SPORE PRINTS

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MUSHROOM GROWING ON LIVE FROG SURPRISES RESEARCHERS

Amanda Kooser

https://www.forbes.com/, Feb 8, 2024

You've heard of a toadstool, but now there's something much stranger: a frog mushroom. Researchers in India came across a frog with a mushroom sprouting from its flank. It may be the first observation of its kind. How the mushroom got there, grew, and fruited is a mystery.

Lohit Y.T

(left) Frog with mushroom growing on its side;

(right) Closeup of mushroom.

The hit HBO show *The Last of Us* pushed mushrooms and fungi into the pop-culture spotlight. In the show (based on a video game), humans are infected by a fungus that turns them into horrifying zombies. The series is fictional, but the frog with a mushroom growing on it sounds a lot like something that could happen in *The Last of Us*. Fortunately, the real-life frog didn't show signs of wanting to chomp on human flesh.

The report in the January issue of *Reptiles & Amphibians* came from hobbyist naturalist Chinmay Maliye and Lohit Y.T.T, a wetlands specialist with conservation organization WWF India.

The star of the report is called a Rao's intermediate golden-backed frog, a species of yellowish amphibian named for the zoologist who first described it in 1937. The researchers encountered the frog in June 2023. It was among several dozen in a small roadside pond formed from rainwater. "One individual perched on a twig had a distinct outgrowth on its left flank," the researchers wrote. "A closer examination clearly revealed a mushroom sprouting from its side." The frog was alive and moving about.

The fungus discovery came as a surprise. "To the best of our knowledge, never has a mushroom sprouting from the flank of a live frog been documented," the researchers said. The eye-catching photos are the highlight of the brief report. Images show the frog and mushroom from several angles. The tiny, gray-capped mushroom extends on a delicate, curved stalk from the frog's left side.

SEX AND POISON MAY EXPLAIN CALIFORNIA DEATH CAP INVASION

Anna Marija Helt

https://baynature.org/, Feb. 1, 2024

It's worth braving the chill of a rainy-season walk at Point Reyes National Seashore. Scents of spicy bay laurel, sweet-sharp conifer, and ocean brine intermingle with a fungal aroma on this windswept peninsula, home to a kaleidoscopic array of mushrooms from tiny purple parasols to stools fit for a large toad.

Increasingly these days, you'll see scads of attractive mushrooms sporting caps in varying combinations of yellow, green, and brown. They're *Amanita phalloides*—Death Caps, commonly—the source of most mushroom fatalities worldwide and the bane of unwary foragers. And they're fruiting now.

Amanita phalloides.

They're relatively recent arrivals, actually. Death Caps are the first invasive ectomycorrhizal (ECM) fungus reported in North America. ECM fungi grow linked with the root tips of woody plants, allowing fungus and plant to swap nutrients. The fungi likely arrived by ship, stowing away aboard plants imported from Europe. Death Caps were first spotted in 1938 on the grounds of the former Del Monte Hotel in Monterey and now grow on the West Coast from Los Angeles to British Columbia, and east to Idaho, including deep within native forests. They emerged on the East Coast in the 1970s but, unlike their West Coast cousins, remain limited in range there.

The Bay Area's Death Caps win the prize for being larger and more abundant than anywhere else, according to mycologist Benjamin Wolfe, an associate professor of biology at Tufts University. In study sites at Point Reyes National Seashore he found that Death Caps dominated native mushrooms by sheer mass. The mushrooms that you see are just the visible sex parts of the larger fungal individual, or mycelium, living underground. "It's difficult, especially in places like Point Reyes, to walk in the woods and see as many Death Caps as giant and prolific as they are and imagine that it's not disturbing natural associations and even shifting plant communities," says Mickey Drott, a mycologist at the U.S. Department of Agriculture's Cereal Disease Lab in St. Paul, Minn.,

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CALENDAR

Mar. 10	PSMS officer and board election ends at midnight
Mar. 12	PSMS annual membership meeting, in-person and via Zoom, 7:30 pm, CUH
Mar. 18	Board meeting, CUH boardroom, 7:30 pm.
Mar. 26	*Spore Prints* deadline

BOARD NEWS — Carolina Kohler

The board had a busy agenda at its second meeting of the year, this past February 19th.

First on the table, after the approval of the financial reports prepared by Treasurer Brenda Fong, was an update on the work being done by the Policies & Procedures task force. Peg Rutchik explained that the conflict of interest policy is undergoing its final review, while work on the fiscal management policy has just begun.

This was followed by a discussion proposed by Wren Hudgins to ensure that the process of identifying and displaying specimens for our 2024 Wild Mushroom Show will be smooth and successful.

