PROMOTING WORLD-WIDE PLANT HEALTH AND FOOD SECURITY

INTERNATIONAL SOCIETY FOR PLANT PATHOLOGY

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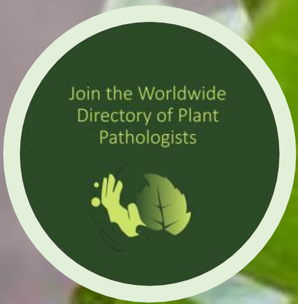
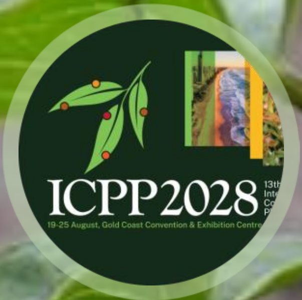
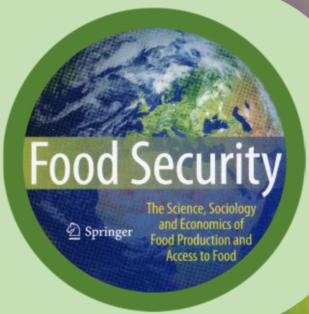


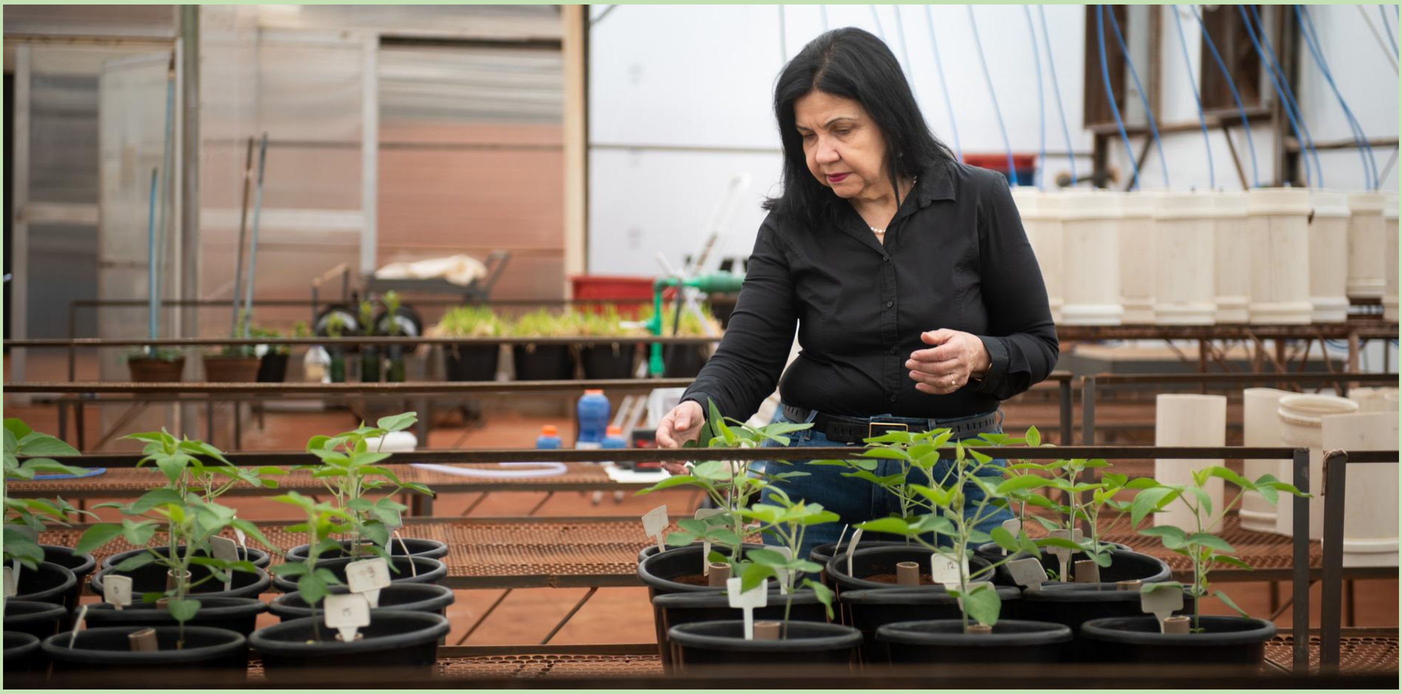




IN THIS ISSUE:

2025 World Food Prize goes to Mariangela Hungria

WORLD FOOD PRIZE FOUNDATION, NEWS



Dr. Mariangela Hungria will receive the 2025 World Food Prize for her extraordinary scientific advancements in biological nitrogen fixation, transforming the sustainability of soil health and crop nutrition for tropical agriculture. The low-cost technologies and products that she has developed have increased crop productivity affordably and sustainably across tens of millions of hectares. By harnessing symbiotic soil microorganisms as an effective alternative to synthetic fertilisers, she has not only improved plant nutrient uptake but also enabled farmers to save billions of dollars while mitigating environmental risks associated with pollution and emissions, producing more with less.

Biography

Hungria entered college in the late 1970s to study microbiology, at a time when soil science was overwhelmingly focused on the use of chemical fertilisers to recover and maintain soil fertility and soil microbiology was considered of minor importance. Her persistence, dedication and scientific rigor throughout her career greatly elevated the importance of soil microbes in the agriculture sector and demonstrated to farmers and scientists that soil fertility should be built with life, not just with chemicals.

"The 1970s had witnessed the significant Green Revolution led by Norman Borlaug, which dramatically increased agricultural production through the intensive use of chemical fertilisers, particularly nitrogen-based ones," said Hungria. "However, I was already working on a different strategy using microorganisms as biofertilisers, envisioning that they could drive a Micro Green Revolution, enhancing agricultural productivity with environmental responsibility."

Nitrogen is an essential nutrient for plant growth and production which is often supplied in agriculture by chemical fertilisers. However, chemical nitrogen fertiliser overuse often results in higher emissions and water pollution with nitrates. Hungria's research principally focused on biological nitrogen fixation, a process by which naturally occurring microorganisms interact with plants to fix nitrogen from the air into the soil, where it can then be taken up by plant roots.

