SPORE PRINTS

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Number 579 February 2022

TEACHING FUNGI HOW TO WRITE

Amanda Caracas
The Sporeprint
L.A. Myco. Soc., Dec. 2021

Spalted wood is a highly sought after material in the high end furniture industry. In a newly developed process, scientists from the Swiss Federal Laboratories for Materials Science and Technology (Empa) have succeeded at controlling the spread of fungi in native wood types to create elaborate marblewood pictures—and even taught the fungi to write some words.

In spalted wood, the lines mark boundaries where different cultures of fungi have clashed and fought for territory and resources in the wood. By drawing up their opponent, the fine threads of the fungal community not only protect their colony, but also prevent bacteria and insects from entering their domain.

Moreover, this defense strategy ensures an ideal amount of moisture in the wooden habitat, allowing the fungus to thrive.

In nature, one of the purposes of fungi is to cause the decay of wood—and although this natural process may seem basic, it is, in fact, quite spectacular. Each decaying piece of wood is uniquely patterned with colors and lines, artfully displaying the synchrony of life and death. This characteristic has made decayed wood a sought-after resource for thousands of years, especially for the production of furniture.

Empa

Fine black lines spread elegantly across the clock face made from pale, fine-grained timber of ash, beech, and maple. Although this intricate pattern evokes a picture of serenity, it is actually the result of a vigorous struggle.

However, naturally obtained decaying wood from the forest floor may take several years to grow fungal-induced patterns, and there is no guarantee that the quality of the wood will suffice for its transformation into a functional item. Empa researchers from the Cellulose & Wood Materials lab led by Francis Schwarze have developed a technology with which native hardwoods such as ash, beech and maple can be specifically treated with fungal cultures so that patterns in the wood can be controlled while retaining the stability and shape of the wood. Schwarze's team identified several fungi growing in nature and analyzed them in the lab to select those with the best properties as wood finishers. Depending on the combination of fungal species, dark lines caused by the pigment melanin appeared in the wood. Melanin is water repellent, antimicrobial, and protects the fungus from natural competitors, e.g., bacteria.

The researchers could even control the patterns in the wood depending on the type of fungi they used, bringing forth different results; some lines were scrambled, others almost geometrically perfect. And last but not least, the team could even "teach" the fungi to write words—a world's first.

While the fungus can be controlled to deliver the desired artistic result, the outcome of the process is also owed to research in the area of wood processing. Most fungi can only colonize and degrade wood when fiber saturation occurs, i.e. when the moisture of the wood is greater than 28–33 percent. In this case, freely available water is present inside the cells, which is essential for the growth of most fungal species

The advantage of the fungi used is that they can colonize wood even at a low wood moisture of 20 percent because they penetrate the cell walls in the absence of water and use the bound water for their growth. Thus, these fungal species become more competitive and the risk of contamination is greatly reduced.

A further advantage is that after completion of the fungal treatment, the wood moisture is still very low and thus less energy is required for drying the wood. Optimizing wood properties with the help of fungi is the research topic of Empa scientist Schwarze. His group focuses on the development of an industrial process for spalting wood in high-value furniture applications.

Behind this project lie two incentives: one is to meet a high customer demand for spalted wood in the high end furniture market. The other is that tree species favored for spalting are normally burnt as energy wood in Switzerland. Due to their abnormal growth formations and a seemingly unattractive coloring, the tree species in question—ash, beech and maple—have limited sales outside of energy wood. However, they are particularly receptive to spalting—and thus highly promising for adding aesthetic value to the upscale furniture market.

Empa

In a specially developed process, Francis Schwarze's team has succeeded at controlling the spalting process of various fungi, thus creating pictures such as this sunset in the colonized wood.

ARE FUNGI THE FUTURE OF BACON?