Next, Randy Richardson announced that work would soon resume on the sometimes challenging, but always necessary, update of the mushroom harvesting rules, and Sandra Ruffner introduced the fascinating topic of eDNA, which she will expand further at the next board meeting.

A lively conversation followed, centering on the topic of scholarships, and you will soon be reading more about this from the chair of the scholarships committee, Pei Pei Sung.

President Colin Meyer rounded up the meeting giving the board an update on the negotiations ahead of our upcoming lease renewal, which could have PSMS moving to a much needed bigger office space at CUH, just a few steps from our current one.

And don't miss two big announcements at our next general membership meeting in March! Not only will we find out the results of this year's elections, but the winner of the 2024 Golden Mushroom award will be revealed as well.

We hope to see you all there!

MEMBERSHIP MEETING — Scott Maxwell

The membership meeting on March 12, 2024, will be a "hybrid" meeting, both in-person at the Center for Urban Horticulture and virtual on Zoom. We will start letting people into the CUH meeting hall at about 7:00 pm and into the Zoom meeting at about 7:20 pm. The lecture will begin at approximately 7:30 pm. This meeting is actually our Annual Membership Meeting and will include the "Golden Mushroom Award" presentation for a lifetime of service, introduction of our candidates for vacant board positions, and a fun and informative presentation by long-time member and award-winning author Langdon Cook! Please attend, be informed, and prepare for the upcoming Spring season.

Langdon Cook

Langdon's presentation is entitled "Morels and Much More: An Overview of Spring Foraging." This presentation will be a virtual field trip in search of local spring bounty, featuring some of the Pacific Northwest's most prized wild edibles. In addition, Langdon will tell you where to find these elusive culinary ingredients and how to prepare them in delicious meals. Slides of plants and fungi in their habitat and in finished dishes will have you reaching for your boots, baskets, and sauté pans. A Q&A session and book signing will follow the presentation.

Langdon Cook is a writer, instructor, and lecturer on wild foods and the outdoors. His books include *Upstream: Searching for Wild Salmon, from River to Table* (Ballantine, May 2017), a finalist for the Washington State Book Award; *The Mushroom Hunters: On the Trail of an Underground America*, winner of the 2014 Pacific Northwest Book Award; and *Fat of the Land: Adventures of a 21st Century Forager*, which the *Seattle Times* called "lyrical, practical, and quixotic." Cook's work has been nominated for two James Beard Awards, a Society for Environmental Journalists award, and a Pushcart Prize. He has been profiled in *Bon Appetit*, *WSJ* magazine, *Whole Living*, and Salon.com. His writing appears in

numerous magazines, newspapers, and online journals, including *National Geographic Travel*, *Outside*, *Eating Well*, *Gray's Sporting Journal*, and *Seattle Magazine*, where he was a regular columnist for a decade. Cook lives in Seattle with his wife and two children.

California Death Caps, *cont. from page 1*

who studies how fungal toxins shape their evolution. "Even the mycorrhizal connections are massive," says Debbie Viess, cofounder of the Bay Area Mycological Society. "You can see them with the naked eye!"

Why is the Bay Area a hotbed of Death Caps? First, they seem to love the mild climate. Second, they've gone "host jumping," moving from the roots of imported trees such as European cork oaks to coast live oaks, which are evergreen and thus give them a year-round supply of carbon from photosynthesis. More carbon may translate to more and bigger mushrooms, which, in turn, means more spores for spreading Death Caps. It also means that they may be competing for underground habitat under oaks with foragers' beloved chanterelles, *Cantharellus californicus*, according to Viess.

But there is a new and sexy twist to the story. Mycologist Yen-Wen (Denny) Wang, now a postdoc at Yale School of Public Health, was studying the origin of Death Caps at Point Reyes when he discovered mushrooms containing DNA from just one parent instead of the normal two. Then a grad student in Anne Pringle's lab at the University of Wisconsin-Madison, Wang looked underground—and found individual mycelia that were capable of reproducing either solo or with a mate. "I was pretty excited," he recalls. To his knowledge, his observation—published recently in *Nature Communications*—is the first in nature of unisexual fruiting bodies among the Agaricomycetes, a large group encompassing mushrooms, puffballs, and shelf fungi.

Unisexuality is a powerful reproductive strategy, if you can swing it. (It requires just one parent to produce spores.) "You only need some individuals that are capable of doing this to start establishment," notes Wang. It's easy to see how that may facilitate invasions. Wang suspects that investigating the invasion fronts on the West Coast may uncover more unisexual Death Caps.