Hungria saw an opportunity to use bacteria to supply nitrogen, which would mitigate the environmental impact of agriculture and allow farmers to reduce their reliance on costly, imported fertilisers. Over decades of research and development at Embrapa Soja, the National Soybean Center of Brazil, Hungria built her field of study from the ground up. She isolated strains of bacteria and tested them for their potential to promote plant growth. She led the development of more than 30 technologies related to microorganisms, including many microbial inoculants, products containing beneficial bacteria that are applied to seeds or soils, for soybeans, common beans, maize, wheat, rice, pasture grasses and other major crops.

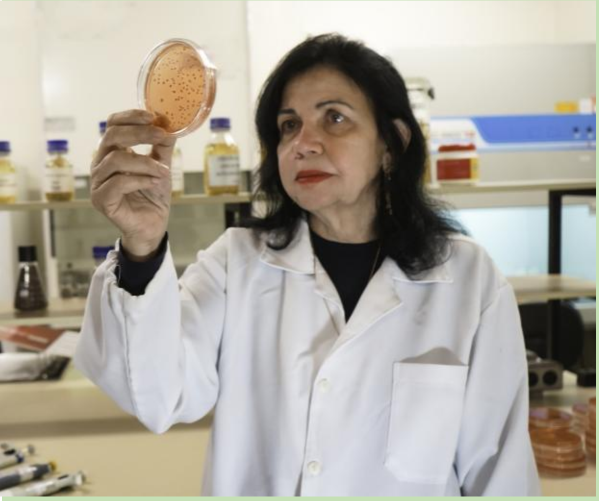
As a field researcher, she worked with farmers to learn what they needed and teach them the uses and economic and environmental benefits of bacteria for crop growth. As a microbiology professor, she trained and mentored young researchers, many of them women. As a science communicator, she published more than 500 scientific articles, technical manuals, books and book chapters.

Hungria's work has contributed significantly to making Brazil the global leader in the commercial use of biological inoculants. The technologies she and her research group developed have been adopted worldwide, including on more than 40 million hectares in Brazil. These innovations have saved Brazilian farmers around $25 billion per year in input costs, prevented the release of 230 million metric tons of CO_2-equivalent emissions, and boosted yields beyond what is possible with synthetic nitrogen fertilizer alone. This achievement, along with other scientific advances, has propelled Brazil to become the world's leading soybean producer and exporter—laying the foundation for the country's agricultural and economic growth over the past several decades.

"For many years—years in which I built my career—the prevailing concept was to produce food to end world hunger. The focus was solely on producing more and more. However, contrary to the dominant thinking at the time, I always worked with the concept of producing food sustainably, which is finally gaining greater credibility each year. Today, there is a growing global demand for increased food production and quality, but with sustainability—reducing soil and water pollution and lowering greenhouse gas emissions," Hungria said.

RESEARCHING RHIZOBIA

While earning her doctorate at the Federal Rural University of Rio de Janeiro, Hungria studied under her mentor, Dr. Johanna Döbereiner, an influential initial proponent of using microorganisms in tropical agriculture. With the skills she learned from Döbereiner, Hungria settled in Londrina in Paraná state to start a new soil microbiology laboratory at the Embrapa National Soybean Center in 1991.



At the time, almost no research existed on using biological nitrogen fixation to produce soybeans in the tropics, so Hungria built her ambitious research program from scratch. She first concentrated on selecting elite strains of rhizobia, a type of symbiotic bacteria that forms nitrogen-fixing nodules on the roots of legumes like soybeans and common beans. She then monitored the effects of introducing these strains to plants (called inoculation) on enhancing crop yield, tested and verified the effects of environmental stresses on the inoculants' performance, and selected plant genotypes with a better response to microorganisms. She took a "basic to applied" approach to soil microbiology, starting with studies on bacteria evolution all the way through to the development of microbial inoculants for farmers' use.

Existing research in the U.S., Australia and Europe had shown that a single inoculation in soybeans did not result in the hoped-for yields equal to those reaped with chemical fertilizer. Hungria, always determined, did not stop there with her experiments. She showed that inoculating soybeans each growing season ensured ready availability of the beneficial bacteria in the soil. Reinoculation each season finally succeeded in producing an eight percent growth in yield over conventional chemical inputs.

In the spirit of Norman Borlaug's "take it to the farmer" philosophy and vision, Hungria spent as much time in the field working with farmers as she did in the lab advancing her scientific research. She participated in field days, led training during extension activities and wrote technical pamphlets. In 1994, she wrote the first Portuguese-language manual for tropical soil microbiology methods. This manual and others she wrote helped industrial manufacturers implement methodologies and protocols for inoculant production.

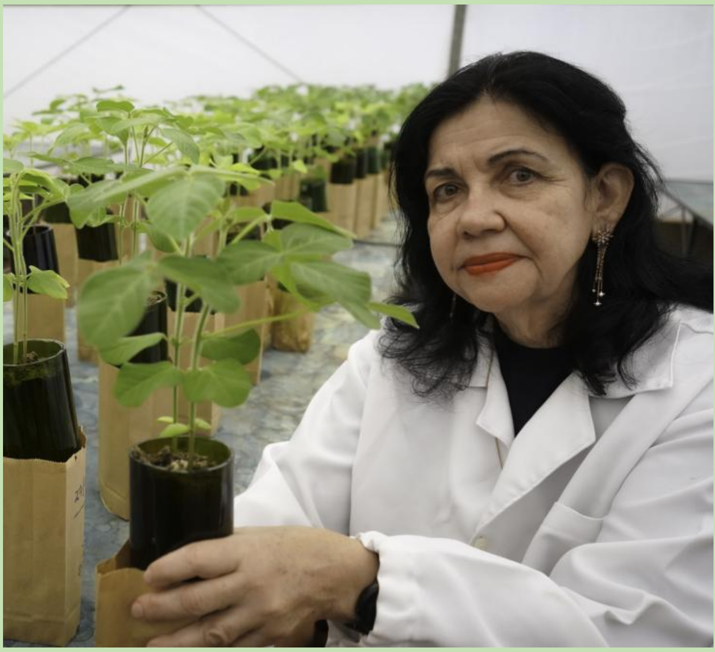
"As a professional, I learned to do science for the farmer—applying scientific concepts to investigate and solve real-world agricultural problems. A participatory science, where I would go to the farmers to understand their challenges and expectations, then return to the laboratory to find solutions," Hungria said. "Later, I would present these solutions, invest heavily in disseminating and popularizing the technologies, and monitor their outcomes. This combination of "basic to applied science" became the defining feature of the research group I started to build—one that spans from genome to field, from microorganism selection to bio-inputs on the shelf."