Amy Buxton
Greenqueen.com via *The Sporeprint*
L.A. Myco. Soc., Dec. 2021

Barcelona-based biotech company Libre Foods has announced its first foray into the world of fungi-based whole-cut meats, with an animal-free bacon designed to captivate meat eaters. Having

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CALENDAR

Feb. 8 Membership meeting (virtual), 7:30 pm
Feb. 15 *Spore Prints* deadline
Feb. 21 Board of Trustees meeting (virtual), 7:30 pm

BOARD NEWS

Su Fenton

Greetings to everyone! I hope that you all had a healthy, safe, and pleasant holiday season! With the beginning of the new year, came a board member shuffle. Esther Kelli Marks became busy with other parts of her life and found it necessary to step down from her Trustee position to become an Alternate. Consequently the current Alternate, Bruce Robertson, moved to the Trustee position. Also, remember that Sweta Agrawal has moved on from her position as chair of the Ben Woo Scholarship committee. If this is something that interests you and it's academically up your alley, be sure and contact Luis Asif who organizes the volunteer positions for the club. Because of the increase in Omicron cases in the community, the February and March general membership meetings will be held by Zoom only. The board approved an extension of Zoom capacity to 500 possible attendees from the 100 allowed this month. Hopefully, there should be less snafus for those trying to attend the meetings to hear our great speakers. The February's speaker will be Marion Richards, who has become our resident expert on dyeing with mushrooms. I can't wait to hear what she has learned!! The annual Golden Mushroom Award will be voted on soon by the board. Anyone can make a nomination for this honor. Past recipients have demonstrated a long service to the club. They are seen to represent a positive influence and deep knowledge of the ever-changing field of mycology. Send your nominations to the board for consideration!

MEMBERSHIP MEETING

Scott Maxwell

Tuesday, February 8, 2022, at 7:30 pm at the Center for Urban Horticulture, 3501 NE 41st Street, Seattle

Our February meeting will be "virtual only" owing to the recent surge in COVID-19. We expect in a month or so we can get back to our hybrid (in-person/virtual) meetings once again. We will be expanding our Zoom account to allow for more people to attend while in-person attendance is paused. A link to this meeting will be provided at the beginning of February on the PSMS web page at www.psms.org and in an e-mail to be sent out to those who have signed up on the e-mail broadcast list by PSMS Outreach Chair Marian Maxwell.


Marion Richards

Once again, we will be featuring one of our talented members of PSMS, Marion Richards, who will present "Time to Dye with Fungi." In her words, "You have probably heard of mushrooms for culinary dishes, but have you ever considered them for other purposes? Outside of eating them, mushrooms can be used to create a unique dye palette as well. Every color of the rainbow can be achieved through various mushrooms and dye techniques, and I am here to share some of this with you."

Marion Richards is an avid mushroom forager, with special focus on using mushrooms for color, through natural dyes. She first became interested in mushrooms in 2011 while attending the University of Washington, and joined the Puget Sound Mycological Society in 2017 to continue learning all about the fungi of the Pacific Northwest. Since Joining PSMS, she has continued to work and learn about using mushrooms for dye. She has taught dye workshops at the Ben Woo Memorial Foray, hosted the dye table at the fall mushroom show, and was a guide and instructor for the Seattle Mountaineers mushroom weekend at Meany Lodge. When she isn't scouring the west coast for mushrooms, she spends her time working at an animal hospital and volunteering with animal welfare groups.

Fungal Bacon, *cont. from page 1*

showcased the rashers at a private tasting event in Barcelona, feedback is being used to push commercial roll-out in early 2022.

Libre Foods has announced a fungi-based bacon product created using precision fermentation technology. It is designed to meet the growing E.U. demand for pork, currently a $53 billion industry, that offers an alternative to the disadvantages of commercial pig farming. The fungi bacon was unveiled to investors and food-tech community members at Libre Haus in Barcelona last week. Founder and CEO Alan Iván Ramos told Green Queen Media, "Not many people know this, yet pork is the second largest market category globally behind beef and the largest in Europe. Moreover, bacon is often the product that meat eaters refuse to give up. We're out to change that, starting with our Libre Bacon."


Atlast Food Company

Fungal "bacon."

Bacon First, Steak to Follow

With a successful pre-seed round closed earlier this year, which saw Sustainable Food Ventures and Good Seed Ventures coming onboard, Libre Foods has been pressing ahead with creating animal-free proteins. In April, Green Queen reported that Libre Foods was hoping to develop a whole-cut beef steak using fungi fermentation technology, but the company has pivoted to bacon after developing a deeper understanding of the intricacies at play.