Meanwhile, Drott's research in collaboration with the Pringle lab adds another possibility. He and his coauthors have found that the collection of toxin genes in Californian Death Caps differs from those in Europe, and even varies among individual fungi. Drott hypothesizes that evolving a diverse suite of toxins may allow Death Caps to spread to new ecological niches—possibly by suppressing competing organisms or by preventing various critters from noshing on the mushrooms. But both Wang and Drott emphasize that they haven't proved these hypotheses. "We need more data," says Wang

"I think it's a really cool situation," says ectomycorrhizal fungus expert Laura Bogar on these possible explanations for the Death Cap invasion. Bogar, an assistant professor of plant biology at U.C. Davis, is establishing a new lab to study mechanisms underlying plant–fungal interactions. She says that a super successful invasive species likely benefits from having such special tricks up its sleeve—and getting lucky with the environments it encounters. Indeed, she and collaborators recently published an article detailing a "fungal fight club" approach to determining the factors—fungal and environmental—that allow one ectomycorrhizal fungus to outcompete others. Such studies are rare, though. Most ectomycorrhizal fungi are, so far, difficult or impossible to grow in the lab, which makes causation difficult to establish, according to Bogar.

The Pringle lab will keep working on solving this invasion mystery, aided by new genetic techniques that have transformed mycology in recent years. Meanwhile, Drott, typically a mold researcher, jokes, "Working on Death Caps has dramatically increased the level of interest I get at cocktail parties."

OUR FAVORITE STINKY CHEESES ARE IN TROUBLE

Gina Carey

https://www.newser.com/, Feb. 17, 2024

Sean Gallup/Getty Images

A cheese stand in Berlin, Germany.

In news that could upend cheese plates everywhere, some of the stinkiest offerings we love to indulge in are in danger. Vox has the scoop on what it calls the "Camembert calamity," and it all boils down to fungi. To get the uniform looks, smells, and tastes we expect when we purchase Camembert, brie, and blue cheeses, producers have relied on very specific strains of fungus. Cheese is made by mixing fresh milk with bacteria and fungi-ike yeasts and molds—the strains used produce different varieties. Brie and Camembert makers switched to an albino mold, *Penicillium camembertii*, in 1898 and 1902, respectively, and it soon became the industry standard.

While *P. camembertii*'s makeup is responsible for the white, creamy cheese we enjoy today, it's an asexual fungus, so it's reproduced through cloning. A century of cloning has weakened the single strain of fungus responsible for all Camembert currently made around the world, and more recent mutations have hampered its ability to produce spores. "We've been able to domesticate these invisible organisms just as we did with dogs or cabbage," says evolutionary biologist Jeanne Ropars of the National Centre for Scientific Research (CNRS). "But what happened, as it does every time an organism large or small is subjected to overly drastic selection, is that their genetic diversity has been greatly reduced."

Limiting genetic diversity has had a similar effect on crops, like bananas or wheat. Vox notes that different varieties of a crop can withstand challenges better than others, so bouts of bad weather or new pathogens may wipe out one type while others manage just fine. "When you lose diversity within a species, you lose adaptability," says CNRS' Tatiana Giraud. Blue cheeses are undergoing a similar fate, but a new population of *P. roquefortii* recently identified by Giraud could be a game changer. And while it's not the kiss of death for Camembert, cheese lovers may need to adapt to new colors, smells, and tastes as producers use new strains. "Camembert is not going to disappear tomorrow," Ropars says. "But it's going to be more and more difficult to produce."

REMARKABLE DUAL EFFECT OF PSILOCYBIN REVEALED IN NEW STUDY

Eric W. Dolan

https://www.psypost.org/, Feb. 18, 2024

"*Magic mushrooms*" *containing psilocybin.*

New research published in *Molecular Psychiatry* provides insight into how psilocybin, a compound found in psychedelic "magic" mushrooms, influences the brain and behavior. By observing the effects of psilocybin on larval zebrafish, scientists uncovered that it not only stimulates exploratory behavior but also buffers against stress-induced changes in activity patterns.

This investigation sheds light on the complex interplay between psychedelic compounds and the serotonergic system—the part of the brain that helps regulate mood, anxiety, and happiness.

What is Psilocybin, and Why Focus on It?

Psilocybin is a naturally occurring psychedelic compound found in certain species of mushrooms renowned for its ability to induce profound changes in perception, mood, and thought. It operates primarily by activating serotonin receptors in the brain, particularly those in regions involved with mood regulation and perception.

This substance has been the subject of increasing scientific interest, especially in the field of psychiatry, due to its potential to offer therapeutic benefits for a range of mood-related disorders. Unlike traditional antidepressants, which often take weeks to show effects and come with various side effects, research suggests that psilocybin might provide rapid and lasting relief after just a few doses.

