER and KLOSTERMAN, SUSAN. Does a quorum sensing mechanism regulate mating competency in Didymium iridis? Didymium iridis is a plasmoidal slime mold with free-living haploid and diploid stages. In heterothallic (sexually reproducing) strains, mating is governed by a one-locus multiple allelic system. The A1 mating type series has been shown to include over a dozen mating types. A compatible mate is necessary for mating to occur, but cells must also be physiologically competent to mate. High cell densities trigger mating competency, therefore Didymium must be able to sense its environment and respond. We propose that a quorum sensing mechanism is responsible for this cell counting ability and that it regulates the transition to mating competency. We found that Didymium iridis and several other cheilomyces (plant patho- and saprotrophic) species used suppression subtractive hybridization. RNA was isolated from the Pan2-16 strain of D. iridis grown to cell densities previously determined to yield pre-com- petent and mating competent cells. cDNA from mating competent cells was sub- tracted with cDNA from pre-competent cells. The subtracted RNA was cloned and a total of 163 clones were sequenced. Clones with overlapping sequences were treated as singletons, resulting in 34 contigs in 2300 Children’s Plaza, Mailstop #212 Chicago 60614 United States. 3University of Illinois at Chicago, Molecular, Cellular, and Developmental Biology Program 845 West Taylor Street Chicago 60607 United States.

SIMMONS, D. RABERN*, JAMES, TIMOTHY Y.3 and LONGCORE, JOYCE E.3. Molecular and ultrastructural evidence from additional isolates support elevation of Polychrytum clade (Chytridiomycetes) to ordinal status. The Polychrytum clade is one of the few remaining groups in the Chytridiomycetes that has not formally been raised to ordinal status. It has been repre- sented in recent phylogenies by two polycentric species and two moncentric iso- lates. Additional isolates with which to determine TEM characters sufficient for an ordinal description have been lacking. We have isolated other chytrids that, based on their preference for growth on chitin and their “Rhizophyctis-Karlin- giomyces” morphology, represent members of this clade. We sequenced the nuc- SSU and nucLSU DNA of these additional isolates and studied the ultrastructure of selected isolates. In a molecular phylogeny, all previously studied and new isolates formed a cohesive group separate from other chytrid orders. Zoospore ultra- structure is diverse within the clade, suggesting that several genera should be de- scribed within this poorly-sampled group. All examined isolates, however, have an elongated nonflagellated cilium, a dense fibrillar connection between the nonflagellated cilium and kinetosome, and a scalloped ring within the kineto- some. Our molecular and TEM evidence support describing the Polychrytum clade as a new order in the Chytridiomycota. Poster 139. University of Maine 5722 Deering Hall Orron 04469-5722 United States. 3University of Michigan 830 N. to mating competency. In order to find genes involved in mating competency we used suppression subtractive hybridization. RNA was isolated from the Pan2-16 strain of D. iridis grown to cell densities previously determined to yield pre-com- petent and mating competent cells. cDNA from mating competent cells was sub- tracted with cDNA from pre-competent cells. The subtracted RNA was cloned and a total of 163 clones were sequenced. Clones with overlapping sequences were treated as singletons, resulting in 34 contigs in 2300 Children’s Plaza, Mailstop #212 Chicago 60614 United States. 3University of Illinois at Chicago, Molecular, Cellular, and Developmental Biology Program 845 West Taylor Street Chicago 60607 United States.

SIMONIN, ANNA*, ROPER, MARCUS2 and GLASS, LOUISE3. The mainte-
The parameters of this environment (architecture of the colony) dictate the distribution and movement of these different nuclei. It is thought that genetic diversity enables these organisms to exploit heterogeneous environments, but few studies have looked at the dispersal of genetic diversity within a single organism. We used Neotyphodium strainss with histone-H^2B labeled nuclei to explore the nature of nuclear mixing within a fungal colony. We found that the rate and amount of flow through hyphae actively maintains mixing of genetically different nuclei within a colony. Poster UC Berkeley 341 Koshland Hall Berkeley 94720 United States.

SIMPSON, WAYNE* and MACE, WADE. Novel associations between epichloë endophytes and grasses: Possibilities and outcomes. Epichloë (Epichloë/Neotyphodium) endophytes are known to infect at least some of the genera of all but one of the seven tribes of the grass subfamily Pooidae. These symbioses, with some exceptions, are the most part host specific. The maintenance of these symbioses in grass populations can afford the hosts of epichloë benefits in natural ecosystems and indeed may explain the success of these fungi. These grass-host advantages have been documented and exploited in agricultural production systems. Central to the use of fungal endophytes in agricultural grasses is the ability to move endophytes from one population to another. This process is made possible by the fact that epichloë, although biotrophic in nature, can be isolated and propagated saprotophically under laboratory conditions. Such manipulations allow not just within species transfers but also between species, between genera and between tribes. The formation of such symbioses offers opportunities for horizontal gene transfer of fungal endophytes in grass based agricultural production systems but also for understanding the nature of the symbiosis. Such understanding can be gleaned by pushing the boundaries of symbiotic combinations and documenting the effect on the symbionts while the use of genetically modified endophytes allows a precise dissection of the effect of specific fungal genes on the symbiosis. This paper examines the methods that can be employed for the transfer of endophytes, few epichloë species, explores the range of host material that has been employed and describes some of the observed effects on both fungal and host phenotypes. Oral AgResearch Ten- nent Drive Palmerston North 4442 New Zealand.

SIMPSON, WAYNE* and MACE, WADE. Sphingolipids in epichloë endophytes. Sphingolipids are ceramide structures consisting of a long chain base with an amino group that is amide-linked to various fatty acids. They are ubiquitous and essential structural components of the plasma membrane of eukaryotic cells. In addition to this structural function there is increasing evidence that they play an important role as molecules involved in cell regulation and indeed may be critical for the activation of signalling pathways that control cell growth and survival. In microbial symbioses sphingolipids are also involved in the regulation of the delicate balance between microbe and host. Where microorganisms, such as most bacteria and viruses, do not produce sphingolipids, they co-opt those produced by the host. In the case of protozoan- and fungus-host interactions both host and microbe sphingolipids are involved. Fungi in which sphingolipids have been found include Agaricus, Amanita, Aspergillus, Candida, Cryptococcus, Neospora, Penicillium, Phytophthora, Saccharomyces and Schizosaccharomyces along with many others. The detection of sphingolipids varies between fungi and the nature of a toxicological tool. Given the importance of sphingolipids in living organisms in general and fungi in particular and the role that they can play in microbe-host interactions we considered it worthwhile to examine endophyte endophytes with a view to profiling their sphingolipid content. We examined mixed samples consisting of Neotyphodium lolii, N. coenophialum and Epichloë festucae using LC-MS/MS techniques. Our analysis shows the presence of phytosphingosine [18-Sph], dehydrosphingosine [16-dhSph] and sphingosine-1-phosphate [20-Sph-1P]. We did observe additional peaks corresponding to possible sphin- golipids, but with no supporting MS2 fragmentation. These peaks were either not selected for fragmentation, or the selected ions fell apart under the fragmentation conditions without giving useful structural information. Poster AgResearch Ten- nent Drive Palmerston North 4442 New Zealand.

SLOT, JASON* and ROKAS, ANTONIS. Multiple origins of fungal galactose metabolism gene clusters through horizontal transfer and gene relocation. Genes involved in successive steps of a metabolic pathway are often physically clustered in fungal genomes. As a case study in the assembly and maintenance of clusters of functionally related genes, we examined the evolution of gene sequences in the galactose utilization (GAL) pathway in whole genome data from 80 diverse fungi. We found the GAL cluster in Saccharomyces and Candida yeasts originated through the relocation of native unclustered genes, whereas the GAL cluster of Schizosaccharomyces yeasts was acquired through horizontal gene transfer from a Candida yeast. In contrast, the GAL cluster ofCryptococcus yeasts was assembled independently from the Saccharomyces / Candida and Schizosaccharomyces GAL clusters found in the Cryptococcus genome with unclustered GAL paralogs. These independently evolved GAL clusters represent a striking example of analogous microsynteny. We also found that species with GAL clusters exhibited significantly higher rates of GAL pathway loss than species with unclustered GAL genes. These results suggest that metabolic gene clusters might facilitate fungal adaptation to changing environments both through the acquisition and loss of metabolic capacities. Oral Van- derbilt University Box 1634, Station B Nashville 37235 United States. Vanderbilt University Box 1634, Station B Nashville 37235 United States.

SMITH, KERI*, BULTMAN, TOM and SULLIVAN, TERRENCE. Effects of novel endophytes on two insect herbivores. Neotyphodium endophytes of tall fescue produce several alkaloids that can help protect the host from herbivores. Variation among endophyte isolates exists naturally in tall fescue within its native range in southern Europe. Isolates have used to create novel endophytes by inoculating them into grass cultivars. We used novel endophytes in Jesup tall fescue to test effects of endophyte genetic variation on preference and performance of two insect herbivores. Using potted plants with 8 different isolates as well as uninfected plants, we found isolate variation affected reproduction of bird-cherry oat aphid as well as development time and weight gain by fall armyworm. Yet, the isolate on which aphids performed best was also an isolate on which fall army- worm performed poorly. Isolate variation did not influence aphid preference, but did impact fall armyworm preference, as measured by foliage removal. We con- clude that fungal isolate can influence insect herbivores, but this can vary across herbivore species. Poster Hope College 35 E. 12th St Holland 49423 United States.

SMITH, MATTHEW*, HENKEL, TERRY W, AIME, M. CATHERINE3, MILLER, STEVEN4, CASTELLANO, MICHAEL1 and VILGALYS, RYTAS. Preliminary observations on the sequestrate ectomycorrhizal fungi from Di- cyembe-dominated forests of the Guiana Shield. Sequestrate “truffle-like” fungi, whose meiospores mature inside of enclosed sporocarps, have not been well char- acterized. In particular, few species of epigaeic fungi, the one population of Dicyembe microfungi, explores the range of host material that has been employed and describes some of the observed effects on both fungal and host phenotypes. Oral AgResearch Ten- nent Drive Palmerston North 4442 New Zealand.
SONG, ZEWE1*, VAIL, ANDREW2, SADOWSKY, MICHAEL2 and SCHILLING, JONATHAN2. Tracking fungal competition during coloniza-
tion of pine, oak and birch, Competition of saprotrophic fungi may change the outcome of colonization, significantly. On wood decomposition, brown rot and white rot fungi can come to dominate on the same wood types, but remarkably little is known about how they coexist and compete. In our research, we studied the competition of a brown rot Gloeophyllum trabeum and a white rot Irpex lacteus fungus colonizing pine, oak and birch dowsels in microcosms. Fungi were cultured in single G. trabeum, single I. lacteus and mixed treatments for up to 8 weeks. The biomass of specific fungi was quantified by quantitative PCR. Sample weight loss, carbon fraction characterization, ergosterol, dilute alkali solubility (DAS) and pH of wood samples were also measured. Wood degraded by G. trabeum and I. lacteus showed predictably distinct properties, while the mixed treatment had similar features as those invaded by I. lacteus. The mass loss of oak was similar among treatments, but G. trabeum caused twice as much weight loss in birch and pine. qPCR and ergosterol analyses revealed that G. trabeum was out competed by I. lacteus when coexisting in all wood types. Samples invaded by I. lacteus or mixed fungi had similar DAS and pH, as well as similar carbon fraction character-
tistics, while G. trabeum caused dramatically increased DAS and decreased pH.

Our research provides a useful, ‘whole-block’ tool to track the contributions of individual competing fungi, one that is especially useful as fungal metagenomics improves. Our work also links distinct forest residues back to the unique fungi responsible, an important link between forest input and outputs. Poster 1Department of Botany and Plant Pathology, Oregon State University 2082 Cordley Hall Corvallis 97331 United States. 2Oregon State University 2082 Cordley Hall Corvallis 97330 United States. 3Department of Botany, Na-
tional Museum of Nature and Science 4-1-1 Amakubo Tsukuba, Ibaraki Pref. 305-0005 Japan.