"We realized just how complex a steak really was, so we want to take all the right steps to make sure that we do it well, focusing on all the learning we obtain from our initial pipeline to bring them all together for our signature product, our Libre Steak," said Ramos.

Fungi Without Mycelium

Developing a faithful replica of animal protein requires a focus on texture as well as taste, which is why mycelium, with its rugged fibrosity, has proven to be a suitable building block. The problem, however, is that E.U. approval is still in progress, meaning that current incarnations of Libre meats are fungi-based but mycelium absent. This has not cooled enthusiasm for the product developments though.

"The regulatory process for new technologies is especially lengthy and difficult in the E.U., yet we're optimistic that the tide will soon turn toward innovation. We're a rapidly increasing global population and will need tangible, innovative solutions to feed ourselves in the not-so-far future. Fungi can help do that," explained Ramos.

Green Queen Media was sent a sample of the Libre animal-free bacon to test and we can confirm that the lack of mycelium is having an impact on the texture, but when it comes to taste, something exciting is happening. Comparably smoky and deep, the cured pork-like notes come through clearly and the use of vegetable fat to recreate a streaky aesthetic adds authenticity. The addition of mycelium, when approved, will drastically alter the mouth feel and has the potential to create one of the most considered alternatives to animal bacon, which 20 percent of adults in the UK alone have cited as smelling too good to stop eating.

"We're focused on all the important characteristics that make bacon, bacon: the crispiness, the fattiness, and just the right amount of smokiness to meatiness. If bacon is the product that meat eaters refuse to give up, our Libre Bacon is here to change that," said Ramos.

ISRAEL'S CANNABOTECH COMPANY WORKING ON NEW TREATMENT FOR PANCREATIC AND COLON CANCER COMBINING CANNABIS AND FUNGUS

Nina Zdinjak

MSN.com, via *The Spore Print*
L.A. Myco. Soc., Jan. 2022

Cannabotech, an Israeli biotech company that develops medical products based on cannabis and fungal extracts, has obtained the exclusive rights to use a patent to develop a plant-based cancer treatment, reported *The Jerusalem Post*. The company aims to create a drug that would help kill cancer cells in those suffering from pancreatic and/or colon cancer.

The news comes on the heels of a new study conducted by Hadassah Medical Center physicians which revealed a six-fold improvement in killing breast cancer cells when using specific Cannabotech's medical cannabis products in combination with standard oncology treatments and drug protocols—chemotherapy, biological, and hormonal—over the existing treatment.

The study discovered that the extract of the fungus *Cyathus striatus* can help potentially reduce the extent of cancerous tumors in animals, without injuring healthy cells.


John Roper

Fluted bird's nest fungus, Cyathus striatus. The "lid" or "epiphragm" is gone, revealing the "eggs" or peridioles that enclose the spores.

Cannabotech and Haifa University's economic company Carmel entered a deal under which Cannabotech will mix cannabinoids with fungal extract to create a drug that could help kill pancreatic and colon cancer cells.

ITALY BANS TRUFFLE HUNTING AFTER SWINE FEVER OUTBREAK POSES RISK

Alberto Brambilla and Megan Durisin

https://www.bloomberg.com/, Jan. 14, 2022

In an unusual twist of culinary fortunes, a swine-disease outbreak in Italy means the harvest season for its renowned truffles is getting cut short.

African swine fever was detected in wild boar this month in the country's northwest. To quell further spread of the illness, which is highly contagious and fatal for pigs, officials issued a six-month ban on activities from mushroom-collecting to hunting and mountain biking to keep people from areas where the boar roam.

That includes scouting for truffles, the prized mushrooms shaved on pasta and infused in oils that can cost thousands per kilogram. Italy's Piedmont region, where the infected pig was found, is famous for the delicacy and hosts an annual showcase in Alba for haute cuisine fans. Truffles grow on tree roots and are often scouted deep into the forest, with dogs trained to sniff out their musky scent.