Hungria's diligent scientific research and open communication with farmers and industry resulted in a quick uptake of microbial inoculation among soybean producers. Today, this technology is used annually on 85 percent of Brazil's total cultivated area of soybeans, more than 30 million hectares—the highest inoculation adoption rate in the world.

In addition to having a beneficial environmental effect, this has significantly reduced farmers' costs. Farmers may use 30-50 kilograms of synthetic fertilizer per hectare at a cost of about US$1 per kilogram. By contrast, farmers spend as little as US$2-3 per hectare on the bacteria inoculant, which can supply the complete nitrogen needs of the crop.

APPLYING AZOSPIRILLUM

The increasing success of inoculation in soybeans had farmers requesting microbial inputs for other crops as well. In response to this need, Hungria incorporated a new line of research on bacteria for non-leguminous crops. Her research identified promising strains of the bacterium *Azospirillum brasilense*, which fixes nitrogen and produces phytohormones which promote plant growth.



These studies led to the release of the first commercial strains of *A. brasilense* which were used to formulate biological inoculants to promote the growth of maize, wheat and rice. Today, this inoculant has been adopted on more than 14 million hectares of maize. She also created the first inoculant for grass pastures, which has the potential to restore existing pastures to health for better, more efficient cattle production, reducing the pressure to clear more land for agricultural use.

Her work also resulted in the first products to be released in Brazil that used a combination of microorganisms to promote plant growth. She paired nitrogen-fixing rhizobia with growth-promoting *A. brasilense* to double the yield increase for soybeans and common beans. The combination had a major impact on root development, improving water and nutrient absorption and increasing drought tolerance.

Hungria developed a unique method to validate the effectiveness of co-inoculation of rhizobia and *A. brasilense* with smallholder farmers, who cultivate soybean on less than 50 hectares and represent the majority of soybean producers in Brazil. Involving more than 3,000 farmers in a five-year study, her team confirmed that farmers using the co-inoculation made an additional profit of US$111.50 per hectare each season. They also mitigated an estimated 350 kg of CO_2-equivalent per hectare from the increased production and the reduced use of chemical nitrogen fertilisers.

Today, more than 70 million doses of inoculants carrying rhizobia and A. brasilense are sold in Brazil each year. The combination is used on more than 35 percent of Brazil's cultivated area of soybeans, about 16 million hectares.

MAKING OF A MICROBIOLOGIST

Hungria knew from a young age that she wanted to be a soil microbiologist. Her grandmother, a high school science teacher, nurtured Hungria's interests by helping her conduct science experiments, studying insects and observing the effects of photosynthesis in the backyard. Her grandfather took her on trips out of town and showed her fields growing different types of crops.

"When I was eight, my grandmother gave me the book Microbe Hunters by Paul de Kruif, about the lives of microbiologists," Hungria said. "I spent the night reading in fascination. By morning, I had no doubts about what I wanted to do for the rest of my life. I wanted to be a microbiologist, but not in the medical field—it had to be about soil and plants. My fascination with agriculture was already within me."

Graduating high school at the top of her class, she proudly declared that she wanted to go to college to study agronomy. This was an unusual choice—the other students in biology had all opted to go into the more prestigious medical field, and agronomy was a very male-dominated career path. Though her teachers tried to convince her otherwise, Hungria was not to be deterred in her passion for agriculture, and she enrolled in the Luiz de Queiroz College of Agriculture at the University of São Paulo.

During her undergraduate studies, she became a mother to two daughters, and for a time, it seemed that her ambition to become a soil microbiologist would be derailed. Many people told her that she would have to drop out of school, or that she could not have a successful career and also be a mother, especially as one of her daughters had special medical needs. Her grandmother, her first mentor, supported her in being both a mother and an agronomist, which gave Hungria the strength and conviction to carry on toward her dream and to support others, especially women, in shaping their professional and personal lives. She graduated third in her class with her bachelor's degree.

Hungria's excellent work and passion for science throughout earning her bachelor's and master's degrees attracted the attention of Dr. Johanna Döbereiner, a pioneer in agricultural microbiology. Döbereiner invited Hungria to do her Ph.D. at the Federal Rural University of Rio de Janeiro and the Embrapa National Center of Agrobiology.

Though recognition of Hungria's work was growing among Brazilian scientists, she realised that she needed international experience, so she traveled to the U.S. to complete postdoctoral studies at Cornell University and University of California-Davis. Her experience in the U.S. provided her with the scientific training to develop international projects and contacts with laboratories in other countries, allowing her to advance in cutting-edge research.

Though she received offers to stay in the U.S., Hungria always intended to return to Brazil because she knew there was so much more that could be done there with soil microorganisms to support sustainable food production. Instead of returning to the Embrapa Center for Agrobiology, she transferred to Embrapa's National Soybean Center in Londrina, where she had better access to medical care and education for her children and could live closer to her grandparents. Though this meant that she would have to build a new laboratory and start her research from scratch, she was more than ready for the challenge.

Hungria's brilliant scientific work, commitment to sustainable crop production and microbiological innovations have gained her global recognition as a transformative agricultural development scientist both at home and abroad. She has been invited to head project committees on almost every continent. She was the only microbiologist on the steering committee for the 10 years of the Gates Foundation-funded N2Africa project. She received the TWAS-Lenovo Science Award and was named a Commander of the National Order of Scientific Merit by President Lula. She was also inducted into the Brazilian Academy of Sciences and the The World Academy of Sciences, and was elected the first woman president of the Brazilian Society of Soil Science. She has written over 380 scientific articles and was listed among the 100,000 most influential researchers in the world by Stanford University.