SPIERS, DONALD*, JOHNSON, JAY, BRYANT, JENNY, SCHAF, BRAD, KISHORE, DEEPAN, COATE, ERIC, EICHEN, PEGGY ANN and MCLA-
NEY, RACHEL. Detection of changes in regional vasomotor activity associ-
ated with fescue toxicosis using a rapid shift in ambient temperature. Al-
though several in vitro studies have shown the impact of ergopeptide alkaloids on vascular contractility, there has been limited success with identification of vaso-
construction in vivo. A short study was conducted following several weeks of heat stress exposure and fescue toxicosis to determine shifts in thermal status of cattle when rapidly moved to a thermoneutral environment. Angus steers from Oklaho-
ma (n=10; 552.8 ± 12.0 Kg BW) were fed diets containing either endophyte-in-
fected (E+; ~30 µg ergovaline/Kg BW/ day) or uninfected (E-) tall fescue seed for 8 days at an ambient temperature (Ta) of 19-22°C (TN) and for 2 weeks of cy-
fusing heat stress. Following the last day of HS after 2100 (Ta = 30.8°C), Ta was reduced to 21.2°C by 1100, and held at this point for the re-
mainder of the day. Feed intake (FI) was recorded daily, along with 6 daily measure-
ments of rectal and skin temperatures on shaved sites (ear, rump, shoulder, upper tail, lower tail) from 0600 to 2100. FI change from pretreatment level was greater for E+ versus E- steers on Day 22 (P<0.05). In contrast, rectal temperature (Ta) was reduced slightly but decreased 1.8°C for E+ versus E- steers during HS exposure. However, all tested sites exhibited a reduction in skin temperature at TN (Day 23) for E+ animals (P<0.05) that ranged from 1.1 to 1.8 (ear and upper tail, respectively) below that of E- animals. These results suggest that although there is only a small difference in skin temperature in the heat that is attributable to fescue toxicosis, the vasomotor constrictor action of ergopeptide alka-
loid is markedly evident with a rapid shift to thermoneutrality. (USDA Agree-
mence No. 58-6227-3-016) Keywords: heat stress, fescue toxicosis, vasomotor ac-
tivity Poster University of Missouri 920 E Campus Dr Columbia 652115300 United States.

STEELE, JAMES*, AIKEN, GLEN, KLOTZ, JAMES, FLYTHE, MICHAEL and BROWN, KELLY. Ergot alkaloids: Toxicokinetics and vas-
cular effects in grazing animals. Endophyte- (Neotyphodium coenophialum) in-
fected tall fescue ( Lolium arundinaceum) occupies nearly 14 million ha within the US. Although the endophyte-forage association is beneficial to the plant’s sur-

vival and production, it is detrimental to grazing livestock as a consequence of ergot alkaloid production. Livestock consuming ergot alkaloid contaminated for-
rated database, a number of physiological and biochemical responses including tempera-
tures, reduced growth and reproductive performance, abnormal hair growth and shedding, and altered hormonal profiles. Several of these responses may be ex-
plained by altered cardiovascular function. Ergot alkaloid induced alterations of cardiovascular function appear to be mediated via interactions with biogenic amine receptors. Understanding interactions of these alkaloids with biogenic amine receptors is vital to determining how pathogenesis is induced in livestock, as well as full remediation of the resulting toxicity syndrome. Both in vitro (e.g., vascular bioassays) and in vivo (e.g., ultrasonography) methodologies have been useful in studying the effects these alkaloids. However, little research has been di-
rected towards fully understanding the metabolism, distribution and clearance of these compounds. A lack of robust, selective and highly sensitive analytical meth-
ods for detection of these alkaloids and metabolites in animal tissues has limited research. Existing literature suggests metabolism of these alkaloids occur at sev-
eral sites including: the ruminal environment, intestinal cells, and liver. Data sug-
gest that these alkaloids are cleared from the body via urinary and fecal routes of el-
mination and that some bioaccumulation may occur. This review provides an overview of ergot alkaloid toxicokinetics, analysis and mechanisms of action with particular focus on the vascular systems of grazing livestock. Oral USDA-ARS Animal Production Research Unit N220 Ag Science North Lexington 40546 United States.

SUGAWARA, KOYA*, ARAKAWA, AKIRA, SHIBA, TAKUYA, OKABE, IKUKO and TSUKIBOSHI, TAKAO. Towards breeding of insect resistant
Italian ryegrass cultivar for forage; the application of endophyte infected
grasses in Japan. Meadows, on which little or no measures for pest control can be
applied due to economic reasons and chemical hygiene consideration for grazing

Continued on following page
livestocks, are sometimes considered hotbeds of pests (especially insects) in farming regions in Japan where it is patchworked with diverse crops. One of the most serious insect problems related to forage grass production in the region is kernel spotting of rice grains (“stained rice” or “pecky rice”), caused by rice bugs, which propagate on grasses. We found that the most important species of the bugs in the region, Trigonotylus caelestialium (Heteroptera: Miridae), can be repelled by Italian ryegrass (Lolium multiflorum), the most prevalent forage grass species of the area, by its epichloë endophyte, Neotyphodium occultans. Detailed experiments indicated the fungus enhances the host plant’s ability both to repel and prevent growth of the bug. Feeding experiments with chemicals purified from infected grasses indicated that the main component repelling the insect is N-formyline, one of the loline alkaloids made by the fungus. Since cultivars of the grass currently available commercially in Japan are not infected with the endophyte, we selected infected clones from naturalized populations and have now been crossing-bred with cultivars bred for forage use for better agricultural traits, with selection for higher content of N-formyline. Through three generations of crossing and selection, we observed a slight increase in N-formyline levels, although the mechanism has to be investigated further. We found the cross can be done with detached panicle cultures with successful seed transmission of the endophyte, and the method enables us to use wider options for breeding of the infected grasses. Having the diverse flora of natural and introduced/invaded grasses with epichloë endophytes in the region, we hope we can make better use of the fungi in our agricultural production and grassland managements in the future. 


SUGAWARA, KOYA1*, TOBINA, HIROYUKI2, AKAWA, AKIRA1, YA-MASHITA, MASAYUKI1, SAWADA, HITOSHI1, OKABE, IKUKO1, TSUKIBOISHI, TAKAO1 and SCHRÄDL, CHRISTOPHER1. A world without nuclei of grass: Neotyphodium endophytes and their chloroplast DNA markers and infection status. Festuca and Lolium species, which include important forage and turf grasses, are often associated with seed-borne asexual fungal endophytes belonging to the genus Neotyphodium, and affected in many ways by these symbionts. The fungi are considered to be evolved (captured) from plant pathogenic Epichloë species, and to have been transmitted maternally through the evolutionary lineages of the grasses. Their history of co-evolution with the host grasses may be estimated by studying chloroplast DNA (cpDNA) of the grasses, another factor inherited maternally, as a molecular clock. We compared part of a gene on cpDNA, cytobrome b 559 (psbE), by a PCR marker (Delezier et al., 1999), and found that there are two alleles (RG451 and RG488) among Festuca and Lolium species. The RG488 allele was only observed in some Lolium species, mainly L. perenne and some cultivars/ clones of L. multiflorum, whereas RG451 was identified in all other Festuca and Lolium species. Among the symbionts, N. loli is only found in plants with RG488, whereas N. occultans can be found in both RG451 and RG488 plants. Since RG488 is considered to be derived from RG451 by repeating a motif in the locus, our results imply the cpDNA with RG488 appeared in a common ancestor of L. multiflorum and L. perenne. Furthermore, that ancestor probably had N. occulans, and the symbiont species was later replaced by N. loli in the clade that gave rise to L. perenne. This scenario corresponds well with the relatively recent speciation or domestication by the host plant of N. loli, which molecular phylogenetic data indicate is a close relative of Epichloë festucae. As the entire cpDNA sequence of many plant species are now available, PCR markers on cpDNA can be very useful as research tools for identifying origins of maternally transmitted endophytes. 


SUN, QIAN1*, CHEN, YONGGAN1, JI, YANLING1, SCHRÄDL, CHRISTOPHER1 and WANG, ZHIWEI1. Cloning and predication of a laccase gene from Chinese endophyte Neotyphodium sinofacetum. Laccases (benzenediol: oxygen oxidoreductase, EC 1.10.3.2) are a diverse group of multicomponent oxidases catalyzing the oxidation of a variety of aromatic compounds. Here, we report the full-length of a laccase gene. By using of primers lac4-forward-L and lac4-reverse-L designated based on Epichloë festucae E2368 genome, we successfully amplified and cloned ca. 5.5kb fragment by LA-PCR from total DNA of Neotyphodium sinofacetum strain Fnj4604. Sequencing analysis by FGENESH (http://linux1.softberry.com/berry.phtml?topic=fgenesh&group=programs&subgroup=gfind) indicated that total 2747bp of coding regions separated into 7 segments by 6 introns; the entire coding region is predicted to encode a mRNA which can be translated to 598 amino acids. It highly similar with a fragment in contig430 in Epichloë festucae E2368 genome. The fragment in contig430 contains 7 introns analyzed, and 5 of them are similar with those of N. sinofacetum Fnj4604 when aligned, probably indicating genetic diversity is also observed in Lac genes among epichloë endophytes. The resulted amino acids sequence had 80% similarity with laccase IV obtained from Paracoccidioides brasiliensis strain P18, laccase D from Trametes sp. strain 420, laccase-1 precursor from Pyrenophora tritici-repentis strain PI-1C-BFP and laccase from Cryptococcus neoformans var. grubii. Three typical Cu-oxidase domains and a signal-sequence peptide region are confirmed by a domain analysis. This study is the first report of complete sequence of a putative laccase gene in Chinese endophytes. 

Poster 1Nanjing Agricultural University No1,Weigang Nanjing 210095 China. 2University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States.

TADYCH, MARIUSZ*, BERGEN, MARSHALL and WHITE, JAMES. Role of epiphyllous conidia in horizontal transmission of Neotyphodium endophyte of Poa annua. It has been shown that some Epichloë and Neotyphodium endophytes produce epiphyllous structures, i.e., hyphae, conidiophores, and conidia, growing on leaf blades of host plants. The production of epiphyllous conidia suggests the possibility that some of these endophytes may have the capacity for plant-to-plant spread using surface produced conidia. These conidia are water transmitted and germinate to produce mycelium. Therefore, vertical transmission of these endophytes may not be a complete model of transmission. In our study we were able to artificially infect the endophyte-free Poa annua plants starting from conidia of the Neotyphodium of the Poa annua. In the field the infected conidial germinated to form an epiphyllous mycelium that colonized all parts of expanding seedlings. No wound of the host plant for inoculation by Neotyphodium was required. After three weeks in the laboratory P. annua seedlings were transferred to the greenhouse. The innermost tissues of surface sterilized 12 week old tillers were tested using the fragment plating method, over 50% of infected plants had the Neotyphodium plants which were grown in the greenhouse had no mycelium growing from these tissues. The results of this study provide new insights into the biology and ecology of grass endophytes, and indicate that horizontal transmission of Neotyphodium species by epiphyllous conidia is probable. 

Poster Rutgers University 59 Dudley Road New Brunswick 08901-8520 United States.

TAKACH, JOHANNA1*, AMARASINGHE, RANAMALIE2, REDDING, MOLLY1, RIVERA, HEIDI1, MICALISTER, FIONA1, SCHRÄDL, CHRISTOPHER L4 and YOUNG, CAROLYN2. Meet the parents: Deconstructing the genome of Neotyphodium coenophialum. Neotyphodium coenophialum is considered an interspecific hybrid consisting of origins from E. festucae, E. typhina and the Lolium-associated endophyte closely related to E. bacoti. The genome complexity of N. coenophialum due to the large size (57 Mb, twice that of E. festucae), heteroploid nature and high copy number repeats has previously made this species intractable for sequencing, but advances in sequencing technologies now makes this genome more affordable. We have started genome sequencing using multiple approaches engaging cosmid/fosmid end sequencing and ‘454’ shotgun and paired end reads. We have identified two cosmids that contain two distinct M. nazara type idiomorphs originating from different ancestral parents of N. coenophialum. A shotgun cloning strategy has been employed to determine the full sequences of these cosmids. Through reiterative sequencing, we will assemble a complete sequence for each cosmid. Comparative analysis using the already sequenced E. festucae E2368 genome will aid in assembly comparison. Comparison of the two N. coenophialum MTA loci to an ancestral parent sequence, E. festucae, may reveal the parental origins of each loci. These sequences may also provide a sneak peak into the evolutionary history and/or recombination events that occurred during the speciation process of N. coenophialum prior to the full sequence assembly. 

Poster 1Noble Foundation 2510 Sam Noble Parkway Ardmore 73401 United States. 2Samuel Roberts Noble Foundation 2510 Sam Noble Parkway Ardmore 73401 United States. 3Southern Oklahoma Technology Center 2610 Sam Noble Parkway Ardmore 73401 United States. 4University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States.