But how does this compound work in the brain? To answer this question, researchers turned to larval zebrafish. The choice of zebrafish stems from their transparent bodies and the remarkable similarity of their serotonergic system to that of humans, which makes them an invaluable tool for studying brain activity and behavior in response to pharmacological treatments.

"Our laboratory mainly studies the functions of the endogenous serotonergic systems in the brain, which is not easy to study in mammals but is more accessible in fish," said study author Takashi Kawashima, an assistant professor in the Department of Brain Sciences at Weizmann Institute of Science. "Hence, the recent psychedelic boom in psychiatry naturally caught our attention. Psychedelics act on serotonin receptors, and we thought we might be able to contribute some basic research insight from our background of serotonin research."

The Research Methodology

For their study, the researchers developed a high-resolution tracking system specifically developed to monitor the movements and behaviors of these tiny aquatic creatures in a controlled environment. The system was capable of capturing the nuanced body kinematics of zebrafish larvae with extraordinary detail, thanks to a custom-built setup featuring a high-speed camera and specialized lighting. This allowed for the precise observation of spontaneous exploration behaviors and responses to visual stimuli, which are critical for understanding the innate and drug-induced behavioral patterns of zebrafish.

To assess the impact of psilocybin, researchers conducted a series of experiments where larval zebrafish were exposed to varying concentrations of the compound as well as to other pharmacological treatments for comparison, including traditional antidepressants (SSRIs). The experimental design also incorporated stress-inducing conditions, such as changes in water temperature, to evaluate how psilocybin influenced stress-related behaviors.

The Findings: Psilocybin's Dual Effects

The study revealed that psilocybin had a dual effect on larval zebrafish: it enhanced spontaneous exploration but also shielded against stress-induced behavioral disruptions.

Psilocybin-treated zebrafish demonstrated a marked increase in spontaneous movement and exploration, suggesting a stimulatory effect of the compound on these behaviors. Furthermore, when subjected to stress, these same fish maintained normal swimming patterns, in stark contrast to the erratic "zig-zag" movements observed in control fish under similar conditions. This indicated a significant anxiolytic effect, with psilocybin helping to mitigate the behavioral manifestations of stress.

"The action of psychedelics has been mostly studied in the cognitive domains of brain functions," Kawashima told the website PsyPost. "However, we found that the psychedelic is at least acutely anxiolytic in fish, which shares evolutionarily old structures with humans. This indicates that psychedelics may also modulate a primitive functionality of the brain."

Through behavioral analyses, the study also revealed that psilocybin's effects were distinct from those of traditional antidepressants, which tended to suppress overall movement rather than stimulate exploratory behavior.

"We are very surprised by the dramatic, visible effects of psilocybin in fish," Kawashima said. "Behavioral phenotypes in these types of model organisms are usually subtle and bar graphs. We did quantify the effects using cutting-edge machine-learning algorithms. Nonetheless, I can easily explain our findings, how the fish change their trajectories under stress and psilocybin, to our preschool daughters."

Further analysis showed that psilocybin's impact extends deep into the brain's serotonergic system, specifically affecting the dorsal raphe nucleus, a key area involved in mood regulation. Here, psilocybin appeared to suppress the activity of serotonergic neurons, offering a clue to its calming effect on stress-induced behaviors.

Limitations and Future Directions

While the findings from this study are compelling, they also highlight the complexity of psilocybin's actions and the need for further research. The larval zebrafish model, though powerful, is a simplified system. Human brains are vastly more complex, and how these findings translate to humans remains to be fully understood.

"First and foremost, this is a study of fish behavior," Kawashima explained. "I studied medicine before turning into a basic researcher and am cautious about direct translation into clinical insights. Second, we haven't demonstrated persistent effects of psychedelics that last for weeks and months, which is the most interesting clinical finding in humans. We are working on this."

Future research will need to explore the long-term effects of psilocybin, its efficacy across different types of stressors and mood

disorders, and its potential side effects. Additionally, studies will benefit from incorporating more advanced imaging techniques to observe changes in neural activity and connectivity in real time, providing a more detailed map of psilocybin's impact on the brain.

This study is a step toward demystifying the mechanisms behind psilocybin's promising effects on mood and behavior. By leveraging the simplicity of the zebrafish model, researchers have begun to unravel the intricate dance between psychedelic compounds and the brain's serotonergic system.

"Zebrafish's brain is entirely accessible for methodologies of circuit studies in neuroscience," Kawashima added. "We intend to clarify which part of the serotonin system psilocybin acts on using whole-brain neural activity imaging that we have expertise in. Also, zebrafish have been used at the first level of drug screening for various biomedical goals. We hope our machine learning approach will advance such industrial aspects of zebrafish use."