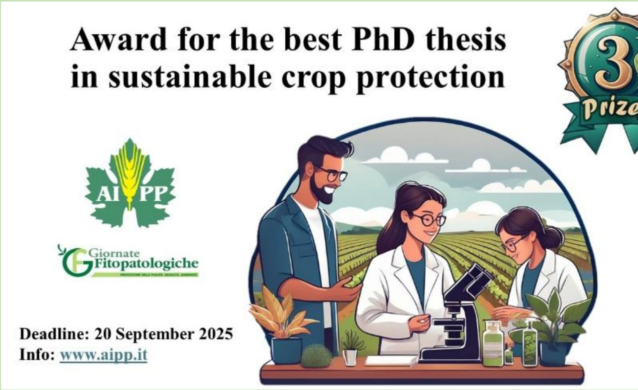
She has been a staunch advocate and mentor for women scientists, lifting up other women in agriculture. As a professor at the State University of Londrina, she supervised more than 200 students, most of them women, guiding them in their professional careers in agricultural science. With authenticity and compassion, she shares her dual journey as a scientist and mother to encourage others who face similar difficulties to thrive in the complexities of both roles and has become an advocate for parents of children with special needs at Embrapa.

"It was a surprise—by sharing my experience of being a young mother, a mother of a child with special needs, and succeeding in science, I began receiving dozens of emails and messages from women saying that they now felt confident to move forward," Hungria said. "I have found that by sharing my story, I inspire and give confidence to women (and men) to keep going, even in the face of challenges. My family strengthens me and my work strengthens my love and care for my family. To live, to breathe, I need both—family and science."

In a time of immense pressure to produce more food with less resources and lower environmental impact, Hungria's work on the use of microorganisms towards achieving regenerative agriculture uplifts and reinforces sustainable production, eco-innovation, re-carbonisation, One Health, and above all, food security.

PHD AWARD ON SUSTAINABLE CROP PROTECTION

The Italian Association for Plant Protection (AIPP), in collaboration with Giornate Fitopatologiche (GF), is pleased to announce the **AIPP–GF PhD Award 2025**. As part of its commitment to supporting young researchers and promoting innovation in plant protection, AIPP is offering three awards of €1,000 each for outstanding PhD theses.



The award is open to PhD graduates of any nationality who are 35 years old or younger and who have been awarded their thesis within the last two years (since October 2023). Eligible research must contribute to advancing sustainable plant protection against diseases and pests.

All submitted theses will be evaluated by experts in the field. The results will be announced during a dedicated webinar in December 2025, where the three winners will be notified in real time and invited to present their work. The exact date of the webinar will be published on the AIPP website (www.aipp.it).

Applications are available on the AIPP website under AIPP – GF PhD Award 2025 – AIPP.
For further information, interested candidates can contact premio.dottorato.aipp@gmail.com.

FROM HERBARIUM TO LIFE: REVIVING 80-YEAR-OLD FUNGI OFFERS NEW CLUES FOR SUSTAINABLE AGRICULTURE

THE HEBREW UNIVESITY OF JERUSALEM, 31 JULY 2025

In a significant scientific milestone, researchers at the Hebrew University of Jerusalem have successfully revived fungal specimens collected over 80 years ago, offering an fresh glimpse into how industrial agriculture has altered the invisible ecosystems that support global food production.

A study published in *iScience*, led by Dr. Dagan Sade and supervised by Professor Gila Kahila, involved researchers from the Hebrew University, Tel Aviv University, Ben-Gurion University, and the Ministry of Agriculture and Rural Development. The research focused on *Botrytis cinerea*, a widespread plant pathogen responsible for gray mold disease in over 200 crop species, causing billions of dollars in agricultural losses annually and threatening food security, trade, and environmental health.

But what happens when we revive fungi from an era before synthetic fertilisers and fungicides, before the Green Revolution fundamentally transformed how we grow food?

To find out, the team revived two strains of *B. cinerea* curated at the National Natural History Collection of the Hebrew University since the early 1940s, decades before modern agrochemicals became standard in farming. These historical specimens were carefully reanimated and subjected to cutting-edge analyses, including whole-genome sequencing, transcriptomics (gene expression profiling), and metabolomics (chemical fingerprinting).

The findings were striking: the historical strains showed significant genetic and behavioral differences compared to modern lab strains of the same fungus. In particular, they revealed:

- Reduced signs of fungicide resistance, a feature that has become prominent in modern strains due to heavy chemical use;
- Differences in pathogenicity, with some traits suggesting the historical fungi were less specialized and aggressive than their contemporary counterparts;
- Adaptations to different environmental conditions, including pH tolerance and host specificity.

"These fungi have been quietly evolving in response to everything we've done in agriculture over the past 80 years," said the researchers. "By comparing ancient and modern strains, we can measure the biological cost of human intervention—and learn how to do better."

A WINDOW INTO THE AGRICULTURAL PAST AND FUTURE

The research has wide-ranging implications. In the era of climate change, pesticide overuse, and declining soil health, understanding how plant pathogens adapt to human activity is key to developing sustainable farming systems. Reviving historical microorganisms provides a baseline for this understanding—a way to distinguish between natural evolutionary changes and those driven by anthropogenic pressures.

"Natural history collections have always been valuable for taxonomy and museum science," said the researchers. "But this work shows they are also dynamic resources for modern biology. They allow us to 'rewind' microbial evolution and anticipate future trends in plant disease."

The study also contributes to global efforts to predict and manage plant disease outbreaks. By revealing how pathogens adapted to previous environmental shifts, scientists can better model future risks and design resilient crop protection strategies, potentially reducing reliance on chemical treatments that harm ecosystems and accelerate resistance.

Reviving More Than Specimens

The success of this project speaks to a broader scientific movement: turning biological archives into tools for addressing 21st century challenges. Whether it's climate change, antibiotic resistance, or declining biodiversity, many of today's most pressing problems require historical context to solve.

"This work is a perfect example of how past and future can intersect through science," said the researchers. "We brought something back to life not for nostalgia, but to help build a more sustainable agricultural system."