The restrictions—announced this week by the agriculture and health ministries—are being enforced in some municipalities and are likely to expand across the region, according to Daniele

cont. on page 4

Italy Truffling Ban, *cont. from page 3*

Stroppiana, a truffle hunter and merchant in Piedmont. January marks the end of the season for white truffles, the most expensive variety which has sold at €6,000 ($6,843) per kilogram this year. But the ban will hurt the harvest for lower-valued black truffles that runs through March.

"We hope that the ban won't help the import of truffles from abroad. Slovenia, Croatia, Romania, and Iran are producers," Stroppiana said by phone.

Truffle markets have been upended in the past two years as the pandemic shuttered restaurants and halted tourism, curbing demand for high-end food. Stroppiana said he secured a special permit for truffle searching during the lock downs, but buyers were lacking.

Still, the new collection limits could ultimately aid future harvests of the elusive mushrooms.

"Truffles would rest for a season and there may be more the next year," Stroppiana said. "Intensive collecting is making truffles more rare to find than before. A rest would be bad in economic terms, but not for natural cycles, for sure."

SCIENTISTS CREATE EGG WHITES USING FUGUS IN THE LAB AS AN "ENVIRONMENTALLY SUSTAINABLE" ALTERNATIVE TO FARMING CHICKENS

Jonathan Chadwick

https://www.dailymail.co.uk/, Jan. 7, 2022

A vegan and environmentally friendly egg white has been created using a fungus, which could provide an alternative to intensive chicken farming.

Researchers in Finland have created ovalbumin, the primary protein in egg white, out of *Trichoderma reesei*, a species of fungi known to degrade clothing. Ovalbumin that's ethically produced using the *T. reesei*—called Tr-OVA—could become a sustainable replacement for chicken egg white protein powder, a widely used ingredient in the food industry.

Currently, one of the most widely used vegan alternatives to egg white at home and in restaurants is aquafaba—the liquid leftover from cooked chickpeas. However, aquafaba has to be whipped fiercely for over 20 minutes to achieve fluffy peaks, while this new replacement holds its shape and "has excellent foaming properties."

The research was conducted by scientists at the University of Helsinki together with VTT Technical Research Centre of Finland. To make Tr-OVA, researchers started by identifying the genetic code for ovalbumin, which accounts for about 54 percent of the total proteins of egg albumen, better known as egg white. Using modern biotechnological tools, including CRISPR, they inserted the gene carrying the blueprints for ovalbumin into the fungus, which then produced and secreted the same protein that chickens produce. The ovalbumin protein was then separated from the cells, concentrated, and dried to create the final product.

The researchers have also compared impacts of Tr-OVA production with an equivalent unit of real dried chicken egg white protein produced in Finland, Germany, and Poland.

"The fungus-produced ovalbumin reduced land use requirements by almost 90 percent and greenhouse gases by 31 to 55 percent compared to the production of its chicken-based counterpart," said Natasha Järviö at the University of Helsinki.

"In the future, when production is based on low carbon energy, precision fermentation has the potential to reduce the impact even by up to 72 percent."

Cell-cultured products generally need more electricity than typical agricultural products, and therefore the type of energy source used affects the level of environmental impact. However, the amount of agricultural inputs needed for ovalbumin production by microbes—such as glucose—is generally substantially lower per kilogram of protein powder.

VTT Technical Research Centre of Finland

Egg white protein produced by "precision fermentation" has "excellent foaming properties," researchers say.

Election **Election** **Election**

About the PSMS Election

Marian Maxwell

Elections are held electronically online. Voting opens on January 31 and ends at midnight on March 5. An email with the link to the voting will be sent out on January 31. This year we will be voting for Vice-President, Treasurer, and five Trustees for the years 2022–2024. Please read the following candidate profiles carefully.

To vote electronically, use the link in the email that is sent on January 31.

Or alternately go to the PSMS website at www.psms.org and click on "Members' Page" under the heading "Membership." Log in with your username and password. If you have forgotten your password, use the password reset link. If you can't remember your username, contact Pacita Roberts at membership@psms.org or Marian Maxwell at outreach@psms.org.