TAKEMOTO, DAIGO1*, KAMAKURA, SACHIKO2, SAIKIA, SANJAY3, WRENN, RUTH1, TANAKA, AIKO3, SUMIMOTO, HIDEKI3 and SCOTT, BARRY3. Reactive oxygen as a signal in grass-epichloë symbiosis. The endophytic fungus Epichloë festucae systemically colonizes the intercellular spaces of perennial ryegrass to establish a mutualistic symbiotic association. We have previously shown that reactive oxygen species (ROS) produced by a specific NADPH oxidase isoform NoxA and associated regulators are essential for regulating hyphal growth in the host plant. In the absence of this ROS signal, E. festucae behaves as a pathogen, causing severe stunting of the host as a result of hyphal hyper-branching and increased biomass. Generation of ROS by E. festucae is controlled by functional assembly of a multicomponent complex composed of a plasma membrane bound NoxA, a regulatory component, NoxR, and the small GTPase, RacA.
However, the mechanism for assembly and activation of this complex at the plasmamembrane is unknown. We found by yeast two-hybrid and co-immunoprecipitation assays that E. festucae NoxR interacts with homologs of the yeast protein, Bem1 and Cdc24. GFP fusions of BemA, Cdc24 and NoxR preferentially localized to actively growing hyphal tips, tips of emerging branch-es and to septa. An E. festucae AhemA mutant was defective in hyphal morphogenesis and growth in culture and in planta. The changes in fungal growth in plant-ta resulted in a defective symbiotic interaction phenotype, characterized by loss of apical dominance and reduced aerial growth of the host plant. These results suggested that BemA and Cdc24 play a critical role in localizing and activating Nox proteins, in order to control fungal hyphal morphogenesis and growth. Oral 1Graduate School of Bioagricultural Sciences, Nagoya University Plant Pathology Laboratory Nagoya 464-8601 Japan. 2Kishu University 3-1-1 Maidashi, Higashiku Fukuoka 812-8582 Japan. 3Michael Smith Laboratories, University of British Columbia 2185 East Mall Vancouver, BC V6T1Z4 Canada. 4Massey University Private Bag 11 222 Palmerston North 4442 New Zealand. 5Nagoya University Furo-cho, Chikusa Nagoya 4648601 Japan. 6Institute of Molecular Biosciences, Massey University Riddet Road, Turitea Campus Palmerston North 4442 New Zealand.

TANAKA, AIKO*, TAKEMOTO, DAIGO*, SAIAKA, SANJAY*, TSUGE, TAKASHI*, CARTWRIGHT, GEMMA* and SCOTT, BARRY*. Identification of a transcription regulator controlling in planta hyphal growth of Epichloë festucae. Epichloë festucae is the obligate biotroph of perennial ryegrass, Lolium perenne. In wild-type associations, E. festucae grows systemically in the intercellular spaces of the leaves as infrequently branched hyphae parallel to the leaf axis. A genetic screen to identify genes of E. festucae responsible for maintaining the mutualistic association has been carried out using Agrobacterium T-DNA mediated transformation of E. festucae and supplementation with sulfo-namid. Epichloë festucae, forms a symbiotic association with perennial ryegrass, Lolium perenne. In wild-type associations, E. festucae grows systemically in the intercellular spaces of the leaves as infrequently branched hyphae parallel to the leaf axis. A genetic screen to identify genes of E. festucae responsible for maintaining the mutualistic association has been carried out using Agrobacterium T-DNA mediated transformation of E. festucae and supplementation with sulfamid. The newly reconstructed Structural and Biochemical Database developed as part of the Assembling the Fungal Tree of Life (AFTOL) project, aims to provide a major resource that manages morphological and biochemical information on Fungi and serves as a phyloinformatics tool for the scientific community. The database, available at https://aftol.ornl.gov, includes new and published images, images and literature, and is additionally combined in NEXUS format from the site permit independent and combined (with molecular data) phylogenetic analyses. Character lists, a major feature of the site, serve as primary reference documents of subcellular and biochemical characters that distinguish taxa across the major fungal lineages. The illustrated character lists with images and drawings are informative for evolutionary and developmental biologists as well as educators, students and the public. The Fungal Subcellular Ontology (FSO) developed as part of this effort is a primary initiative to provide a controlled vocabulary describing subcellular structures unique to Fungi. FSO establishes a full complement of terms that provide an operating on-tological framework for the database. Poster 1University of Minnesota Plant Biology Department St Paul 55108 United States. 2University of Minnesota Museum of Natural History, University of Minnesota 55108 United States. 3Louisiana State University Department of Biological Sciences Baton Rouge 70803 United States. 4University of Alabama Department of Biological Sciences Tuscaloosa 35487 United States. 5Arizona State University School of Life Sciences Tempe 85287 United States.

TIMPER, PATRICIA* and BOUTON, JOE*: Variable response of non-ergot-producing strains of Neotyphodium coenophialum in tall fescue to lesion nematodes. Tall fescue (Lolium arundinaceum) is mutually associated with the endophytic fungus Neotyphodium coenophialum. The fungus confers resistance to several plant pests, including some plant-parasitic nematodes, but also produces ergot alkaloids which are toxic to livestock when ingested. To alleviate the problem of ‘fescue toxicosis’, naturally occurring strains of N. coenophialum producing low to nil levels of ergot alkaloids have been artificially inoculated into elite tall fescue cultivars (novel association). In an earlier study, three of these novel strains differed from the wild-type strain in that they were unable to confer resistance to the lesion nematode (Pratylenchus scribneri). There is evidence indicating that ergot alkaloids are not involved in nematode resistance. Therefore, our objective was to test additional non-ergot strains of N. coenophialum for suppression of lesion nematode populations. Nine trials were conducted with different subgroups of 24 non-ergot strains in either ‘Jesup’ or ‘KY-31’ tall fescue. Each trial included endophyte-free plants (E-free) and plants containing the wild-type (WT) strain, and seven to eight replicate pots for each endophyte status. In eight of nine trials, nematode numbers were lower in plants with the WT strain compared to E-free plants. Eight non-ergot strains also had lower nematode numbers compared to E-free plants in at least one trial. However, the ability of these eight strains to suppress nematode numbers was not consistent among the trials. Random variation in nematode reproduction does not sufficiently explain our inconsistent results with the non-ergot strains. We suspect that some of these strains have the ability to reduce nematode numbers, but hypothesis that this ability is not stable due to the new association of the endophyte and plant genotype. Oral USAID ARS P.O. Box 748 Tifton 31793.

Continued on following page
Endophyte infection frequency and vertical transmission efficiency in Italian ryegrass populations along a river in Japan. Italian ryegrass (Lolium multiflorum), a non-native, grass has been widely planted for forage production and soil preservation in Japan. It has invaded other areas from sites where it was originally planted and has become widely naturalized in disturbed habitats such as roadsides and riversides throughout Japan. Most naturalized Italian ryegrass in Japan has been infected by Neoty- phodium occultans. However, fine-scale variations in infection frequency and vertical transmission efficiency of those populations are unknown. Here, we examined these variations in invading Italian ryegrass populations along the Abe River in Shizuoka, Japan. We studied six sites ranging from 1 to 25 km apart from the mouth of the Abe river. All sites had three habitat types that differed in flooding intensity: gravelly flood plain, flood fringe, and river bank. Within each site, seeds of L. multiflorum were collected twice, without washing each habitat type were sampled. The presence or absence of the Neotyphodium endophyte was assessed using light microscopy. The endophyte transmission efficiency was calculated only for endo- phyte-infected plants as the number of infected seeds divided by the total number of seeds examined. The populations in gravelly flood plains exhibited lower infection frequencies (mean = 78%) compared with the other populations (mean = 92%). The colonization was imperfect in all habitat types. The flood fringe and the gravelly flood plain populations exhibited lower transmission efficiencies than the river bank populations. The findings suggest that imperfect vertical transmission and/or loss of the endophyte may occur in habitats that are frequently temporarily flooded due to heavy rain. Poster Shizuoka University 836 Ohya Suruga-ku Shizuoka 422-8529 Japan.

TORRES, MARIA* and VAILLANCOURT, LISA. Induced Susceptibility of Maize Inoculated with Colletotrichum graminicola. Colletotrichum graminicola is one of the most important fungal pathogens of maize worldwide. A mutation in the CPR1 gene encoding a conserved component of the signal peptidase, led to loss of pathogenicity. When the cpr1 mutant was inoculated on detached corn leaf sheaths, it germinated and produced appressoria, but did not usually colonize more than a single cell. The mutant was able to colonize sheath tissues normally if they were compromised by treatment with the herbicide parquat. To test the hypothesis that wild-type C. graminicola suppresses host defense responses while the cpr1 mutant does not, both strains were co-inoculated on detached corn leaf sheaths. Co-inoculation with the wild type significantly increased the number of cells that were colonized by the mutant in both susceptible and resistant cultivars. Surprisingly, this was true even if the wild type and mutant inoculation sites were separated by up to 1 cm. Plant cells surrounding the inoculation sites plasmolyzed and took up neutral red indicating that they were still alive. We “triple-inoculated” individual leaf sheaths with wild type C. graminicola, mutant C. graminicola and the non-pathogen related fungus C. sublineolum. C. subline- olum does not colonize healthy maize tissue, though it was able to colonize parasitically infected sheath tissues. Co-inoculation with the wild type C. graminicola did not facilitate infection by C. sublineolum, whereas the cpr1 mutant was able to colo- nize the same leaf sheaths. Preliminary results of DAB staining to assess the pro- duction of ROS indicated that wild type C. graminicola suppresses ROS production by the host, while the mutant seems to induce ROS production. Our results suggest that C. graminicola suppresses the ability of host cells to defend them- selves against colonization, but without killing them. This suppression may result from the secretion of effectors. The cpr1 mutant may be unable to produce these effectors. Oral University of Kentucky 201F FSBS 1405 Veterans Drive Lexington 40546 United States.

TOURNAS, V.H.*+, RIVERA CALO, J.2 and MEMON, S.3. Comparison of the SimPlate Yeast & Mold Color Indicator to the BAM Method for Quantifi- cation of Fungi in Naturally-Contaminated Foods. A total of 260 samples from six food groups (grains and grain products, tree nuts, dried fruits, fresh pro- duce, fruit juice, and dairy products) were tested for levels of fungal contamina- tion using the SimPlate Yeast and Mold Color Indicator (YM-CI) and the FDA official (BAM) method. Results showed that the SimPlate, in most cases, gave results faster than the reference method. Some difficulties were encountered when spreader moulds were present. Poster 1Center for Food Safety and Applied Nutrition, FDA 5100 Paint Branch Parkway College Park 20740 United States. University of Puerto Rico Mayaguez Campus Mayaguez 00910 Puerto Rico. Uni- versity of Maryland College of Chemical and Life Science College Park 20740 United States.

USIF, MANSURU1*, ISIKHUENHIE, OMOMAIGHE1, ANIKE, FELICIA1 and OHIMAIN, ELIJAH I2. Biodegradation of peanuts shells and corn stalks by Pleurotus ostreatus under solid state cultivation conditions. Peanut shells (PS) are of particular interest in bioconversion because of its mass accumulation as a waste from agro-industrial activity. However its bioconversion to useful value-added products has been limited by its high lignin content (40%). Corn stalks (CS), is also an abundant agricultural waste reported to be amenable to biocon- version by white rot fungi. The aim of this research is to determine the ability of Pleurotus ostreatus to convert peanut shells and in combination with cornstalks to mushrooms and to determine macromolecule profiles of degraded substrates. Pre- liminary studies on PS & CS in 21 substrate combinations, with 5% and 10% rye added as a supplement to some of the combinations, showed that faster colonization of mixed PS and CS substrates (70PS:5Rye:25CS, 85PS:5Rye:10CS, & 50PS:50CS) was favored by Pleurotus ostreatus over whole peanut shells or corn- stalks substrates. Fruit body induction studies also indicated that mixed PS and CS substrates, supplemented with 10% rye, produced the highest mushroom yield. Ongoing work to further characterize optimum substrate combination for mush- room yield and value added spent substrate will be presented. Oral 1North Car- olina A&T State University 1601 East Market St Greensboro 27411 United States. 2Biological Sciences Department, Niger Delta University Wilberforce Is- land Nigeria.