The project was conducted in collaboration with genomic, microbiology, and metabolomics experts. The team hopes the findings will encourage other institutions to reassess the hidden power of their biological collections and push for more interdisciplinary approaches to solving global food and environmental crises.

Phytopathogenic Fungi Collection of the National Herbarium at the NNHC-HUJI (Photo credits: Dagan Sade).

AI-POWERED PLANT IMMUNITY COULD PROTECT CROPS FROM BACTERIAL DISEASES

AMY QUINTON, UC DAVIS NEWS, 28 JULY 2025

Scientists at the University of California, Davis, used artificial intelligence (AI) to help plants recognise a wider range of bacterial threats which may lead to new ways to protect crops like tomatoes and potatoes from devastating diseases. The study was published in *Nature Plants*.

Plants, like animals, have immune systems. Part of their defense toolkit includes immune receptors, which give them the ability to detect bacteria and defend against it. One of those receptors, called FLS2, helps plants recognise flagellin, a protein in the tiny tails bacteria use to swim. But bacteria are sneaky and constantly evolving to avoid detection.

"Bacteria are in an arms race with their plant hosts, and they can change the underlying amino acids in flagellin to evade detection," said lead author Gitta Coaker, professor in the Department of Plant Pathology.

To help plants keep up, Coaker's team turned to using natural variation coupled with AI, specifically AlphaFold, a tool developed to predict the 3D shape of proteins and reengineered FLS2, essentially upgrading its immune system to catch more intruders.

The team focused on receptors already known to recognise more bacteria, even if they weren't found in useful crop species. By comparing them with more narrowly focused receptors, the researchers were able to identify which amino acids to change.

"We were able to resurrect a defeated receptor, one where the pathogen has won, and enable the plant to have a chance to resist infection in a much more targeted and precise way," Coaker said.

WHY IT MATTERS

Coaker said this opens the door to developing broad-spectrum disease resistance in crops using predictive design.

One of the researchers' targets is a major crop threat: *Ralstonia solanacearum*, the cause of bacterial wilt. Some strains of the soil-borne pathogen can infect more than 200 plant species, including staple crops like tomato and potato.

Looking ahead, the team is developing machine learning tools to predict which immune receptors are worth editing in the future. They're also trying to narrow down the number of amino acids that need to be changed.

This approach could be used to boost the perception capability of other immune receptors using a similar strategy.

ENDOPHYTIC FUNGI AS BIOCONTROL AGENTS: A METABOLITE-DRIVEN APPROACH TO CROP PROTECTION AND SUSTAINABLE AGRICULTURE

A review by Muhammad Faiq *et al.* titled "Endophytic fungi as biocontrol agents: A metabolite-driven approach to crop protection and sustainable agriculture" was published in November 2025 by *Physiological and Molecular Plant Pathology* (vol. 140, article number 102857). The abstract is as follows:-

The growing concerns over pesticide resistance, environmental pollution, and crop losses have increased the demand for sustainable and eco-friendly alternatives to chemical crop protection. Endophytic fungi, symbiotic microorganisms residing within plant tissues have emerged as promising biological control agents due to their ability to produce diverse bioactive secondary metabolites (SMs). These compounds, including alkaloids, terpenoids, polyketides, and peptides, exhibit potent antifungal, antibacterial, and insecticidal activities. This review consolidates current knowledge on the taxonomy, ecology, and colonization strategies of endophytic fungi, as well as their habitat-driven functional diversity. We explore the biosynthetic mechanisms underlying metabolite production, with an emphasis on the role of biosynthetic gene clusters (BGCs) in driving chemical diversity. Key classes of fungal metabolites are summarized based on their structure, biological activities, and role in plant protection. The review also discusses both direct and indirect mechanism through which endophytic fungi enhance plant immunity, including, competitive exclusion, antimicrobial compound production, defense responses activation, phosphate solubilization, siderophore production, and phytohormone modulations. Additionally, the significance of these endophytes in climate-resilient agriculture and post-harvest disease management is addressed. Despite promising advances, challenges such as inconsistent colonization, environmental variability, and regulatory barriers hinder their widespread application. This review aims to provide a comprehensive understanding of fungal endophyte-derived secondary metabolites as viable tools for sustainable crop protection and improved agricultural resilience.

Read paper.

21ST REINHARDSBRUNN SYMPOSIUM 2026 – MODERN FUNGICIDES AND ANTIFUNGAL COMPOUNDS

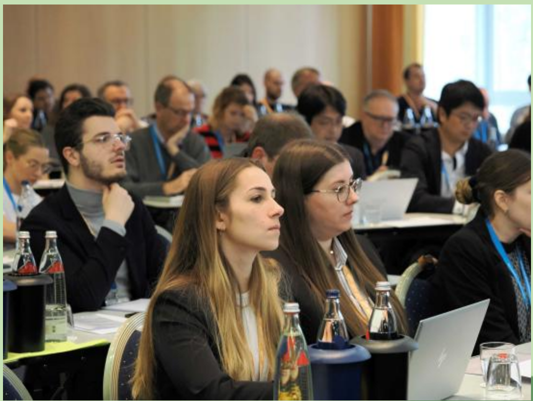
NOEMI MEßMER

The Reinhardsbrunn Symposium 2026 will take place from 19 to 23 April 2026 in Friedrichroda, Germany, once again bringing together international experts from research, industry, and advisory services. Under the theme “"Modern Fungicides and Antifungal Compounds,” this long-established conference offers a high-level platform for discussing current developments in fungicide research. Key topics include resistance management, new classes of active ingredients, biological control strategies, molecular approaches, and regulatory frameworks.

For over 55 years, the Reinhardsbrunn Symposium has been recognised as one of the most important international forums for dialogue in the field of crop protection, attracting participants from universities, research institutions, regulatory bodies, and companies. What sets the symposium apart is its unique blend of scientific excellence and a collegial atmosphere that fosters both in-depth academic exchange and personal interaction, often sparking new collaborations.

The event will be held at the H+ Hotel Friedrichroda, near the historic Reinhardsbrunn Castle, beautifully situated in the Thuringian Forest and equipped with modern conference facilities. Early-career scientists and established researchers alike will have the opportunity to present their work and engage with peers from around the world.