The study, "High-resolution tracking of unconfined zebrafish behavior reveals stimulatory and anxiolytic effects of psilocybin," was authored by Dotan Braun, Ayelet M. Rosenberg, Elad Rabaniam, Ravid Haruvi, Dorel Malamud, Rani Barbara, Tomer Aiznkot, Berta Levavi-Sivan, and Takashi Kawashima.

FUNGUS THAT SPARKED DEADLY MENINGITIS OUTBREAK AGGRESSIVELY ATTACKED THE BRAINSTEM

Barbara Mantel

https://www.nbcnews.com/, Feb. 8, 2024

The fungus behind a spate of deadly meningitis cases last year linked to medical clinics in Mexico was found to have aggressively attacked the base of patients' brains, researchers said Wednesday in a report published in *The New England Journal of Medicine*.

Fungal meningitis was reported in as many as 24 patients from the United States who visited two medical clinics in Matamoros, Mexico. Many came from Texas. Twelve died.

All of the patients had undergone cosmetic procedures—such as breast implants, butt lifts, or liposuction—that required epidural anesthesia. It was later discovered that the epidural was contaminated with a fungus called *Fusarium solani*; the epidural, experts said, introduced the fungus into the patients' cerebrospinal fluid, a liquid found in and around the spinal cord and brain that provides nourishment and protection and removes waste.

In the report, researchers from the University of Texas System and the Centers for Disease Control and Prevention scrutinized the electronic health records, imaging, and pathology reports of 13 of the patients. They found that the fungus, which has a predilection for sticking to blood vessels, was rampant in the vessel-rich brainstem.

"What we ended up seeing is, literally, this fungus eating through blood vessels and causing clotting as well," said Dr. Luis Ostrosky, division director of infectious diseases at UTHealth Houston and one of the paper's authors.

As a result, patients suffered strokes, brain hemorrhages, and increased pressure within the brain as inflammation blocked the flow of the spinal fluid.

"Seeing how the brain stem was impacted in very specific ways, which were unexpected and unusual, is an important finding and potentially could help alert clinicians to future cases" and lead to better and quicker diagnosis and treatment, said Dr. Celeste Philip, the senior public health adviser of health and medical affairs at the American Public Health Association. Philip was not involved with the new report.

Getting treatment early is critical, said Dr. Katrina Byrd, an infectious disease expert and epidemic intelligence officer at the CDC. "If we can catch infection early, the length of the treatment is shorter and the effect of the infection on the body is less severe," she said.

Many of the patients in the Matamoros outbreak were not evaluated and treated for a month or more after the onset of meningitis symptoms, such as chronic headache, light and sound sensitivity, and fever. Some were turned away from emergency departments and were told that they probably had post-epidural headaches. Others, some without health insurance, ignored their symptoms.

Six of the surviving patients received an experimental antifungal drug late in the outbreak after it was discovered through lab tests that the fungal strain was resistant to current drugs, said Dallas Smith, an epidemiologist with the Mycotic Diseases Branch in the CDC's National Center for Zoonotic and Emerging Infectious Diseases, who led the agency's efforts on the outbreak. A seventh patient also received the drug but died.

He noted that it is difficult to grow the fungus in the lab from spinal fluid; the sample that was successfully cultured came from the brain of a patient who had died.

Survivors, as well as some who died, also received steroids for inflammation, shunts to divert backed-up spinal fluid, and other advanced treatments to address the attack on the brainstem.

Contaminated Epidural

It remains unclear exactly how the fungus entered the epidural solution at the Matamoros clinics, but the CDC has a theory. The morphine that was mixed with the anesthesia most likely was contaminated, said Smith.

Because of drug shortages, morphine is hard to come by in Mexico, and so the anesthesiologist, who moved between both clinics, likely purchased it on the black market, said Smith, who was an author on the new report.

Several weeks ago, the CDC was able to grow the *Fusarium* fungus from the spinal fluid of a patient in Tennessee and compare it to the fungus cultured last year from the brain autopsy. The two patients had each visited a different clinic, yet the strains were genetically almost identical. That finding supports the theory that the fungus was introduced into the epidural by contaminated morphine and not poor hygiene during surgery, Smith said. Either way, the fungus was directly delivered into the epidural space of the spine, "and that's why we got this devastating mortality rate."

An Unusual Outbreak, But Not The Last

Despite the unusual and severe nature of the outbreak, experts warned that there are likely more to come. "This is probably not our last fungal outbreak," said Ostrosky, who is also chief of infectious diseases and epidemiology at Memorial Hermann Health System in Houston.

OUTBREAK OF DEADLY FUNGUS CONFIRMED IN WASHINGTON STATE

Elise Tokahama

Seattle Times, Jan. 31, 2024

The first known outbreak of a particular deadly fungus has hit Washington state, King County public health officials confirmed Tuesday.