Scroll to the bottom of the member's area page to "Member's Area Features." Under the heading "Engagement" click on the link "Elections." This will open the ballot for the 2022 PSMS election. Make your selections and *be sure to click on "submit" at the bottom of the ballot when finish*ed.

Please note: Some biographies in *Spore Prints* have been abbreviated owing to space considerations. Online bios are as originally submitted. It will be helpful to have your *Spore Prints* issue with the candidates' photos and bios available to view when voting. You may only vote once. There are two votes per family membership; each person has to log in separately and use their individual user ID to vote. If you have any questions or confusion about voting, please contact Molly Watts or Joe Zapotopsky at elections@psms.org .

Election results will be announced at the annual membership meeting on March 8.

Scott Maxwell *Vice-President*

I would appreciate your vote in consideration of the following: I stepped up from board member to current PSMS Interim VP; helped establish methods to continue club activities during COVID-19; established contracts with the UW favorable to PSMS; helped establish hybrid meetings to allow maximum member participation; scheduled monthly speakers featuring member's fungi-related talents and interests; have been a PSMS member for 30+ years; have supported most facets of PSMS. Thank You for Your Vote!

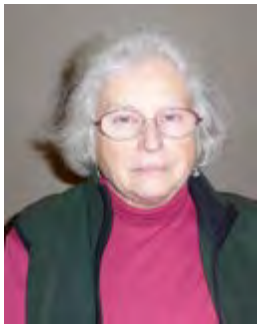
Treasurer **Brenda Fong**

As the current Treasurer I have had the opportunity to serve PSMS in a different and more challenging way than in my previous capacity as Hospitality Co-chair and Board member. I would like to serve another term and continue my work with the various committees and on different projects to promote the goals of the organization.

Trustees

Luise Asif

As a former member of the Board of Trustees and then PSMS Secretary, I would like to serve again. As volunteer chair and support for the Bridle Trails study, I believe being on the board will help improve communications to members as I stay on top of events happening in PSMS. I look forward to an exciting new future for PSMS.



Thad Steffen

Hello PSMS! I've been a member since 2015. You may have seen me volunteering for the big show, tray arranging, sorting, and at the mushroom dye station. PSMS has given and taught me so much! I want to do everything I can to ensure this group continues in perpetuity. To me, that means helping in whatever way I can.

Marcus Sarracino

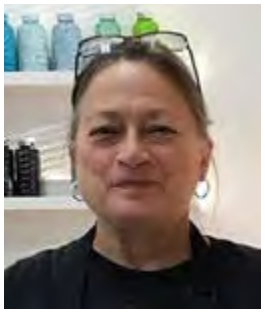
It's been a fun mycological journey with PSMS these past 7 years. In that time I've served as a field trip host, a field trip guide, chair of volunteer hospitality at the annual show, and for the last 2 years, I've been honored to serve as a trustee on the board. If picked for another term, I will do my best to serve our club.

Anne Polyakov

I am a PhD student in the Quantitative Ecology and Resource Management program at the University of Washington. I use techniques such as stable isotope analysis, genetic analysis, and modeling to better understand the role of the mycorrhizal symbiosis in forest ecosystems, specifically integrating mycorrhizal models into global-scale carbon/nitrogen cycling models.

Marian Maxwell

After serving on the Board of Trustees this past year, I would be appreciative of your support to serve again. I've found that as the Outreach Chair being on the board helps me to stay on top of events happening in PSMS. My passion is continuing to promote our mission to further the appreciation of fungi within our group and community.