TRETTER, ERIC*+, GUARDIA VALLE, LAIA2, STRONGMAN, DOUGLAS3 and WHITE, MERLIN1. A preliminary multigene phylogeny of the Orphella clade of gut fungi. Molecular systematics continues to provide new in- sights as we continue to refine our phylogenetic analyses of the basal groups of fungi. The genus Orphella is a group of trichomycete gut fungi that is currently placed within the family Legeriomycetaceae and the order Harpellales. However, both significant differences in morphology and recent genetic data call this place- ment into question. Furthermore, the internal genetic placement of the individual species of Orphella within the genus remains unexplored. We have sequenced a number of Orphella samples at multiple highly conserved genetic loci frequently used for phylogenetic analyses of fungi. To help solve the phylogenetic place- ment, we have constructed multiple phylogenetic trees. Our sequences include the 18S, 5.8S, and part of the 28S ribosomal subunit genes for several Or- phella species, to infer the placement of the Orphella clade within the larger fungal tree. We also demonstrate the utility of 28S and 5.8S ribosomal subunit genes, as well as the ITS1 and ITS2 spacer regions, for trees with more Orphella species to help decipher individual species relationships. Both single-gene and multi-gene trees will be presented for each analysis. By constructing these trees, we hope to demonstrate the monophyly of Orphella as well as to resolve the ordinal place- ment pending the completion of well-supported phylogenies. The multiple-se- quence alignments used in creating these trees should allow us to refine our primers and prepare for constructing a complete phylogeny of the Orphella clade involving multiple sequences for each known species as well as more gene re- version by white rot fungi. The aim of this research is to determine the ability of Pleurotus ostreatus to convert peanut shells and in combination with cornstalks to mushrooms and to determine macromolecule profiles of degraded substrates. Pre- liminary studies on PS & CS in 21 substrate combinations, with 5% and 10% rye added as a supplement to some of the combinations, showed that faster colonization of mixed PS and CS substrates (70PS:5Rye:25CS, 85PS:5Rye:10CS, & 50PS:50CS) was favored by Pleurotus ostreatus over whole peanut shells or corn- stalks substrates. Fruit body induction studies also indicated that mixed PS and CS substrates, supplemented with 10% rye, produced the highest mushroom yield. Ongoing work to further characterize optimum substrate combination for mush- room yield and value added spent substrate will be presented. Oral 1North Car- olina A&T State University 1601 East Market St Greensboro 27411 United States. 2Biological Sciences Department, Niger Delta University Wilberforce Is- land Nigeria.

VAN TWEST, SYLVIE M.1*, CUCULLO, JESSICA1, GRANT, SANDRA J2 and DOBINSON, KATHERINE F.2. The role of ATG8 autophagy gene ho- mologs in resting structure development in Verticillium dahliae and Vertici- llium albo-atrum. Vascular wilt caused by the fungal plant pathogens, Vertici- llium dahliae and the closely related Verticillium albo-atrum is responsible for billions of dollars in yield losses annually. Both species have broad host ranges and produce melanised resting structures that enable long term survival and serve as inoculum during infections. While V. dahliae produces swollen hypheae that septate to form clusters of spherical, melanised cells called microsclerotia (MCS), V. albo-atrum hyphae do not differentiate and simply melanise, resulting in dark resting mycelia (DRM). The molecular mechanisms that control resting structure development are poorly understood. To this end, our laboratory constructed cDNA libraries from cells grown in two environments; a simulated xylem fluid medium where the fungus exhibits dimorphic growth, and conditions that favour near-synchronous microsclerotia development, in order to identify candidate genes for resting structure development. Sequences highly similar to the known gene cDNA libraries from cells grown in two environments; a simulated xylem fluid medium where the fungus exhibits dimorphic growth, and conditions that favour near-synchronous microsclerotia development, in order to identify candidate genes for resting structure development. Sequences highly similar to the known gene

80 Inoculum 61(4), August 2010

Continued on following page
In microsclerotial development, conidiation and dimorphic growth in V. dahliae. However, no morphological defects were observed in V. albo-atrum atg8 knockout strains. Studies with the autophagy inhibitor 3-Methyladenine, and inducer Rapamycin support our comparative data. Northern hybridization analysis, construction and analysis of strains carrying a VdATG8-yellow fluorescent protein fusion construct are being done to better understand how ATG8 expression changes during development. Poster 1Department of Biology, University of Western Ontario 1151 Richardson Street London N6A 3K7 Canada. 2Southern Crop Protection and Food Research Centre, Agriculture and Agri-food Canada 1391 Sandford Street London, Ontario N5V 4T3 Canada.

VAUGHAN, MICHAEL JOE*, MAIER, RAINA and PRYOR, BARRY. Examining culturable fungal diversity from speleothem surfaces in karterchen caverns, Benson, Arizona, USA. Karterchen Caverns, located near Benson, Arizona, is a living carbonate cave renowned for its mineralogical and speleothem diversity. Since its discovery in 1974, special attention has been paid toward preserving the cave in pristine condition. As such, Karterchen Caverns has provided a unique opportunity as an established NSF Microbial Observatory to explore microbial communities in subterranean environments. Broadly, this project seeks to define the microbial diversity that exists inside the cave, correlate this diversity with varied cave substrata, and examine how these organisms functionally contribute to cave ecosystems. This project focused on examining the culturable fungal diversity recoverable from speleothem surfaces as a prelude to non-culture-based analyses of speleothem surface communities to explore functional properties. Sampling was conducted across five sites throughout the cave. Isolates were identified to genus based on morphology and molecular data. Sites were compared in light of the recoverable number of morphologically distinct taxonomic units (MTU) and the number of genera represented. Speleothem sampling resulted in the recovery of 173 isolates representing 53 genera. There were 136 taxa of isolated fungi, with 18 genera of MTU’s found among sites. Similarly, there was no significant difference in the number of isolated genera among sampling sites. Preliminary collection data suggested that there were differences in the taxonomic diversity between the two distinct sections of the caverns: one section that harbors a bat population, which had less MTU diversity, and the other section that has not harbored bats for many millennia, which had greater MTU diversity. However, the fungi recovered in this sampling revealed no significant difference in the numbers of MTU’s or genera between the two sides of the cave. Oral University of Arizona 1140 E. South Campus Dr. Tucson 85721 United States.

VELEZ, PATRICIA*, GONZALEZ, MARIA C1, CAPELLO, SILVIA1 and HANLIN, MARTHA T. Diversity of marine arenicolous ascomycetes from some coastal beaches of Tabasco, Mexico. The intermural zone of ten sandy beaches spread along the coast of the State of Tabasco was sampled in September, 2008 and the fungal diversity was evaluated. In each of the beaches, 20 samples of washed up detritus were collected. In the laboratory, the collected samples were incubated up to a period of 12 months and examined periodically for the presence of ascocarps, asci and ascospores. A total of twenty taxa were registered. The highest diversity of arenicolous ascomycetes was obtained from Sanchez Ma-gallanes Beach, and the lowest in La Union Beach. These results agree with the highest diversity of arenicolous ascomycetes in Southern Ontario, where the endophyte flora has been little studied to date. Using visual inspection and an immunoblot technique, we screened over 60 populations including those of three native species (Festuca subverticillata, F. saximontana and F. occidentalis), four introduced (naturalized) species (S. phoenix, S. pratensis, F. arthrophylla and F. filiformis), and one species with both native and introduced populations (F. rubra). Overall infection frequency was not significantly higher among introduced species (mean 56%) than among native species (53%). In F. rubra, native populations had considerably higher infection frequency (69%) than introduced populations (41%), contrary to our prediction. However, the highest infection frequencies occurred in the introduced S. pratensis (90%) and S. phoenix (78%), while the lowest was in the native F. occidentalis (16%). Infection frequencies in S. pratensis were consistently high, unlike those reported from its native range where the fungus has relatively low infection frequencies. Infection frequencies in F. rubra were not significantly high between introduced species other than S. phoenix, infected genotypes may be more fit outside their native range. Further investigation of the relationship between herbivory, abiotic factors and the effect of infection on host fitness in the region is warranted. Poster Department of Biology, York University 4700 Keele Street Toronto M3J 1P3 Canada.

VICARI, MARK* and BAZELY, DAWN. Epichloë endophytes of native and naturalized fescues in Southern Ontario. In the U.S. the status of tall fescue, Schedonorus phoenix, as an invasive plant appears to be largely dependent on its endophyte. This is consistent with the novel weapons hypothesis, which predicts that successful invaders would desensitize their defenses to fewer pathogens and have more potential to be successful in their new environment than those lacking such defenses. Given the wide inter- and intraspecific variation in the suites of alkaloids found in Epichloë-infected grasses, we hypothesized that introduced hosts should generally have higher infection frequencies than native hosts, since the former have greater potential to benefit from infection in terms of herbivore de-fence. We measured infection frequencies of fescues in Southern Ontario, where the endophyte flora has been little studied to date. Using visual inspection and an immunoblot technique, we screened over 60 populations including those of three native species (Festuca subverticillata, F. saximontana and F. occidentalis), four introduced (naturalized) species (S. phoenix, S. pratensis, F. arthrophylla and F. filiformis), and one species with both native and introduced populations (F. rubra). Overall infection frequency was not significantly higher among introduced species (mean 56%) than among native species (53%). In F. rubra, native populations had considerably higher infection frequency (69%) than introduced populations (41%), contrary to our prediction. However, the highest infection frequencies occurred in the introduced S. pratensis (90%) and S. phoenix (78%), while the lowest was in the native F. occidentalis (16%). Infection frequencies in S. pratensis were consistently high, unlike those reported from its native range where the fungus has relatively low infection frequencies. Infection frequencies in F. rubra were not significantly high between introduced species other than S. phoenix, infected genotypes may be more fit outside their native range. Further investigation of the relationship between herbivory, abiotic factors and the effect of infection on host fitness in the region is warranted. Poster Department of Biology, York University 4700 Keele Street Toronto M3J 1P3 Canada.

VIGNALE, MARIA VICTORIA1*, NOVAS, MARIA VICTORIA1, PINGET, ALBERTINA DANIELA2, ASTIZ GASSO, MARTA MONICA1, DE BATTISTA, JOSE PEDRO2 and IANNONE, LEOPOLDO JAVIER4. The role of Neotyphodium on the interaction of Bromus auleticus with the smut fungus Ustilago bulbata and mycorrhizal fungi. The interactions among endophytes, that is, mutual fungal pathogens or mycorrhizal fungi are being currently studied in agronomic grasses. However this knowledge is limited in native grasses. Numerous grasses native to Argentina are infected with epichloë-endophytes. Among them, Bromus auleticus is a promising forage grass and different ecotypes are associated with different Neotyphodium species. In this work we study the role of endo-phytes on the interaction of B. auleticus with a common plant pathogen (the smut Ustilago bulbata) and with root mutualistic fungi (arbuscular mycorrhizal fungi, AMF). To study the resistance to smuts, E+ and E- seeds from two host ecotypes were inoculated with teleiospores. Plants germinated from E+ seeds from the eco-type El Palmar (N. tembladerae infected) presented less mortality than the E- ones, but no differences were observed in mortality between E+ (N. panameum) infected and E- plants from La Pampa ecotype. However, whereas 100% and 30% of the E- plants from El Palmar and La Pampa ecotypes, respectively, developed smut symptoms on the flowers, no disease symptoms were observed in E+ plants. To study how the endophytes and soil fertilization level affect AMF colonization,
E+ and E- seeds of both ecotypes were planted in the field and after seedling emergence two fertilizer levels were applied. Mycorrhizal colonization was studied on 4 month-old plants. E+ plants from El Palmar presented a significantly higher frequency of ectomycorrhizal fungi when compared to E- plants from different localities. These results indicate that the morphology of ectomycorrhizal fungi may be important to obtaining nitrogen. This study also demonstrates that relatively undisrupted temperate forest communities of the northeastern US contain species of ectomycorrhizal fungi that no longer occur in areas of Europe where anthropogenic nitrogen deposition (0.7 - 2.2 kg N ha-1 year-1) is known to reduce ectomycorrhizal species richness, sporocarp production, and decrease mycelial biomass. Additionally, high levels of soil nitrogen result in decreased relative abundance of species producing significant amounts of extramatrical hyphae and rhizomorphs. To test if similar patterns occur under relatively natural conditions, we examined temperate forest ectomycorrhizal communities that receive low amounts of nitrogen deposition (0.7 - 2.2 kg N ha-1 year-1). We sampled root tip and soil fungi over a two-year period and used ITS sequences to identify the fungal species. Measurements of foliar nitrogen were calculated from absorbance data collected from an AVIRIS spectrophotometer at each of our sites. We observed a negative relationship between foliar nitrogen and the abundance of the characters of fungi that root through production of extramatrical hyphae, while no difference in species richness was detected. Analysis of species turnover was significant among several sites, but the extreme ends of the gradient were similar in species composition. These results indicate that the morphology of ectomycorrhizal fungi may be important to obtaining nitrogen. This study also demonstrates that relatively undisturbed temperate forest communities of the northeastern US contain species of ectomycorrhizal fungi that no longer occur in areas of Europe where anthropogenic N deposition is known to be high. Poster 1SUNY ESF 1 Forestry Drive Syracuse 13210 United States. 2University of New Hampshire 8 College Rd. Durham 03824 United States.