The fungus, called *Candida auris*, or *C. auris*, first emerged in the state in July, when a Pierce County resident tested positive for the fungus at Kindred Hospital, a long-term acute care hospital in Seattle, according to Public Health–Seattle & King County. No further cases were found at the time.

This month, another *C. auris* infection was confirmed in a patient who was recently admitted to Kindred, the public health agency said in a blog post. The patient was tested through a state Department of Health screening program that encourages early detection of multidrug resistant organisms, or organisms like *C. auris* that can be resistant to treatment, the post said.

More than a week later, three other cases were confirmed at the hospital, all in patients who had tested negative for the fungus when they were first admitted—meaning the infection had started to spread in the state's first known *C. auris* outbreak.

Public health officials said they were not yet sure of the initial source of the infection adding that it "may never be identified." No further information about the patients was immediately available.

"Public Health continues to work together with Kindred to help limit spread," the post said. "This includes keeping patients who test positive for *C. auris* away from other patients to reduce risk of spread and using specific disinfecting cleaning products effective for *C. auris*."

Kindred is in the process of notifying other facilities that received patients who were previously at Kindred.

Candida auris infections are considered an urgent public health threat and spread at an "alarming" rate during the coronavirus pandemic, the Centers for Disease Control and Prevention said last spring. The fungus was first reported in the United States 2016, and was responsible for a 200 percent jump in infections between 2029 and 2021, *The New York Times* reported last year.

Claire Bostrom-Smith, manager of King County's health care-associated infections program, said in the blog post that *C. auris* is particularly concerning because it is resistant to common antifungal medications. It can also spread in the body without the patient having any symptoms—a process called "colonization," Bostrom-Smith said.

Between 5 percent and 10 percent of patients "colonized" with *C. auris* will eventually develop "invasive" infections that can be serious, Bostrom-Smith added. More than 45 percent of people with invasive infections die within the first 30 days, Bostrom-Smith said.

Those in long-term acute care facilities are generally most at risk, largely because they tend to be very ill and rely on devices like catheters or breathing tubes, Bostrom-Smith said.

In general, *C. auris* is not a threat to healthy people, according to the CDC.

Symptoms generally include infections in different parts of the body, including in the bloodstream, open wounds, and ears, though it depends on the location and severity of the infection, the CDC says. Some symptoms might be similar to others caused by bacteria, the agency noted, adding that there "is not a common set of symptoms" specific to *C. auris* infections.

The fungus can also be difficult to get rid of in health care settings because it can live on some surfaces for weeks or longer, Bostrom-Smith added.

Because public health teams have been working with Kindred for months to implement the early screening program, they expected *C. auris* would "eventually be found in Washington," the Tuesday post said.

"Early identification is key to control the spread of *C. auris* so that prevention strategies can be in place before it becomes widespread," according to Public Health–Seattle & King County.

USDA APPROVES SALE OF GLOW-IN-THE-DARK "FIREFLY" PETUNIAS MODIFIED WITH MUSHROOM DNA

Jonathan Berisford

https://technabob.com/, Feb. 16, 2024

Glowing petunias via mushroom DNA.

The USDA has just given the green light to biotech startup Light Bio to start selling"Firefly" petunias, modified with the DNA of glowing mushrooms to provide the plants with bioluminescence. The petunias will naturally glow in the dark (no blacklight required) and be visible to the naked eye. They can be pre-ordered now for $29, with shipping beginning in April. That's cool, but I would have created bioluminescent begonias instead of petunias and named them beGLOWnias. But that's just me, and I was a marketing major in college.

The fungus (the poisonous mushroom *Neonothopanus nambi*) feeds its light-emitting reaction with the molecule caffeic acid, which terrestrial plants also happen to make. By inserting the mushroom genes into the petunia, researchers made it possible for the plant to produce enzymes that can convert caffeic acid into the light-emitting molecule luciferin and then recycle it back into caffeic acid—enabling sustained bioluminescence.

The entirety of the plants will glow, with new growth and flowers emitting the brightest light and the glow dimming in older parts of the plant. I just have two questions before making my purchase decision: (1) can they be grown as houseplants? and (2) are they bright enough to light the way to the bathroom at night? Because if so, you've got yourself a customer.

ADORABLE ITALIAN ROBOT USES BLASTS OF RADIATION TO FIGHT MILDEW ON FARMS

Jo Borrás

https://electrek.co/, Feb. 12, 2024

This adorable little Italian farm robot packs a radioactive punch—the ICARO X4 helps the country's storied vineyards to combat harmful fungi and mildew by blasting it with UV-C radiation.