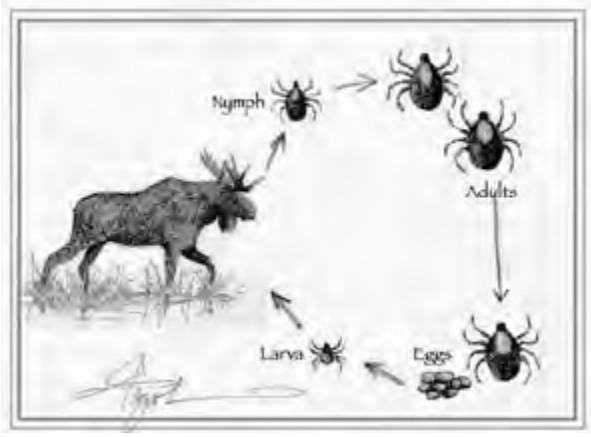
Vince Stanton

A Midwesterner by birth, I have lived in Seattle since 2015 and am passionate about the tremendous natural beauty of the Pacific Northwest. Most of all, I have fallen in love with the pursuit of mushrooms! I joined PSMS in 2017 and have been a regular volunteer for the fall Wild Mushroom Show as well as the springtime Mushroom Maynia. As a financial planner by trade, I hope to bring a valuable skill set to the board of PSMS.

FUNGI MAY KILL WINTER TICKS—AND HELP MOOSE SURVIVE

Rachel Sargent Mirus

https://www.concordmonitor.com/, Jan. 17, 2022



Legend says a stake through the heart will kill a vampire. But it's a bit more complicated if you're plagued—as moose can be—by tens of thousands of tiny blood-suckers. In the case of moose, the vampires are winter ticks (*Dermacentor albipictus*), and finding a way to stake them has been tricky. However, recent research has found a potential—and microscopic—vampire hunter.

Winter ticks are a one-host parasite, meaning all three active stages—larvae, nymphs, and adults—feed on a single host animal. This species prefers to feast on ungulates and is often called the "moose tick" because—unlike deer—moose are unable to remove the ticks through grooming, leaving them particularly vulnerable to large tick loads. Average tick counts on a single moose can hover around 47,000, with high counts toping 96,000.

That many ticks can drain the blood of a calf in two to three weeks. From 2017 to 2019, researchers with the Vermont Cooperative Fish and Wildlife Research Unit at the University of Vermont noted a 91 percent mortality of moose calves in Vermont. And from 2014 through 2016, researchers from the Department of Natural Resources and the Environment at the University of New Hampshire saw 70 percent mortality in northern New Hampshire and western Maine due to winter ticks.

Such alarming mortality rates have raised concern among wildlife management officials about the health of the New England moose population. Owing to the ticks' life history, however, finding a management strategy for winter ticks has been challenging.

Winter tick larvae quest—or seek hosts—from late summer through fall. After attaching to a host, the ticks feed, molt, and mate on the same animal through the winter. When adult female ticks are maximally engorged—generally between March and May—they drop to the ground.

Over the course of summer and early fall, the females lay eggs and die, then the larvae emerge and hang out at soil level and—again—begin questing.

Because of their one-host nature and the timing of their life cycle, the winter tick population depends on plentiful hosts and a window of time in the fall to find one. Limited numbers of hosts, cold fall temperatures, and early snows will inhibit ticks—but these are all conditions that are impractical to manage in favor of moose.

Enter Cheryl Sullivan, an entomologist with the Entomology Research Laboratory at the University of Vermont (UVM). She is spearheading a project investigating entomopathogenic fungi as potential allies against the winter tick. These fungi consume arthropods like insects, spiders, and—yes—ticks.

Entomopathogenic fungi are found naturally in soils worldwide and infect hosts through aerial spores. When a spore lands on a tick, it germinates, puncturing the tick's outer shell, then spreads its hyphae—the threads that comprise the fungi's mycelium network—through the tick's body.

Like something out of a horror movie, the growing fungus tears apart its host's internal organs and produces toxins, eventually killing the host. Fruiting bodies sprout from the host, releasing more spores.

Sullivan and the team at UVM tested fungal strains of *Metarhizium anisopliae* and *M. brunneum* against winter ticks. Some strains are already available commercially to control insects and mites in residential settings, and some were isolated from forest soils in northern Vermont. While commercial strains were most effective, Sullivan found that in laboratory experiments a local strain killed 89 percent of tick larvae within three weeks.

The UVM researchers are specifically interested in exposing ticks to fungal spores at the larval stage, before they've found a host. This is the phase when the winter tick is most vulnerable: the larvae are living in the fungi's natural home (soil and leaf litter), and both need similarly damp conditions to thrive.