VOLK, THOMAS*, HOWER, JAMES C.2 and O’KEEFE, JENNIFER M.K.1. Spores, sclerotia, and hyphae in resinite of coal. Coal is an organic rock that was formed from plants in swamps and mires that had various associations with fungi. The plants were preserved from degradation and oxidation by mud or acidic water. As these reserves were trapped underground, they were exposed to high temperatures and pressures, during which time they underwent metamorphosis into coal. While it can be difficult to find any traces of fungi in coal, they are typically found in coal and the abundance of the characters of fungi that root through production of extramatrical hyphae, while no difference in species richness was detected. Analysis of species turnover was significant among several sites, but the extreme ends of the gradient were similar in species composition. These results indicate that the morphology of ectomycorrhizal fungi may be important to obtaining nitrogen. This study also demonstrates that relatively undisturbed temperate forest communities of the northeastern US contain species of ectomycorrhizal fungi that no longer occur in areas of Europe where anthropogenic N deposition is known to be high. Poster 1SUNY ESF 1 Forestry Drive Syracuse 13210 United States. 2University of New Hampshire 8 College Rd. Durham 03824 United States.

WALBERG, ERIC* and VOLK, THOMAS2. Possible mechanism for observed fungal growth in ionizing radiation. When robots were sent to examine the insides of Chernobyl years after the disaster, fungi were found growing. Sparked by this, it was demonstrated that some fungi can grow toward radiation sources. More recently, it was demonstrated that some fungi may grow better in ionizing radiation than without, and that this phenomenon may require or be enhanced by the presence of melanin (Dadachova et al. 2007). We are attempting to determine the mechanism for the observed effect of ionizing radiation on fungi. Thus far we have determined one potential mechanism with Cryptococcus neoformans which we shall present. Although our results with C. neoformans mimic the results of Dadachova et al. (2007) in terms of increased growth in ionizing radiation, the mechanism appears to be more general, with no detectable dependence on melanin at our radiation doses. If correct, our mechanism would not allow fungi to use radiation as an energy source per se, but future tests may show whether this mechanism is a cause of the previously observed increased growth. Oral University of Wisconsin - La Crosse, Dept. of Biology 1725 State Street La Crosse 54601 United States.

WALL, PIPPA R.*, LAITINEN, RIITTA1, HELSTROM, KALLE1, HEDLAND, MARJO2 and SAIKKONEN, KARI3. Different habitats select Epichloë festucae-fine fescue symbioses with different characters. The outcome of the symbiosis between grass endophytes (Epichloë/Neotyphodium fungi) and their host grasses has been shown to vary from antagonistic to mutualistic. Especially high variation is expected in wild grass populations. Hence we explore whether habitat of origin, different growing conditions and additional players change the interaction between subarctic Festuca rubra s.l. and its Epichloë festucae endophyte. In addition, we tested how the endophyte affects the performance of other plant species that interact with the grass. We grew endophyte-infected (E+) and endophyte-free (E-) Festuca rubra individuals from two different habitats (river banks and seminatural meadows) in different experimental setups in order to study the performance of F. rubra in different growing conditions and ecological multispecies interactions among plant species and the grass endophyte. Endophyte infection was manipulated in part of the experiments. Grasses originating from different habitats differed in several traits and significant variation among different grass seed families was detected. Also the endophyte infection affects differently the grasses from different habitats. Endophyte seems to show high plasticity and that the characters of fungi that root through production of extramatrical hyphae, while no difference in species richness was detected. Analysis of species turnover was significant among several sites, but the extreme ends of the gradient were similar in species composition. These results indicate that the morphology of ectomycorrhizal fungi may be important to obtaining nitrogen. This study also demonstrates that relatively undisturbed temperate forest communities of the northeastern US contain species of ectomycorrhizal fungi that no longer occur in areas of Europe where anthropogenic N deposition is known to be high. Poster 1SUNY ESF 1 Forestry Drive Syracuse 13210 United States. 2University of New Hampshire 8 College Rd. Durham 03824 United States.

WALKER, DONALD M.*, CASTLEBURY, LISA A.2, ROSSMAN, AMY Y.1 and WHITE, JAMES1. Use of three new single copy loci for systematics in the genus Ophiognomonia (Gnomoniaceae, Diaporthales). Species of Ophiognomonia are leaf- and stem-inhabiting pyrenomycetes that infect plants mostly in the Fagales but also in the Lauraceae, Rosaceae, Salicaceae, and Tiliaceae. Walnut anthracnose and leaf blight are caused by O. leptoystyla in the eastern and midwestern United States. In addition, the asaceous species Siroccusus clavignanti-juglandicarum, a serious pathogen of butternut, falls within Ophiognomonia. Species of Ophiognomonia are generally characterized as producing single discrete asexual conidiomata with one-septate, cylindrical, fusoid, or fusiform asci. Analyses of DNA sequences from three gene regions, β-tubulin, translation elongation factor 1a (tef-1a) and the ITS regions were used to define species in Ophiognomonia. Primers for three new single copy genes (FG1093, FG1565, MS204) were designed and used to resolve species in Ophiognomonia. The new genes provided additional resolution at the species rank. The resulting trees were congruent with those based on β-tubulin, ITS, and tef-1a. Host preference trends and use of morphological characters for identification of species were also investigated. All species identified by Sogonov et al. (2008) were recovered by these analyses with at least four new species identified. Oral 1Rutgers University 59 Dudley Rd. New Brunswick 08901 United States. 2University of Turku Dept. Biology Turku 20014 Finland. 3MTT Agrifood Research Finland R building Jokioinen 31600 Finland.

WALKER, ALLISON K. and CAMPBELL, JINX. Marine fungal diversity of Florida barrier island beaches. Marine fungi are an important but often overlooked component of marine ecosystems. Primarily decomposers, they are vital to coastal food webs and nutrient cycling processes. Fungi also play a role as plant and animal pathogens and biofouling organisms in the marine environment. However, this marine fungal diversity data is lacking in many parts of the world. This study sought to delineate the parameters shaping marine fungal distribution and biodiversity along a latitudinal gradient, via a comparison of marine fungal communities of selected Florida barrier island beaches. Beach detritus (wood, sea grass, saltmarsh and mangrove) and sand were collected in winter and summer and incubated in the laboratory for six to twelve months. Sea foam was also collected and examined for the presence of marine fungal spores. As marine fungi are microscopic, identifications were conducted with the aid of a compound mi-
WANG, ZHIWEI1 and JI, YANLING. Endophytic fungi harbored in Chinese native graminaceous plants. Ephichloë endophytes, including Neotyphodium spp. and Epichloë spp., enhance plant growth, mediate more plant tolerance or resistance to biotic and abiotic stresses, and also synthesize various biologically active compounds in their host plants, and important in many areas. But fungal endophytes within native Asian plants were poorly investigated in the last century. Recently, an Ephichloë sp. and 6 Neotyphodium spp. and a variety of N. gansuense were isolated from steppe and grassland. A new species of Neotyphodium is described in China, 2 species and a variety, N. gansuense, N. gansuense var. inebrianse and N. inebrianse, were reported from Achnatherum sp. Enhanced ammonium assimilation from field plots at a semi-arid site was observed. We also described a new species, Epichloë sp., and evaluated for dehydrin expression, SOD activity, and total phenolic concentration and plant survival. The summer-dormant populations achieved 90-99% survival, whereas survival of KY-31 ranged from 37-76%. Western blotting indicated substantially greater dehydrin presence in KY-31 than Flecha and TX-line, with no discernible difference between the latter two. There was no discernible difference in dehydrin expression due to endophyte presence in any of the populations. Phenolic activity and total phenolic concentration were consistently highest in KY-31 and lowest in the summer-dormant populations, again, with no significant differences due to endophyte. Expression of biochemical compounds and activities associated with protection of drought-stressed plant tissues was negatively associated with drought survival. The high survival rates of summer-dormant populations were more likely caused by reduced metabolism and growth, with no interaction with endophyte. Poster 1University of Arkansas 1366 W. Altheimer Dr. Fayetteville 72704 United States. 2Texas AgriLife HYW 70 Vernon 76385 United States.
ceous and non-clavicipitaceous endophytes alike, including improvements in: 1) resistance to herbivore consumption of host tissues; 2) abiotic stress tolerance of hosts including heavy metal and drought tolerance; 3) resistance of hosts to diseases; and 4) extension of geographic ranges or habitats of hosts. Because the endophytic organisms colonize plant host that shows enhanced protection from abiotic and biotic threats the symbiosis is often referred to as a defensive mutualism. Understanding the mechanisms whereby fungal endophytes modify host plant fitness and performance in terms of herbivore deterrence, stress tolerance and disease resistance may reveal mechanisms for mutualism that are common in other microbial-plant symbioses. The current explanations of the mechanisms of endophyte protection of host plants involve several distinct phenomena. It seems obvious that herbivore deterrence is the result of defensive chemistry, including alkaloids. There is evidence to support that the mechanism of host protection to abiotic stresses and fungal diseases is through improved resistance to reactive oxygen species (ROS) and suppression of plant cell apoptosis (cell death). The persistence of living, but highly modified, plant tissues within stromata of Epiclholae and Balanisia species reflect the suppression of cell death. In addition, several studies have demonstrated enhanced antioxidant production in endophyte-infected plants. Endophytes may also produce mannitol and other antioxidant carbohydrates. And these also may play a role in enhancing antioxidant capacity of infected host plants. Antioxidants produced in symbiotic plants may protect plants from oxidative stress and reduce destructive oxidative bursts due to plant diseases, droughts, heavy metals, and other reactive oxygen species stressors. Oral 1Rutgers University 59 Dudley Rd New Brunswick 08901 United States. 2Louisiana State University 321 Koshland Hall Baton Rouge 70803 United States. 3Department of Biological Sciences, Humboldt State University Arcata 95521 United States.
two Italian ryegrass populations were examined for the presence or absence of endophytes. The terraced paddy population exhibited a markedly high infection frequency (91.0%), possibly due to selective consumption of non-infected seeds by insects. In contrast, the wheat-soybean farmland population had almost no infection (1.1%), whereas the putative source of the invasion in the proximity exhibited a relatively high infection rate (64.4%). Such a micro-scale variation in infection frequencies may be attributable to a loss in endophyte viability within the wheat-soybean field. The findings suggest that endophyte infection frequency may have high variation among the Italian ryegrass populations even within the same region, presumably depending on the abundance of seed-eating insects, farmland management regimes and/or environmental conditions. Poster Shizuoka University 836 Ohya Suruga-ku Shizuoka 422-8529 Japan. 2Shizuoka Prefectural Research Institute of Agriculture and Forestry 678-1 Tomioka Iwata 438-0803 Japan.

YI, MIHWA* and VALENT, BARBARA. Localization of secreted proteins of the rice blast fungus during early invasive growth in planta. The rice blast fungus, Magnaporthe oryzae, is a devastating fungal pathogen that threatens staple rice production worldwide. The fungus develops specialized intracellular invasive hyphae (IH) in living rice cells, and interacts with host cells across a plant-derived extracellular-hyphal membrane (EHM). Although secreted proteins from the fungus play an important role in manipulating the host responses during the interaction, current information on secreted proteins is limited. Previous microscopy analysis in our laboratory identified fungal genes that were highly expressed during the early biotrophic stage of rice blast disease. We used the SKIGO-NALP program to identify secreted protein candidates showing 10-fold and higher levels of up-regulation compared to expression during the vegetative growth stage. We labeled the proteins with either C-terminal GFP or RFP by a high throughput Gateway cloning system and localized the fusion proteins in planta using immunofluorescence. We identified 29 genes within a clade of secreted proteins that were specifically expressed by biotrophic invasive hyphae and that localized in the Biotrophic Interfacial Complex (BIC) similar to the known blast effector proteins AVR-Pita, PW1 and PW1.2. In addition, 8 of the BIC-localized proteins were translocated across the EHM into the rice cytoplasm, and 5 of these translocated proteins moved into adjoining uninfected cells, possibly preparing these host cells for subsequent fungal invasion. These results will accelerate cataloging candidate blast effector proteins and elucidating the secretion mechanism of effectors during fungal-plant interactions. Oral Department of Plant Pathology Kansas State University Manhattan 66506 United States.