Developed by Italian equipment manufacturer Maschio Gaspardo, the ICARO X4 farm robot was designed to navigate around Italy's famous vineyards autonomously while also determining the best time to treat the crops to prevent the growth of harmful bacteria based on humidity and temperature data it gathers with its own onboard weather station, as well as "locally trained" weather pattern algorithms. Crucially, the ICARO can do so *without* the use of harmful chemicals and pesticides.

The ICARO robot is equipped with UV generating light panels on both sides between the axles that extend like wings (Icaro = Icarus, get it?).

Once in position, the "wings" are lowered over the vines, stopping a few inches away from the leaves for optimal treatment (read: radiation blasts). According to the manufacturer, each of the ICARO robots can keep up to 15 hectares (about 37 acres) of vineyard free from fungi and mildew, potentially reducing a farm's chemical fungicide use by 70 percent.

Electrek

ICARO X4 in action.

The ICARO X4 is driven by electric motors and can be fitted with a 2-cyl. Kohler diesel motor that serves as a range-extender when the batteries are low—a crucial feature that enables the robot to work for up to 72 consecutive hours (3 days) during the summer months, when molds and mildews run rampant.

The company showed the ICARO X4 at World FIRA this past weekend, and says that five such robots were already in operation in France and Italy, with plans to sell more throughout the year—but they're not cheap. Each ICARO comes with a €115,000 price tag.

IF PLANTS CAN PICK FUNGI TO HELP FIGHT PESTS AND DISEASES, IT OPENS A DOOR TO GREENER FARMING AND ECOSYSTEM RECOVERY

Adam Frew, et al.

https://phys.org/, Feb. 7, 2024

Just beneath your feet, an ancient and silent alliance endures. This alliance between plants and arbuscular mycorrhizal (AM) fungi is one of the oldest biological partnerships on Earth.

Going back almost half-a-billion years, this relationship paved the way for plants to make it onto land. These early plants, simple and without the complex root systems of plants today, forged an alliance with fungi. This alliance has been instrumental to the evolution of plant life and has helped shape our ecosystems.

These fungi grow into roots where the plants supply them with the carbon (as sugar and fat) they need to survive. The fungi extend thin root-like threads called mycelia into the soil to make expansive networks that can access nutrients beyond the reach of plant roots.

But these hidden microbes do more than just help plants get nutrients. Plants are constantly dealing with insect pests and diseases, and have done for a long time. To deal with this, they evolved sophisticated defenses. AM fungi can dramatically enhance these defenses.

So could plants be picking their fungal allies based on their ability to enhance defenses against pests and diseases? We recently explored this question and proposed hypotheses around how this could happen. The answer could have huge implications for making agriculture more sustainable.

Harnessing the Ancient Alliance

Considering the benefits AM fungi can provide plants, it's no surprise there has been a lot of interest in using them in environmental management. Studies show AM fungi can have huge benefits for ecosystem restoration by supporting the establishment of native plant communities. Their importance to ecosystem function makes it clear mycorrhizal fungi should be included in conservation efforts.

In agricultural systems, fungi can increase crop growth, nutrient uptake, and yields. These benefits have been a major focus for researchers since the 1950s.

While there is ample evidence of the benefits AM fungi can provide for crops, results in the field are inconsistent. There can be a mismatch between the nutritional needs of the crops and the ability of the fungi that are present or introduced to the soil to meet those needs.

Do Plants Pick Their Fungal Partners for Defense?

Within the roots of a single plant, numerous fungal species can co-exist, forming complex communities. The species that make up these communities may each offer different capabilities—some are better at defense, while others are better at nutrient uptake. The benefit a plant gets from its fungal partners is, in part, determined by which species are present within its roots.

We can apply AM fungi to the soil but this doesn't mean these fungi will actually partner up with the plant.

So what determines which fungi gain entry to the roots? Do plants have a say in this? And, if so, how do they choose? These questions have long been on the minds of ecologists and biologists.

At the core of this relationship is a complex exchange system. Plants provide the fungi with carbon they need and the fungi provide benefits to the plants.

Research has shown a plant will play favorites (at least in some cases) with the fungi. They will partner up and give more carbon to the fungi that provide the most nutrients.

Yet there are significant challenges to exploiting these nutritional benefits in agriculture, where large inputs of nutrients are added to the soil. This can limit our ability to use the fungi in this way by removing plant reliance on the fungi for nutrients.

But can we exploit this partnership for plant defenses? Globally, insect pests consume up to 20 percent of the major grain crops alone.

Given that we know plants can play favorites, could they select their fungi to boost defense? We have developed hypotheses to try to better understand this question, to set the stage for future research.

CHINA REVEALS 2023 MUSHROOM POISONING DATA

Joe Whitworth

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According to recently published figures, mushroom poisoning remains a significant problem in China.