The conference language is English, and abstract submissions for oral and poster presentations are highly encouraged. The deadline for submissions is 1st December 2025. Anyone interested in the future of plant protection and in shaping innovative developments in fungicide research should save the date—Reinhardsbrunn Symposium 2026 promises to be a scientific highlight with lasting impact.



When: 19-23 April 2026

Where: Friedrichroda, Germany

Who: Fungicide experts from agriculture, research, consulting, and industry from around the world. Ideal for established researchers and young scientists alike – establish valuable contacts with the next generation of fungicide experts.

Highlights: Keynote talks, Excursion to Erfurt, Inspiring conversations during coffee breaks, evening events, and in the nearby castle park

Deadlines:

- Registration with contribution, 1st December 2025
- Registration without contribution. 10th February 2026

More information: https://reinhardsbrunn-symposium.de/de/

FIRST-EVER MAPPING OF SOIL PATHOGENS OFFERS HOPE FOR ETHIOPIAN FARMERS

THE UNIVERSITY OF WESTERN AUSTRALIA NEWS, 23 JULY 2025

An international study has identified the mix of soilborne pathogens behind root diseases in Ethiopia's faba bean crops, marking a step forward in the fight for food security.

Researchers discovered the scale and diversity of root rot disease affecting Ethiopia's most important legume crop, which provides a roadmap for managing this agricultural challenge.

Led by the Ethiopian Institute of Agricultural Research, researchers from The University of Western Australia's School of Agriculture and Environment, UWA Institute of Agriculture, the Tamworth Agricultural Institute, the South Australian Research and Development Institute, and the International Center for Agricultural Research in the Dry Areas in Morocco collaborated on the study published in *Pathogens*.

Soilborne diseases are a leading cause of crop loss in Ethiopian faba bean production, with farmers losing between 45 per cent and 70 per cent of their harvest to root rot each season.

Researchers assessed root disease and collected soil samples from 150 faba bean fields across seven major growing regions that were analysed using advanced DNA testing to identify and quantify 29 different pests and pathogens.

The study revealed widespread pathogens including some reported for the first time in Ethiopia. In addition to root rot pathogens, the study found high levels of foliar diseases as well as the root-lesion nematode, which is a serious threat to plant health.

Professor Martin Barbetti, from UWA's School of Agriculture and Environment and The UWA Institute of Agriculture said efforts to identify the cause of root disease in faba bean have relied heavily on traditional observation and culture methods, which often missed or misidentified pathogens.

"This research used modern molecular tools to deliver a clear picture of which pathogens are present and how they occur in combinations that make diseases harder to treat," Professor Barbetti said.

"The ability to reliably and accurately define the pathogens involved in soilborne disease complexes is foundational to being able to predict and manage them."

The research confirms chemical treatments such as fungicides are unlikely to be effective when multiple pathogens coexist in the soil.

The findings call for integrated disease management approaches including screening for resistant and tolerant faba bean varieties and tailored farming practices adapted to local soil and environmental conditions.

The research was supported by the Australian Government through Australian Centre for International Agricultural Research (ACIAR).

UNUSAL GENE DUO IN WILD WHEAT OFFERS HOPE AGAINST CROP DISEASES

ERIN MATTHEWS, UNIVERSITY OF SASKATCHEWAN RESEARCH NEWS, 11 JUNE 2025

Dr. Valentyna Klymiuk (PhD), a research officer at USask's Crop Development Centre (CDC), is studying wild wheat varieties that carry resistance to these harmful pathogens. (Photo: Chris Hendrickson)

To get ahead of these pathogens, University of Saskatchewan (USask) researchers like Dr. Valentyna Klymiuk (PhD) and Dr. Curtis Pozniak (PhD) are studying wild wheat varieties that carry resistance to these harmful pathogens. This led them to discover something they've never encountered before, a unique pair of genes that work together to protect against disease.

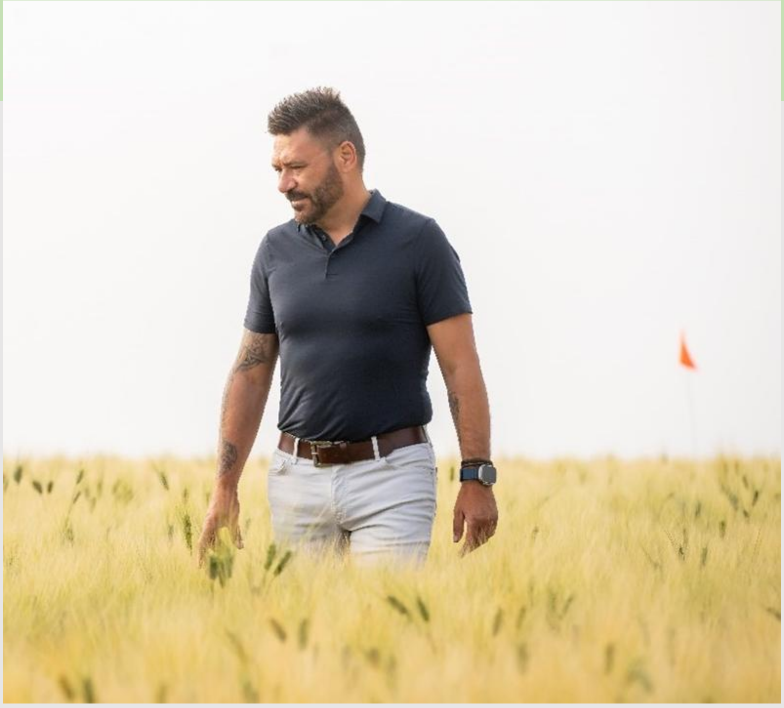
To support its variety development program, USask's Crop Development Centre (CDC) has been diving back into the gene pool of wheat and screening its wild relatives for useful traits that can be effectively deployed in new wheat cultivars. Wild wheat has not been domesticated, so it cannot be used directly in breeding, but it contains useful diversity to respond to environmental threats. This makes it ideal for learning new methods of crop resistance.

Research at the CDC focuses on improving crop varieties. By integrating basic research into crop breeding, the CDC translates scientific discoveries into new high yielding varieties that can be used by growers.