Deliberately exposing ticks to specific fungal pathogens in their environment is a more sustainable alternative to chemical pesticides, although it's not without challenges. As Sullivan explains, "Entomopathogenic fungi require specific environmental conditions, including temperature and humidity, ample spore contact with a host, and applications timed appropriately to a susceptible life stage for their use to be effective." Spreading fungal spores everywhere moose live is impractical, so moose conservationists would need to target places Sullivan describes as "localized areas of optimal habitat where moose are known to congregate and be prone to winter tick recruitment."

While researchers are still evaluating the practicality of using entomopathogenic fungi to attack winter ticks, it is nice to know that when moose are faced with swarms of miniature vampires, they might be helped in the battle by microscopic vampire hunters.

FORM, FUNCTION, AND A DEADLY FUNGUS

https://www.sciencedaily.com/, Dec. 21, 2021

In 2009, a microorganism known as *Candida auris* emerged seemingly from thin air.

The fungus, which led to deadly outbreaks in hospitals and other care settings, soon alarmed scientists worldwide as it evaded traditional medications to treat fungal infections. Since then, the race has been on to better understand the fungus and hopefully better control it.

Getty Images

Candida auris.

New research from University of Michigan, published in *Nature Communications*, marks a major step forward in understanding *C. auris* biology, homing in on the genetics behind its ability to shape-shift from a round yeast form to a more hair-like, filamentous form.

"Almost all fungal pathogens, from valley fever to yeast infections, have morphological changes, and seem to couple virulence processes with the change in form," said Teresa O'Meara, Ph.D., assistant professor in the Department of Microbiology and Immunology at the University of Michigan Medical School. "But people hadn't figured out whether *Candida auris* could do it or how."

Notably, the fungus has now been found on all inhabited continents, and different variants and morphologies have emerged in different parts of the world. Determining the genetics behind these variants is key to determining how form and disease are related. But until now, studying *C. auris*' genes has been incredibly difficult.

"It's pretty well known in the field that it is hard to do genetic manipulation in this organism," said Darian Santana, a Ph.D. student in O'Meara's lab and first author on the paper. "I think a lot of researchers avoid it or spend a lot of time and energy to get something to work."

He and O'Meara developed their own genetic tools using a DNA-based CRISPR-Cas9 technique and a bacterium that commonly infects plants.

Exploiting the bacteria's ability to infect fungi as well, the team used it to insert DNA into the genome of *C. auris*. Screening the genetically modified cells for ones that had different morphologies, or structures, lent clues to which genes were controlling it. The team is the first to use these methods successfully in *C. auris*, says Santana.

"The genes are not only important for morphology, but they're also important for virulence and for drug resistance," said O'Meara. Their work is an important proof of concept for *C. auris* research, one they hope will aid the research community studying the deadly pathogen to more quickly evaluate strains and screen for the genetics behind why some are more disease causing or drug resistant than others.

"The things you learn in one strain don't necessarily apply to another, so it's important to be able to do genetic manipulation in fungi with diverse backgrounds," she added.

O'Meara and Santana next hope to uncover the genetic factors behind *C. auris'* ability to spread so well on hospital and other surfaces.

"Once an infection in a patient is identified, infection prevention will swab the entire room. Generally, with *Candida auris*, you see that it ends up everywhere—on nurses' lanyards, temperature probes, bedding, etc. Removal is a pretty extensive process, and this enhanced ability to transmit seems to be somewhat unique to *Candida auris*," Santana said.

When he found that the fungus was killin'
The germs, Alex Fleming was willin'
To examine the mold
Found on bread; we are told
That's the way that he found penicillin.

— Janet McConnaughey

To dream of mushrooms denotes fleeting happiness,
to dream you are gathering them,
fickleness in a lover or consort.
— Richard Folkard in Plant Lore (1884)

FUNGI THAT LIVE ON EUCALYPTUS ROOTS CAN CONTROL TREES' GENE ACTIVITY

Michael Le Page
https://www.newscientist.com/, Jan. 10, 2022

A root fungus that helps eucalyptus trees get nutrients and water has a surprising way of maintaining this symbiotic relationship. It releases tiny bits of RNA that manipulate gene activity in the tree roots.