In 2023, the Chinese Center for Disease Control and Prevention (CDC) investigated 505 reports of mushroom poisoning, resulting in 1,303 patients and 16 deaths.

Incidents increased compared to 2022, but the number of patients was lower, according to the study published in the *China CDC Weekly* journal.

Mushroom poisoning in China is a significant food safety concern. Following an incident, CDC staff and hospital professionals collect mushroom specimens and photos, which are then sent to mycologists for identification. In parallel, toxin detection is performed on mushrooms and biological samples from patients, such as blood and urine.

Ninety-seven poisonous mushroom species, including 12 newly recorded ones, were identified, leading to six distinct clinical manifestations. This brings the cumulative number of species involved in poisoning incidents in China to 220.

Newly Discovered Dangers

The number of patients per incident ranged from 1 to 15, with an average of 2—only six involved more than ten patients. Among the cases, 23 patients from 11 incidents consumed poisonous mushrooms purchased from markets, while 23 patients from nine incidents were poisoned after eating dried mushrooms. Also, 217 patients and five deaths resulted from 70 incidents where individuals consumed mixed wild mushrooms either self-collected or purchased from markets.

Between May and October, 461 incidents, 1,207 patients, and 15 deaths were reported, with a peak in June. May had the most deaths, with seven. Hunan, Yunnan, Guizhou, Sichuan, and Hubei were the top affected regions.

A total of 97 species of poisonous mushrooms were identified in poisoning cases, leading to six clinical syndromes. Among these species, 12 were newly discovered as poisonous in China.

Collybia subtropica, *Russula brevispora*, *Russula flavescens*, and *Russula pseudojaponica* were newly described species in 2023. *Coprinopsis strossmayeri*, *Gymnopus dysodes*, and *Gymnopus similis* were three newly recorded poisonous varieties that caused gastroenteritis.

The most deadly mushroom was *Amanita fuligineoides* with seven deaths. *Amanita subpallidorosea* and *Russula subnigricans* both caused two deaths. *Chlorophyllum molybdites* was associated with the most poisonings, appearing in 150 incidents and affecting 303 patients. While some species caused acute liver or renal failure, others led to gastroenteritis or psycho-neurological disorders.

Scientists said in many incidents, no mushroom specimens or photos were obtained, making it challenging to confirm the species of poisonous mushrooms and provide targeted treatment for patients.

Example Incident

Another study published in the same journal reported on poisoning from a toxin in mushrooms. Wild mushrooms containing *Amanita* toxins induce gastrointestinal symptoms initially, which are followed by potentially life-threatening acute liver damage.

In September 2023, five people in Xingtai City, Hebei Province, fell sick. All experienced different levels of liver damage, but none died.

The patients were members of the same family and had symptoms including nausea, vomiting, abdominal pain, and diarrhea. They had a history of consuming self-forged wild mushrooms before the onset of symptoms. The group consisted of three males and two females, ages 34 to 45.

One patient, who had previous experience identifying and consuming wild mushrooms in Guizhou, said collected mushrooms were edible. Patients harvested the mushrooms themselves from a pine forest. They were later identified as *Amanita subjunquillea*. Health officials said the identification of toxic and nontoxic mushrooms should not solely rely on personal experience or appearance.

Local authorities initiated public education programs to raise awareness of the risks of consuming wild mushrooms and prohibited residents from foraging for and eating them.

VIRGINIA FIFTH-GRADER SHARES CANDY INFUSED WITH "MAGIC MUSHROOMS" WITH CLASSMATES

Nour Habib

https://www.pilotonline.com/, Feb. 20, 2024

HAMPTON, VA - A fifth-grade student at the George P. Phenix PreK-8 School shared psilocybin-infused candy with 10 classmates last week.

The incident happened at the end of the school day Wednesday and again on Thursday, a division spokesperson said. A parent contacted the school Thursday evening, and the school administration began an investigation.

School officials said four of the 10 students who were given the candy, known as Mr. Mushies, consumed it. School officials personally contacted the parents of students involved, and the principal sent an email to all families Friday afternoon. Psilocybin is a psychedelic found in "magic mushrooms." Mr. Mushies is a product that can be bought online. There are no reports of children at Phenix getting sick after eating it.

The school resource officer facilitated the testing of the candy.

In her email to parents, Phenix Principal Robin Hunt-Crenshaw said safety is a top priority and asked families to emphasize to children the serious repercussions of bringing prohibited items to school. "Furthermore, we believe it's crucial to stress to your child the importance of refraining from accepting or consuming items whose contents they are unfamiliar with, to include items that look like candy," Hunt-Crenshaw wrote.