"Part of our research is keeping one step ahead of pathogens by identifying new resistance genes which ideally could be stacked, like Lego blocks, so the pathogen can't easily overcome the resistance," said Klymiuk.

Looking deeper into a wild strain of wheat, Klymiuk and Pozniak found that it demonstrated significant resistance to stripe rust, a type of fungal infection that is one of the top five diseases of concern for producers. Klymiuk and Pozniak soon realized that the resistance they identified in this wild strain was behaving differently than expected. Their findings were recently published in Nature Genetics.

"Once we started assessing the resistance, we could see that it was different to others that we have studied before. The resistance was acting in an atypical way, which signalled a very different plant response," said Pozniak, professor and director of the CDC at USask. "We were quite intrigued about what was really going on."



As director of the CDC, Dr. Curtis Pozniak (PhD) leads the variety development program. By integrating basic research into crop breeding, the CDC translates scientific discoveries into new high yielding varieties that can be used by growers. (Photo: Chris Hendrickson)

Klymiuk, a research officer in Pozniak's program, said that typically one gene is responsible for the expression of a stripe rust, but in the case of this wild wheat, they determined that two genes working together as a pair were required for full resistance. One gene is responsible for sensing the invading pathogen while the other activates the immune response of the plant to stop the pathogen in its tracks.

To confirm which genes were responsible for resistance, Klymiuk's experiments turned each of the genes "off" like flipping the breaker to see which room of the house goes dark. When the gene is switched "off" the plant can no longer protect itself and becomes susceptible to the pathogen. However, this unique gene pair proved to be a bit of an anomaly, which caused a hiccup in the researcher's results.

"Initially, we thought only a single gene was responsible. Most of our results made sense but there were a few plants that didn't give us the expected results. This was a head scratcher, so we went back to rethink our experiments and to test if two genes were actually involved. Once we retested, the results became clear," said Klymiuk.

The team dug deeper and found that the two outlier genes interact at a protein level, physically coming together to initiate the resistance response.

"A lot of the time when things don't line up the temptation is to move forward, but we really dug into the weeds to figure out what was going on and that's when we realized that the genes were communicating and working together and that's what's really new," said Pozniak. "If we had given up after the first set of experiments, we never would have concluded that two genes coming together was needed for resistance. It's a great science story."

Identifying complex gene interactions that offer greater resistance, like the ones published in this most recent paper, are crucial in the continued battle against crop disease. Because of the genes' odd behaviour, Klymuik developed a DNA test to ensure the pair of genes are present in new plants. With this DNA test, these genes can be used routinely in the breeding program.

These discoveries allow the CDC to add robust tools to their genetic tool kit, helping to produce stronger and more resilient varieties of wheat for many years to come.

"The interconnectivity of research and breeding lets us keep the eye on the prize and develop the most productive varieties for farmers. This project also really helps us understand and appreciate the complexity of plant biology. Plants really need to adapt, and they do it in cool and interesting ways," said Pozniak.

FUNCTIONAL TEAM SELECTION AS A FRAMEWORK FOR LOCAL ADAPTATION IN PLANTS AND THEIR BELOWGROUND MICROBIOMES

A review by Nancy Collins Johnson and César Marín titled "Functional team selection as a framework for local adaptation in plants and their belowground microbiomes" was published on 2 July 2025 by *The ISME Journal* (wraf137). The abstract is as follows:-

Multicellular organisms are hosts to diverse communities of smaller organisms known as microbiomes. Plants have distinctive microbiomes that can provide important functions related to nutrition, defense, and stress tolerance. Empirical studies provide convincing evidence that in some -but not all - circumstances, belowground microbiomes help plants adapt to their local environment. The purpose of this review is to develop functional team selection (FTS) as a framework to help predict the conditions necessary for root microbiomes to generate local adaptation for their plant hosts. FTS envisions plants and their microbiomes as complex adaptive systems, and plant adaptations as emergent properties of these systems. If plants have the capacity to recognize and cultivate beneficial microbes and suppress pathogens, then it is possible for plants to evolve the capacity to gain adaptations by curating their microbiome. In resource-limited and stressful environments, the emergent functions of complex microbial systems may contribute to positive feedback linked to plant vigor, and ultimately, local adaptation. The key factors in this process are: 1) selective force, 2) host constitution, 3) microbial diversity, and 4) time. There is increasing interest in harnessing beneficial microbial interactions in agriculture and many microbial growth-promoting products are commercially available, but their use is controversial because a large proportion of these products fail to consistently enhance plant growth. The FTS framework may help direct the development of durable plant-microbiome systems that enhance crop production and diminish pathogens. It may also provide valuable insights for understanding and managing other kinds of host-microbe systems.

Read paper.

CURRENT VACANCIES

Lecturer / Senior Lecturer in Plant Pathology, The University of Sydney

The School of Life and Environmental Sciences (SOLES) at The University of Sydney is seeking to appoint a Lecturer or Senior Lecturer in Plant Pathology to be based at the Camperdown or Camden Campus. The University of Sydney has world-class strengths in both basic and translational plant science including plant pathology, breeding and genetics, agronomy, molecular biology, developmental biology, plant physiology and digital agriculture; augmented by outstanding soil and environmental science. There are two world-class research groups closely associated with the school, the Sydney Institute of Agriculture and the Plant Breeding Institute.

The successful applicant will bring expertise in plant pathology including pathogen diversity and biology, diagnostics, epidemiology, biosecurity and disease management with a focus on horticulture, crops, or environmental sustainability and resilience. They will have a track record of success in teaching, research and publication commensurate with an early/mid-career scientist on a rising trajectory.

The successful applicant will have research interests that complement and/or enrich the existing strengths and expertise in the school in the general area of plant sciences. They should have a track-record of successful collaboration nationally and internationally and articulate a vision for innovative collaborations within SOLES, across the University of Sydney and beyond.

The University places emphasis on research excellence and research with impact; inter-disciplinary research is encouraged. SOLES has a program of undergraduate teaching in agriculture from first year to Honours/Masters level and the successful applicant will be expected to contribute across this teaching in Camperdown and Narrabri, in addition to being actively involved in postgraduate training. The successful applicant will also be expected to participate in management and administration and should be able to demonstrate a strong commitment to the promotion of teaching and learning.This is an 11-month appointment for the first three years, then a 9-month appointment thereafter. The candidate may supplement their salary for the additional month(s).