YOUNG, WILLIAM * The Oregon Grass Seed Industry. Oregon is the world’s major producer of cool-season forage and turf grass seed and a widely recognized center of expertise in seed production. Grass seed was introduced in the 1920s as an alternate crop in the southern Willamette Valley, and since the 1940s the industry has made steady growth. However, seed production technologies have not remained static. Indeed, the most significant challenge to confront Oregon seed growers has been legislation to reduce reliance on open-field burning of post-harvest crop residues. In the absence of burning, straw marketing opportunities have not materialized to provide the quality alkaloid content desired in endophyte-infected turfgrasses. With reduced open-field burning the was an availability of approximately 888,850 to 1,029,325 Mg (tonne) of grass seed straw from Willamette Valley fields. Prior to 1990, a small export market for grass straw had been developing; however, through the 1990s the straw export market grew rapidly as an increased availability of unburned crop residues were removed from seed fields by baling. Thus, in the last 20 years grass straw exports have increased approximately 183%, or to the point that over one half (52%) of the estimated total production is shipped off-shore. Most of the grass seed varieties grown today are turf-type, which in recent years have been developed with high levels of fungal endophyte infection. Concern for the safe use of these grass straw residues has led to a routine analysis by the OSU College of Agricultural Science’s Endophyte Service Laboratory for the novel toxin content presented to consuming markets. This testing service is now used by Oregon straw exporters to insure that ergovaline and lolitrem B levels are below the thresholds known to produce clinical signs in livestock. Oral Oregon State University Crop Science Bldg., Rm. 127 Croval- lis 97331 United States.

YOUNG, CAROLYN1*, TAKACH, JOHANNA2, MITTAL, SHIPRA2, ANDREYEA, KALINA1, FLOREA, SIMONA1 and SCHARDL, CHRISTOPHER L.1. Alkaloid diversity across the epilochae: It’s all in the genes. The epilochae (Epichloë and Neotyphodium species) are important fungal symbionts that form mutualistic symbioses with cool season grasses. These fungi are known to produce the bio-protective alkaloids, specifically peramine, lolines, ergot alkaloids and lolitremers, which provide anti-insect and anti-mammalian properties to the host. The genus currently contains 33 known bioprotective alkaloids that have been cloned and characterized from E. festucae as well as a number of Neo- typhodium species present in agriculturally important grasses. As with other fungal secondary metabolite biosynthesis genes, the genes for three of the four alkaloid groups are present as co-regulated gene clusters. Generally, the inability of the endophyte to synthesize an alkaloid in planta is due to the absence of key pathway genes or complete gene clusters. The availability of the gene sequences now allows us to rapidly PCR profile many epilochae for the presence of each alkaloid cluster and predict metabolite diversity across naturally occurring endophytes based on the presence or absence of genes. In some cases, analysis of the asseu- nal Neotyphodium sp., which are often interspecific hybrids that stem from two or three Epichloë progenitor species, has shown retention of alkaloid biosynthesis genes that are seemingly no longer present in the extant relatives. Long range mapping of E. festucae alkaloid biosynthesis genes indicates that the loline, ergot alkaloids and additional secondary metabolite gene clusters are associated with subtelomeric repeats. The subtelomeric location of these clusters may have an impact on maintaining alkaloid polymorphism and provide additional insight to the evolutionary history of the epilochae. Oral 1Samuel Roberts Noble Foundation 2510 Sam Noble Parkway Ardmore 73401 United States. 2Noble Foundation 2510 Sam Noble Parkway Ardmore 73401 United States. 3University of Kentucky 1405 Veterans Drive Lexington 40546-0312 United States. 4University of Kentucky 201F PSB, 1405 Veterans Drive Lexington 40546-0312 United States. 5University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States.

YUN, HYE YOUNG2, MINNIS, ANDREW M.2 and KIM, YOUNG HO1. The rust fungus Frommeælla revisited. Frommeælla (Phragmidiaæceae, Pucciniales, Basidiomycota), which includes two species and is typified by F. tormentillae, causes rust on members of tribe Potentillææ (Rosacæae). It has been distinguished from F. frommeælla on the basis of having only one germ pore per cell of the teliospore rather than two or three and by aecial characters. Phylogenetic analyses of both Frommeælla spp. utilizing nLSU DNA data suggest that Frommeælla was paraphyletic, with F. frommeælla and Frommeælla should be considered to be a larger generic synonym of Phragmidiaæ. Analyses also indicate that Frommeælla tormentillae on Potentilla is distinct from but sister to Frommeælla mexicana on Duchesnea. Phragmidiaæ tormentillae is considered to be the correct name for the former species. Based on data regarding type specimens that were presented in a prior study by McCain & Hennes, Phragmidiaæ mexicana (Mains), comb. prov., is tentatively presented as the correct name for the latter species. Phragmidiaæ mexicana (F. mexicana) is reported for the first time in Korea and on Duchesnea chrysantha, a new host record. Duchesnea is placed in synonymy with Potentilla by some recent authors and further examination of species boundaries and host ranges of the fungi formerly classified in Frommeælla is warranted. Poster 1Department of Plant Pathology, Iowa State University 350 Bessey Hall Ames 50011 United States. 2Systematic Mycology & Microbiology Laboratory, USDA-ARS Rm. 304, B011A, 10300 Baltimore Ave. Beltsville 20705 United States. 3Department of Agricultural Biotechnology, Seoul National University Seoul 151-921 Korea, Republic of.

YURKONIS, KATHRYN A.1*, NEWMAN, JONATHAN A.2 and MAHER-ALI, HAFIZ2. Effects of invasion by Schedonorus phoenix and Loliurn perene on plant communities not driven by endophyte status. The community and ecosystem impacts of endophyte infection in grasses has been mostly studied in a few cultivars of Schedonorus phoenix (Tall fescue) and Lolium perene (Perennial ryegrass). Such studies have suggested that endophyte infection may increase the competitive ability of the host species and that communities invaded with infected hosts may be less diverse than those invaded with non-infected hosts. However, few studies have tested the generality of these effects across multiple species and cultivars. In an experimental field study, five infected and five non-infected cultivars of S. phoenix and L. perene were seeded into a tiled matrix in 2007. Communities developed on these sites via re-colonization from the local propagule pool. By the second growing season there was an effect of species but not initial endophyte infection status on community diversity and resource use metrics. Furthermore, responses were similar among cultivars in each species- endophyte group. In general, S. phoenix plots were more diverse, had higher soil moisture and were more productive later in the season than L. perene plots. Our results indicate that cultivars of the same species and infection status have similar ecological effects and the effect of endophyte infection status on initial invasion of S. phoenix and L. perene is limited. Future studies will assess if these communities diverge in structure and function over time. Poster 1University of Guelph 59 Stone Road East Guelph, ON N1G 2W1 Canada. 2University of Guelph School of Environmental Sciences Guelph N1G 2W1 Canada.

ZELENSKI, STEVEN E.1*, METHVEN, ANDREW2 and MILLER, ANDREW2. Phylogeographic Relationships between Gyromitra and Morchella. The phylogenetic relationships of the sister families Discinaceae and Morchellaceae within the subclass Basidiomycetes were examined in this study. Within those families there are two genera of

Continued on following page
human interest - Gyromitra and Morchella. A phylogeny based on 28S large subunit (LSU) ribosomal data was created using parsimony, maximum likelihood, and Bayesian analyses. From this working knowledge of evolutionary relationships, a phylogeographic analysis was done to see how the lineages are related geographically in North America. Using ArcGIS 9.3.1 a visual representation of the genera was mapped using a color coded gradient to show ancestral and derived species localities. The mapping showed a clear distinction between Eastern and Western North American species. A DIVA analysis was also run to reconstruct distributional history based on extant locations and phylogeographic history. Poster
University of Illinois 505 S. Goodwin Ave, Rm. 649 Urbana 61801 United States. Eastern Illinois University Department of Biological Sciences Charleston 61920 United States. Illinois Natural History Survey 1816 S. Oak St Champaign 61820 United States.

ZHANG, YING1 and HYDE, KEVIN2. Monograph of Pleosporales based on the generic types. We are working on a monograph of Pleosporales by examining the type specimen of each genus or other collections. We will fully describe the type specimens and illustrate the genera using photographic plates and line drawings. Type species of 106 genera from 12 families have been studied, viz Delitschiaceae, Lophiomatomataceae, Massariaceae, Melanommataceae, Montagnulaceae, Pheosphaeriaceae, Phaeotrichaceae, Pleomassariaceae, Pleosporaceae, Sporormiaceae and Teichosporaceae. Of which, type specimens of 96 genera (91%) have been studied. About 90 % type specimens studied are in good condition. The Phaeotrichaceae is characterized by its membranous-walled cleistothecial ascomata with appendages, evanescent asci, conspicuous terminal germ pores of the ascospores, as well as the absence of pseudoparaphyses. All of these characters indicate its disagreement with other pleosporalean taxa. In addition, based on morphological characters, Kriegerella should be a member of Microthyriaceae and Pyenidiophora should be assigned to Eurotiaceae (Eurotiales). Eptypes will also be designate using the fresh materials as living isolates and/or DNA sequences of these specimens obtained. Poster
Division of Microbiology, School of Biological Sciences, The University of Hong Kong Pokfulam Road Hong Kong SAR Nil China. 2School of Science, Mae Fah Luang University Tasud, Muang Chiang Rai 57100 Thailand.

ZHAO, PATRICK XUECHUN 1, 2, DAI, XINBIN 1, LI, JUN 1, AMARASINGHE, RANAMALIE 3, YOUNG, CAROLYN 1, DINKINS, RANDY 2, HESSE, ULIJANA 1, JAROMCZYK, JERZY 3 and SCHARDL, CHRISTOPHER L. 4. An integrated database for grass and endophyte genomics at www.grassendophyte.org. The endophytic microbes are able to promote plant growth and health under various stresses via their symbiotic association with host plants. Genome-wide comparative analysis has been extensively employed to decipher complex mechanisms of interactions between endophytic microbes and host plants, resulting in fast accumulation of large scale genomics data. However, until recently, only a very limited amount of genomics information is publically available in scattered databases. We present an integrated database, which is freely available at http://www.grassendophyte.org/, to facilitate genomics study of grass-endophyte symbiotic association. The database hosts a large volume of genomics data from model endophyte, Epichloe festucae, and associated Lolium and Festuca grasses, including gene models/unigenes, annotations and Illumina sequencing-based gene expression data from both fungi and plants. The genominc sequence databases were annotated by BLASTX against 1) the Gene Ontology (http://www.geneontology.org/) sequence database and 2) the uniprot trembl database (http://www.ebi.ac.uk/uniprot/). The top five hits with meaningful annotations in uniprot trembl database were retrieved as effective annotations. Illumina reads were mapped to corresponding genes, providing gene expression data for different developmental stages of the endophyte. The database also integrates bioinformatics tools for mining genes of interest and the analysis of gene expression profiles. Oral
1Samuel Roberts Noble Foundation 2510 Sam Noble Parkway Ardmore 73401 United States. 2USDA ARS 1100 S Limestone Agricultural Building N Lexington 40546 United States. 3University of Kentucky 775 Anderson Hall (FPAT) Lexington 40546 United States. 4University of Kentucky Department of Plant Pathology Lexington 40546-0312 United States.

MYCOLOGIST’S BOOKSHELF

After seven years as Book Review Editor for Inoculum, this is my last contribution. It’s been great fun seeing all the new books and interacting with so many of you. I really appreciate the volunteers willing and otherwise who wrote these book reviews. Keep up the good work with our new Book Review Editor, Dr. Barrie Overton. Barrie teaches at Lochhaven University in Pennsylvania where he is inspiring many new students in the study of fungi. Three books are reviewed in this issue and five new books have been received. Send your requests to review these books to Barrie at Boverton@hlu.edu.