"It is a bit like a key and lock mechanism where the RNA is a key needed to unlock access to the plant," says Jonathan Plett at Western Sydney University in Australia.

Many trees form symbiotic relationtions with ectomycorrhizal fungi, which wrap around small roots. "Think like a hot dog in a bun, where the root is the hot dog and the fungus is the bun surrounding it," says Plett.

Pisolithus microcarpus mycorrhizal root tips on Eucalyptus grandis.

This process stops the root growing, but fungal finger-like projections—hyphae—extend out into the soil far beyond the normal root system of the tree. They gather nutrients that the fungus trades for plant sugars.

It is known that ectomycorrhizal fungi "talk" to plants by releasing a variety of proteins. Now Plett and his colleagues have shown that one fungus (*Pisolithus microcarpus*) also releases a microRNA when it colonizes the roots of the flooded gum tree (*Eucalyptus grandis*).

MicroRNAs are small bits of RNA that reduce the production of certain sets of proteins. Cells normally use microRNAs to control their own gene activity, but some pathogens also release microRNAs to turn off genes involved in cellular defense in a potential target organism.

Pisolithus microcarpus does something similar. After discovering that *P. microcarpus* releases a microRNA called Pmic_miR-8, Plett's team blocked Pmic_miR-8 in the roots of seedlings growing in the lab. They found that previously colonized roots resumed growth, showing that Pmic_miR-8 is essential to maintaining the symbiotic relationship.

It is likely that many other ectomycorrhizal fungi release similar microRNAs. "By identifying the 'keys' used by beneficial microbes to colonize plants, we can hope in future to guide plant breeders to develop plants that will be better able to associate with beneficial microbes," says Plett.

This could make plants less reliant on fertilizers, making forestry and farming more sustainable, he says.

Margaret E. Dilly

Sept. 3, 1927 – Dec. 26, 2021

It is with deep sadness that we report the death of long-time PSMS member Margaret Dilly on December 26. She and her husband, Claude, joined PSMS in 1965, just missing being charter members by one year. They were deeply involved in all aspects of PSMS for many years. For decades Margaret took charge of organizing the specimen sorting boxes on the Friday before and then the Saturday tray arranging for our annual wild mushroom exhibit, streamlining these functions. From 1972–1984 she chaired the Morel Committee headed by Dr. Daniel E. Stuntz, UW Professor of Botany, a co-founder of PSMS, and our first Scientific Advisor until his death in 1983. She served as PSMS President from 1984–86. Margaret spearheaded the push for state legislation to help regulate commercial wild mushroom picking. This required 12 years of work, including some clandestine undercover operations to get a first-hand view of the commercial buying and processing of wild mushrooms. She worked with local Washington State Senator Mary Haugen to eventually design bills requiring licenses, permits, fees, and documentation by commercial pickers. In 2014 she and Claude received the Patrice Benson PSMS Golden Mushroom Award, the highest honor our club bestows on members for their contributions.

Margaret's legacy wasn't restricted to her 56 years with PSMS. After they retired and moved from Ballard to Oak Harbor on Whidbey Island, she and Claude joined the Bellingham Northwest Mushroomers Association, where Margaret was instrumental in turning the new group into a professional society—reorganizing the annual mushroom show, leading forays, and, most important, teaching identification skills to new members. Every fall, NMA holds a Dilly Foray in honor of her contribution.

She was charter member of the Pacific Northwest Key Council organized in 1974, where she wrote their first macro key to the genus *Agaricus*. She was on the board of the Daniel E. Stuntz Foundation established in 1984 to provide financial aid for mycological education and research in the Pacific Northwest. She and Claude were also members of the North American Mycological Association.

Margaret had four children, three of whom are still living, along with 11 grandchildren and 9 great grandchildren.

A virtual and in-person memorial is set for Feb. 5, 2022, at the Whidbey Presbyterian Church. Details will be posted on the Neptune Society website and Facebook.

— Brian Luther & Agnes Sieger

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