Deadline: Application close Sunday 10 August 2025.

More information on job and submit application.

ACKNOWLEDGEMENTS

Thanks to Grahame Jackson, Greg Johnson, Noemi Meßmer, and Gianfranco Romanazzi for contributions.

COMING EVENTS

Plant Health 2025
2 August – 5 August, 2025
Honolulu, Hawaii
Website:
www.apsnet.org/meetings/annual/PH2025/Pages/default.aspx

Plant Pathology 2025
9 September – 11 September, 2025
Nottingham, UK
Contact and email: Richard Oliver
meetings@bspp.org.uk
Website: www.bspp.org.uk/conference-info-plant-pathology-2025-ppath2025-and-early-careers-plant-pathology-2025-ecpp2025/

Conference of the IOBC/WPRS Working Group "Integrated Protection in Viticulture"
13 October – 15 October, 2025
Mikulov, Czech Republic
Website: event.fourwaves.com/ipvc/pages

14th Arab Congress of Plant Protection Sciences
3 November – 7 November, 2025
Algeria city, Algeria
Contact and Email: info@acpp-aspp.com
Website: acpp-aspp.com

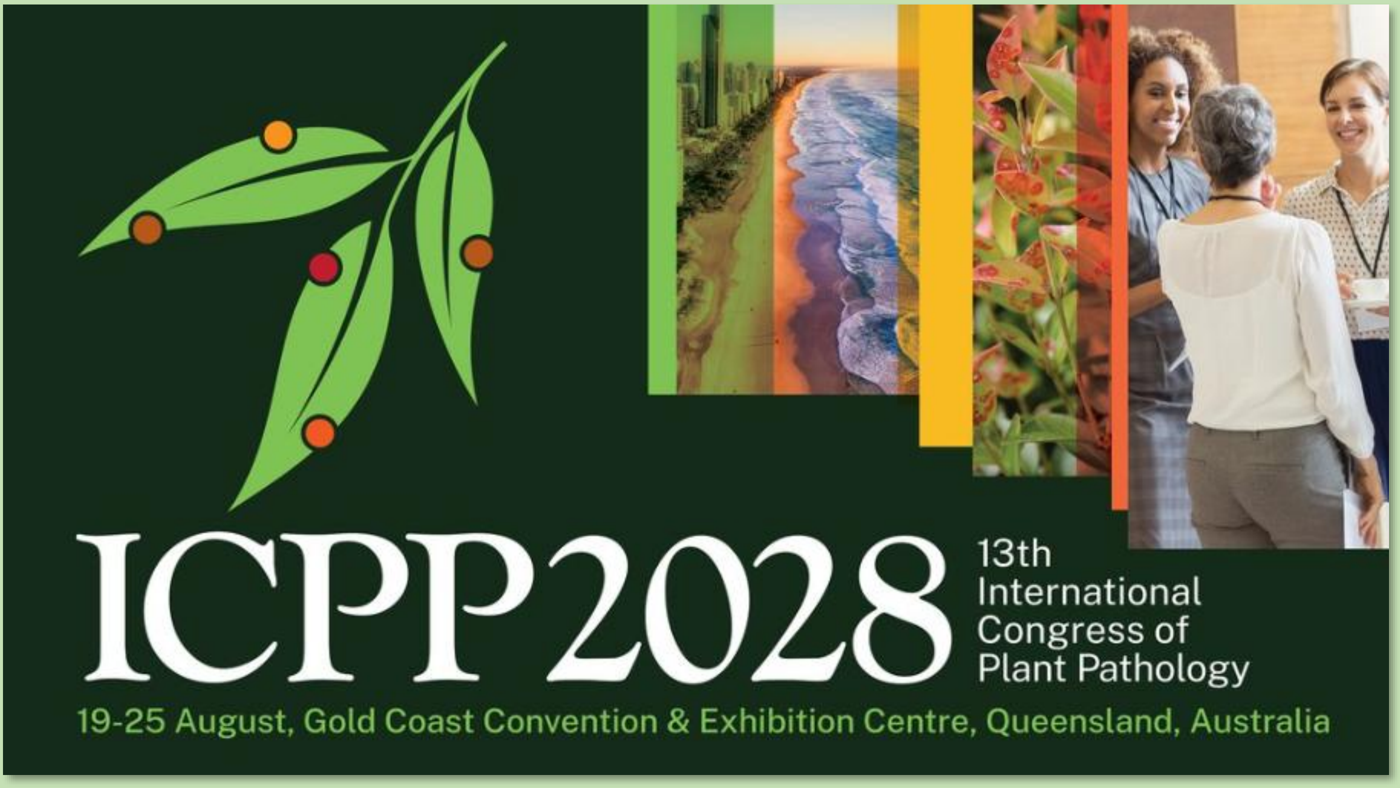
Plant-Parasitic Nematode Identification Course
12 December – 19 December, 2025
Clemson, South Carolina
Contact Email: ckhanal@clemson.edu
Website: www.clemson.edu/cafls/nematology

Plant and Animal Genome Conference (PAG 33)
9 January – 14 January, 2026
San Diego California, USA
Website: https://intlpag.org/PAG33/

8th International Bacterial Wilt Symposium (IBWS)
22 March – 26 March, 2026
Wageningen, the Netherlands
Website: event.wur.nl/ibws2026

21st Reinhardsbrunn Symposium 2026 – Modern Fungicides and Antifungal Compounds
19 April – 23 April, 2026
Friedrichroda, Germany
Website: event.wur.nl/ibws2026

13th International Congress of Plant Pathology 2028
19 August – 25 August, 2028
Gold Coast, Queensland, Australia
Website: reinhardsbrunn-symposium.de/de/


ICPP2028
13th
International
Congress of
Plant Pathology
19-25 August, Gold Coast Convention & Exhibition Centre, Queensland, Australia

INTERNATIONAL SOCIETY FOR PLANT PATHOLOGY (ISPP)

WWW.ISPPWEB.ORG

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