Remarkable Biologists: From Ray to Hamilton


This is the third in a series of books covering the lives of famous and not-so-famous scientists, the first two on Mathematicians and Physicists, respectively. The 170-odd pages are an easy and enjoyable read (notwithstanding some awkward choices in punctuation), with a selection of details about each of the 38 scientists. Each chapter reveals something about their background and character, and how these factors influenced decisions they made during their careers. The book starts with John Ray (1627-1705), considered the “father of natural history,” and ends with William Hamilton (1936-2000), who studied altruism in the context of evolutionary genetics. Along the way, we learn of Emperor Hirohito’s (1901-1989) important work on slime molds and coelenterates; Beatrix Potter’s (1866-1943) – yes, of “Tales of Peter Rabbit” fame – early work studying mycology, including her distinction as among the first to advocate for the symbiotic nature of lichens. Of course, the book features the likes of Charles Darwin, Gregor Mendel, Barbara McClintock, and Rachel Carson, but also includes an interesting account of the life of Alfred Wallace, Darwin’s contemporary who justly deserves to be considered his coequal in formulation of a theory of evolution by natural selection.

The intent of the book is not to detail the science, but rather to give the reader some sense of who these people were, what sorts of lives they led, etc. In this regard, the author has done an admirable job.

—Robert E. Marra
Department of Plant Pathology and Ecology Connecticut Agricultural Experiment Station New Haven CT 06504-1106 robert.marra@ct.gov
A Phylogenetic Re-evaluation of Dothideomycetes


This new volume presents an overview as well as the latest phylogenies for many groups of the loculoascomycetes aka Dothideomycetes. Don’t be fooled by the pretty pictures of gorgeous fruiting bodies, incredible micrographs of asci and ascospores, and close-ups of gelatinous sheaths, ornamented ascospore surfaces, and curvaceous conidiophores. This collection of contributed papers is much, much more than a superficial account—each chapter includes a multigene phylogeny plus descriptions and illustrations of new genera and species.

The dedication includes photos and brief accounts of three of the foremost dothideomycetologists—Josef Adolf von Arx, Emil Müller, and Margaret Elizabeth Barr Bigelow. Even now, in that great fungus garden in the sky, they are comparing notes and gently expressing their respective views based on their keen knowledge of these fungi. These mycologists collected and really “knew” these organisms and must surely welcome the results presented here.

The overview of the class Dothideomycetes presents a three-page multigene phylogeny useful in outlining, for ex-

Some minor imperfections do not significantly mar the high quality of the book, such as typos including some names of taxa, oddly spelled scientific terms, author citations for the same infrageneric taxa that vary between species treatments, listing classification in stirpes for some and not for others, confusion of the symbols < and >, and missing parts of couplets in the dichotomous keys. A thought-to-be undescribed species of Volvariella from Thailand is a welcome extralimital taxon. More serious oversights include citation of taxa like “section Atrimarginatus” of Pluteus that does not exist and not including in the key several species of Pluteus described as new species from Japan since the authors state, incorrectly in some cases, that a prior study did not discuss infrageneric classification of these taxa.

A number of the species described in this book were identified as confer this or that species or as genus sp. and those given names often displayed morphological variation when compared to materials from other geographic localities. This highlights the difficulty many mycologists are faced with when applying species concepts based on extralimital materials to an understudied region. On the topic of Pluteus, Richard Homola was probably frustrated when he observed that there are a large number of names in relation to the small number of reliable taxonomic characters. In spite of this, mycologists also find that there are not enough names as modern studies reveal distinct and frequently overlooked taxa. The names of taxa in this book may be changed upon further study, but the quality, detailed descriptions, beautiful illustrations, and voucher specimens are an invaluable contribution to the study of fungal diversity, especially for Asian taxa, and a great resource for current and future monographers of the included genera. This book is a must-see for mycologists interested in these genera, even for those illiterate in Japanese like myself.

—Drew Minnis
Systematic Mycology & Microbiology Laboratory
10300 Baltimore Ave.
Beltsville, MD 20705
Drew.Minnis@ars.usda.gov

Continued on following page
ample, the nineteen families plus unnamed clades currently recognized in the Pleosporales. Although less thoroughly sampled here, the remaining ten orders are presented in more detail in the following chapters. The type species of the type genus of the class, *Dothidea sambuci*, is included and, in fact, well-illustrated. In the next chapter on the Capnodiales, the plant pathogen-rich Mycosphaerellaceae, Teratosphaeriaceae, and Davideliaceae including *Cladosporium* are analyzed in detail. Again, two three page trees are presented, one for partial LSU sequences and the other for SSU, 5.8S nr DNA and LSU sequences, that includes more than 100 species, especially in the very large Mycosphaerellaceae with diverse anamorphs such as *Cercospora, Passalora, Ramularia,* and *Septoria* intermixed with *Mycosphaerella.* Now, how to sort out this hodge-podge of names? Eric Boehm and colleagues have tackled the fungi forming hysterothecia finding them to be quite diverse (what a surprise!) and have sorted them into four different orders. This outstanding chapter includes keys to both genera and species as well as descriptions of many new and existing taxa.

The two following chapters provide details based on families in the Pleosporales. The illustrations in the chapter by George Mugambi and Sabine Huhndorf are particularly stunning and detailed. The chapter on rock-inhabiting fungi is interesting in the diversity found—these seem to be ubiquitous and previously unknown. Oh dear, the next chapter on lichenized fungi in the Dothideomyceta (why not –mycota?) also presents stunning macroshots of these primarily crustose lichens as well as another multigene phylogeny. Carol Shearer and colleagues’ chapter on freshwater Dothideomycetes consists primarily of an extensive phylogeny showing the diversity of these fungi, but that’s fine because many of these fungi are described and illustrated on her website. The marine fungi are equally diverse and beautiful—are you sensing a theme here? The final chapter examines the bambusicolous members of the Tetraphlosphaeriaceae, a new family in the Pleosporales having *Tetraploa*-like anamorphs. Many of the genera and species are described as new to science while others are transferred from such diverse genera as *Didymella, Lophiostoma,* and *Massarina.* Yet, these fungi form a monophyletic family with all occurring on the bamboos.

In summary, despite the multi-authored chapters, this volume is a cohesive unit that provides a treasure trove of phylogenies and descriptions with illustrations about the Dothideomycetes in their diverse habitats. One annoying feature is that the figure legends do not always indicate which genes were analyzed, but that simply requires a glance back at the Materials and methods. This is hardly worth mentioning in comparison to the incredible amount of new data presented here about these fascinating fungi!

—Amy Y. Rossman
Systematic Mycology & Microbiology Laboratory
USDA—Agricultural Research Service
Beltsville, MD 20705
Amy.Rossman@ars.usda.gov

Recently Received Books


Previously Listed Books


Identification and contamination control for manufactured goods, medical technology, buildings, animal and plant diseases. Inkjet fluid bio-challenge tests, ASTM & Mil-Spec testing for fungal resistance of materials. 10% discount for regular and sustaining MSA members. Email: microbe@pioneer.net. For more information see www.abbeylab.com.

Center for Regulatory Research, LLC specializes in regulatory permit application services for biological control and biotechnology organisms/products. Let us evaluate your research discoveries for commercial potential and environmental impacts. We also offer assistance with writing proposals for SBIR grant programs (Small Business Innovation Research) that fund new commercial ventures. Contact Dr. Sue Cohen by email (sdcohen@regresearch.com) or by phone (612-623-8089). For more information about our company, visit our website at www.regresearch.com.

The USDA Systematic Mycology and Microbiology Laboratory in Beltsville, MD (outside of Washington, DC) is seeking a Research Molecular Biologist/Microbiologist/Botanist (Mycology)/Geneticist to conduct independent research developing new knowledge and application of the systematics of fungi that threaten the food supply and serve to control harmful insects and plant pathogens. This scientist will conduct research to characterize fungi both inside and outside of the United States to prevent entry of destructive fungi and lead to the ability to control the diseases they cause. This research will involve determining phylogenetic relationships among members of plant-associated fungi especially those of importance to agriculture; characterizing the genetic variability, population structure and systematic relationships of plant pathogenic fungi; correlating molecular results with morphological characteristics based on examination of specimens; combining molecular and morphological results with existing geographic and host information to accurately define plant pathogenic fungi species; and developing molecular tools for the identification of these fungi. This position has promotion potential to a GS-15. Applications accepted until August 16, 2010.

To apply see announcement at USAJOBS: http://jobview.usajobs.gov/GetJob.aspx?JobID=89447874&JobTitle=Interdisciplinary%3a+Research+Molecular+Biologist%2fMicrobiologist%2fBotanist%2fGeneticist&q=ars-x10e-0182&where=&brd=3876&cvw=b&FedEmp=N&FedPub=Y&x=44&y=15&AVSDM=2010-07-19+11%3a03%3a00

For more information, contact Dr. Amy Rossman Amy.Rossman@ars.usda.gov
NOTE TO MEMBERS:
Those wishing to list upcoming mycological courses, workshops, conventions, symposia, and forays in the Calendar of Events should include complete postal/electronic addresses and submit to *Inoculum* editor Jinx Campbell at jinx.campbell@usm.edu.

**July 26-August 7, 2010**  
Fleshy Fungi of the Highlands Plateau  
Highlands Biological Station, NC  
[www.wcu.edu/hbs](http://www.wcu.edu/hbs)

**August 1-6, 2010**  
9th International Mycological Congress (IMC9)  
Edinburgh, UK  

**August 8-14, September 14-18, 2010**  
Mycology seminars  
at the Humboldt Institute  
The Humboldt Institute, Steuben, ME  

**August 12-15, 2010**  
North American Mycological Association  
50th Anniversary Foray  
Snow Mountain Ranch, CO

**November 29-December 2, 2010**  
VI Brazilian Mycological Congress  
Brasília, Brazil

**July 18-21, 2011**  
VII Latin American Mycological Congress  
San Jose, Costa Rica  
[www.almic.org](http://www.almic.org)

**July 23-30, 2011**  
The International Botanical Congress (IBC 2011)  
Melbourne, Australia  

**August 1-6, 2011**  
MSA Meeting  
University of Alaska  
Fairbanks, AK, USA  
[http://mercury2.iab.uaf.edu/msa](http://mercury2.iab.uaf.edu/msa)

**September 19-23, 2011**  
XVI Congress of European Mycologists  
Thessaloniki, Greece  
[www.xvicem.org](http://www.xvicem.org)

**2011 UMS Congresses**  
XIII International Congress of Mycology  
Sapporo, Japan

---

**Mycological Society of America — Gift Membership Form**

Sponsoring a gift membership in MSA offers tangible support both for the recipient of the membership as well as for mycology in general. Providing both *Mycologia* and *Inoculum*, a gift membership is an excellent way to further the efforts of our mycological colleagues, especially those who cannot afford an MSA membership. In addition to a feeling of great satisfaction, you also will receive a convenient reminder for renewal of the gift membership the following year.

I want to provide an MSA Gift Membership to the following individual:

Name ________________________________________________________________________________________

Institution __________________________________________________________________________________

Complete Address ______________________________________________________________________________

Phone _____________________ FAX _________________________ Email _______________________

Please send renewal notices to:
(YOUR name) ________________________________________________________________________________

(YOUR address) ______________________________________________________________________________

Phone _____________________ FAX _________________________ Email _______________________

I agree to pay $98* for this membership by check (payable to MSA, drawn on US bank) _____ VISA _____ Mastercard _____

Acct. # ______________________ Name (as it appears on card) ____________ Exp. date _____________

Send this form to: MSA Business Office, PO Box 1897, Lawrence KS 66044  
or FAX to (785) 843-1274, Attn: Processing Department

*If this membership is given after June 1, please add $10 to cover postage for past issues.
Below is an alphabetical list of websites featured in *Inoculum*. Those wishing to add sites to this directory or to edit addresses should email <jinx.campbell@usm.edu>. Unless otherwise notified, listings will be automatically deleted after one year (at the editors discretion).

A New Web Page About Tropical Fungi, Hongos Del Parque “El Haya” (58-5) hongosdelhaya.blogspot.com/

Ascomycota of Sweden
www.umu.se/myconet/asco/indexASCOr.html

Bibliography of Systematic Mycology
www.speciesfungorum.org/BSM/bsm.htm

Cold Spring Harbor Laboratory; Meetings & Courses Programs (58-2) meetings.cshl.edu

Collection of 800 Pictures of Macro- and Micro-fungi
www.mycolog.com

Cordyceps Website
www.mushtech.org

Cornell Mushroom Blog (58-1) hosts.cce.cornell.edu/mushroom_blog/

Cortbase (58-2)
andromeda.botany.gu.se/cortbase.html

Corticoid Nomenclatural Database (56-2)
www.phyloinformatics.org/

The Cybertruffle internet server for mycology seeks to provide information about fungi from a global standpoint (59-3).
www.cybertruffle.org.uk

Cyberliber, a digital library for mycology (59-3).
www.cybertruffle.org.uk/cyberliber

Cybernome provides nomenclatural and taxonomic information about fungi and their associated organisms, with access to over 548,000 records of scientific names (59-3).
www.cybertruffle.org.uk/cybernome

Dictionary of The Fungi Classification
www.indexfungorum.org/names/fundic.asp

Distribution Maps of Caribbean Fungi (56-2)
www.biodiversity.ac.psiweb.com/carimaps/index.htm

Entomopathogenic Fungal Culture Collection (EFCC)

Fungal Environmental Sampling and Informatics Network (58-2)
www.bio.utk.edu/fesin/

Fungi of Ecuador
www.mycokey.com/Ecuador.html

German Mycological Society DGfM
www.dgfem-ev.de

HighWire Press (58-3)
mycologia.org

Humboldt Institute — Located on the eastern coast of Maine, the institute is known for the extensive series of advanced and professional-level natural history science seminars it has offered in Maine since 1987, along with ecological restoration seminars and expeditions to the neotropics. It publishes the *Northeastern Naturalist* and *Southeastern Naturalist*, two scholarly, peer-reviewed, natural history science journals which provide an integrated publishing and research resource for eastern North America, including eastern Canada. 59(4)

www.eaglehill.us

www.eaglehill.us/programs/nhs/natural-history-seminars.shtml

www.eaglehill.us/nena

www.eaglehill.us/lena

www.eaglehill.us/jona

Hysteriaceae & Mytilinidiaceae — Website relating to the taxonomy of the Hysteriaceae & Mytilinidiaceae (Pleosporomycetidae, Dothideomycetes, Ascomycota) to facilitate species identification using a set of updated and revised keys based on those first published by Hans Zogg in 1962. 59(4)
http://www.foehm.com/

Index of Fungi
www.indexfungorum.org/names/names.asp

Interactive Key to Hypocreales of Southeastern United States (57-2)
n.s-grin.gov/sbmlweb/fungi/keydata.cfm

ISHAM: the International Society for Human and Animal Mycology
www.isham.org

JSTOR (58-3)
jstor.org

Libri Fungorum Mycological Publications (58-3) 194.203.77.76/LibriFungorum/

Mold Testing and Identification Services (58-2)
mold pioneers.net/~/microbe/abbeylab.html

McCrone Research Institute (McRI) is an internationally recognized not-for-profit educational institute specializing primarily in teaching applied microscopy. 59(4)
www.mcrl.org

Mountain Justice Summer (58-3)
www.MountainJusticeSummer.org

Mycology Education Mart where all relevant mycology courses can be posted. www2.bio.ku.dk/mycology/courses/

MycoKey
www.mycokey.com

The Myconet Classification of the Ascomycota
www.fieldmuseum.org/myconet

New Electronic Journal about mushrooms from Southeast Mexico (61-4) http://fungavera.blogspot.com

Northeast Mycological Federation (NEMF) foray database (58-2) www.nemidata.org

www.pnwfungi.org/

Pleurotus spp.
www.oystermushrooms.net

Rare, Endangered or Under-recorded Fungi in Ukraine (56-2) www.cybertruffle.org.uk/redlists/index.htm

Registry of Mushrooms in Art
members.cox.net/mushroomsinart/

Robigalia provides information about field observations, published records and reference collection specimens of fungi and their associated organisms, with access to over 685,000 records (59-3).
www.cybertruffle.org.uk/robigalia

Searchable database of culture collection of wood decay fungi (56-6)
www.fpl.fs.fed.us/rrs/4501/index.html

Small Things Considered. A microbe blog on microbes in general, but carries occasional pieces specifically on fungi.
schaechter.asmblog.org/schaechter/

Tree canopy biodiversity project University of Central Missouri (58-4) faculty.cmsu.edu/myxo/

Trichomycete site includes monograph, interactive keys, a complete database, world literature, etc. (61-4)
www.nhm.ku.edu/~fungi

The TRTC Fungarium (58-1)

U.S. National Fungus Collections (BPI) Complete Mushroom Specimen Database (57-1) www.ars.usda.gov/ba/psi/sbml

Valhalla provides information about mycologists of the past, with names, dates of birth and death and, in some cases, biographies and/or portraits (59-3).
www.cybertruffle.org.uk/valhalla

Website for the mycological journal Mycena (56-2)
www.mycoena.org/index.htm

Wild Mushrooms From Tokyo
www.ne.jp/asahi/mushroom/tokyo/
The Mycological Society of America
Sustaining Members 2010

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

Fungi Perfecti
Attn: Paul Stamets
PO Box 7634
Olympia, WA, 98507
(360)426-9292
info@fungi.com

Mycotaxon, Ltd.
Attn: Richard P. Korf
PO Box 264
Ithaca, NY, 14851-0264
(607) 273-0508
info@mycotaxon.com

Triarch, Inc.
Attn: P.L. Conant - President
PO Box 98
Ripon, WI, 54971
(920)748-5125

Sylvan, Inc.
Attn: Mark Wach
Research Dept Library
198 Noite Drive
Kittanning, PA, 16201
(724)543-3948
mwach@sylvaninc.com

Syngenta Seeds, Inc.
Attn: Rita Kuznia
Dept Head, Plant Pathology
317 330th Street
Stanton, MN, 55018-4308
(507) 663-7631
rita.kuznia@syngenta.com

Genencor Internation, Inc.
Attn: Michael Ward
925 Page Mill Rd
Palo Alto, CA, 94304
(650)846-5850
mward@genencor.com

Fungal & Decay Diagnostics, LLC
Attn: Dr. Harold H Burdsall Jr.
9350 Union Valley Rd
Black Earth, WI, 53515-9798
(608)767-3930
Fax (608)767-3920
burdsall@fungaldecay.com

Novozymes, Inc.
Attn: Wendy Yoder
1445 Drew Ave
Davis, CA, 95618
(530) 757-8110
wty@novozymes.com

BCN Research Laboratories, Inc.
Attn: Emilia Rico
2491 Stock Creek Blvd
Rockford, TN, 37853
(865)558-6819
emirico@msn.com

Unicorn Imp & Mfg Corp
Attn: Lou Hsu
PO Box 461119
113 Hwy 24
Garland, TX, 75040
(972) 272-2588
unicornbag@aol.com

You are encouraged to inform the Membership Committee (Maren Klich, Chair, mklich@srrc.ars.usda.gov) 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 Sustaining Members in all issues of Mycologia and Inoculum.

REMINDER: MSA Directory Update

Is your information up-to-date in the MSA directory? The Society is relying more and more on email to bring you the latest MSA news, awards announcements and other timely information, and our newsletter. To ensure that you receive Society blast emails and the Inoculum as soon as it comes out, and so that your colleagues can keep in touch, please check the accuracy of your email address and contact information in the online directory. This can be accessed via our web site at www.msafungi.org. If you need assistance with updating your membership information, or help with your membership log-in ID and password, please contact Kay Rose, Association Manager at Allen Press, at krose@allenpress.com.
Inoculum
The Newsletter of the
Mycological Society of America

Supplement to Mycologia
Volume 61, No. 4
August 2010

Inoculum is published six times a year in even numbered months (February, April, June, August, October, December). Submit copy to the Editor by email as attachments, preferably in MS Word. If you submit pictures, these need to be sent as separate JPEGS or GIFFS, not embedded in the word document. The Editor reserves the right to edit copy submitted in accordance with the policies of Inoculum and the Council of the Mycological Society of America.

Jinx Campbell, Editor
Dept. of Coastal Sciences, Gulf Coast Research Lab
University of Southern Mississippi
703 East Beach Drive
Ocean Springs, MS 39564
(228) 818-8878 Fax: (228) 872-4264
jinx.campbell@usm.edu

MSA Officers
President, Thomas D Bruns
Department of Plant and Microbiology
University of California
Berkeley, CA 94720
Phone: 510-642-7987 Fax: 510-642-4995
pogon@berkeley.edu

President Elect, David Hibbett
Department of Biology
Clark University
950 Main St.
Worcester, MA 01610
Phone: 508-793-7332 Fax: 508-793-8861
dhibbett@clarku.edu

Vice President, Mary Berbee
Department of Botany
University of British Columbia
6270 University Blvd.
Vancouver, BC V6T 124
Canada
Phone: 604-822-3780 Fax: 604-822-6089
berbee@interchange.ubc.ca

Secretary, Jessie A. Glaeser
USDA-Forest Service
Forest Products Lab
One Gifford Pinchot Dr.
Madison, WI 53726
Phone: 608-231-9215 Fax: 608-231-9592
msasec1@yahoo.com

Treasurer, Marc Cubetta
Department of Plant Pathology
Center for Integrated Fungal Research
North Carolina State University
Box 7567 Partners III Room 225
Raleigh, NC 27695
Phone: 919-513-1227 Fax: 919-513-0024
marc_cubetta@ncsu.edu

Past President: Rytas Vilgalys
gungi@duke.edu

MSA Homepage: msafungi.org

MSA Endowment Funds Contributions

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

____ Alexopoulos _____ Emerson-Fuller-Whisler _____ Miller
____ Barksdale-Raper _____ Fitzpatrick _____ Thiers
____ Barr _____ Gilbertson _____ Trappe
____ Bigelow _____ Korf _____ Uecker
____ Butler _____ Luttrell _____ Wells
____ Denison

Research Funds
____ Alexander H. and Helen V. Smith Award
____ Myron P. Backus Graduate Award
____ Clark T. Rogerson Award
____ George W. Martin/Gladys E. Baker Award
____ John Rippon Graduate Research Award
____ Undergraduate Research Award

Other Funds
____ Constantine J. Alexopoulos Prize
____ John S. Karling Lecture Fund
____ Uncommitted Endowment
____ Other (specify)

I wish to pledge $________ a year for ________ years

____ to the following fund (s) ______________________________
____ to some other specified purpose ______________________________
____ to the uncommitted endowment

Name: ________________________________________________

Address: ________________________________________________

___ Check ___ Credit Card (Visa, MC, etc): ________________

Credit Card No. ____________________ Exp. Date: ________

Signature: __________________________________________

Please send this completed form and your contribution to:

A. Elizabeth Arnold, Chair
MSA Endowment Committee
Division of Plant Pathology and Microbiology
Dept. of Plant Sciences
University of Arizona
Tucson, AZ 85721
arnold@ag.arizona.edu
(520) 621-7212

Please make checks payable to the
Mycological Society of America
An Invitation to Join MSA

THE MYCOLOGICAL SOCIETY OF AMERICA

2010 MEMBERSHIP FORM
(You may apply for membership on-line at msafungi.org)

(Please print clearly)

Last name ______________________________     First name _________________________________     M.I. ______

Dept./Street _______________________________________________________________________________________

Univ./Organization __________________________________________________________________________________

City __________________________ State/Prov. __________ Country ____________________ ZIP_________________

Telephone: (____)________ ______________ Email _______________________ Fax (____)______________________

TYPE OF MEMBERSHIP

Cyber Memberships
___ Regular   $98  (Includes on-line access to Mycologia and Inoculum)
___ Student   $50  (Includes on-line access to Mycologia and Inoculum)

Hardcopy Memberships
___ Regular   $98  (Includes print Mycologia, and on-line access
to Mycologia and Inoculum)
___ Student   $50  (Includes print Mycologia, and on-line access
to Mycologia and Inoculum)
___ Sustaining $278  (Includes print Mycologia, and on-line access to Mycologia
and Inoculum, plus listing in Mycologia and Inoculum)
___ Life      $1,500 + $20 for each family member  (One-time payment, Includes print
Mycologia, and on-line access to Mycologia and Inoculum)
___ Family    $98  (Includes one print copy of Mycologia, and on-line
access to Mycologia and Inoculum)
___ Emeritus  $50  (Includes print Mycologia, and on-line access
 to Mycologia and Inoculum)

Other Memberships
___ Associate $50  (Includes on-line access to Inoculum)
___ Emeritus  $0  (Includes on-line access to Inoculum)

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 Mycological Society of America and
drawn in US dollars 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: Kay Rose
P.O. Box 1897, Lawrence, KS 66044-8897
Phone: (800) 627-0629 or (785) 843-1221
Fax: (800) 627-0326 or (785) 843-1234
Email: krose@allenpress.com