INTERNATIONAL ALLIANCE FOR PHYTOBIOMES RESEARCH

Annual Report

2022

www.phytobiomesalliance.com

PHYTOBIOMES ALLIANCE

Opening Letter

By Kellye Eversole, Phytobiomes Alliance Executive Director

In 2022, we were pleased to see finally the fruits of our efforts to promote **interdisciplinary projects** as three Alliance led or supported collaborative, interdisciplinary projects addressing knowledge gaps in various components of phytobiomes began. With this success, we expanded the Alliance structure by adding four **Working Groups** tasked by the Coordinating Committee to lead, identify gaps in resources or knowledge, and coordinate specific aspects within disciplines and technologies. And, last but not least, we were thrilled to finally meet in person at the **International Phytobiomes Conference** held September 2022 in Denver, Colorado. The event showcased many insightful presentations covering all of the geophysical and biological disciplines involved in phytobiomes research, and abundant networking opportunities among participants. For the first time, agricultural producers joined scientists, government and industry representatives as attendees. One highlight was hearing from the state of Georgia's youngest ag producer, Kendall Rae Johnson.

One of the Alliance's collaborative research projects received a second round of funding from the USDA-Animal Plant Health Inspection Service. The goal of the project is to develop a sequence-based classification system that could be used for speeding regulatory review of microbial-based biological products. This project focuses on the select agent *Ralstonia solanacearum* and will complement and extend the results from the phenotypic and genomic research obtained in the first phase of the project that was completed in 2021.

A second project that began in March 2022 in Australia is a four-year effort focused on developing novel microbiome-based products to increase horticulture crop yields and profitability. Funded by Hort Innovation and other Australian partners, the project brings together the Phytobiomes Alliance and academic partners from four countries. This project is a great opportunity to generate knowledge on the phytobiomes of horticulture crops and to increase the quality of food produced, while contributing to grower profitability.

In April 2022, the Alliance received funding from the U.S. National Science Foundation (NSF) to lead the United States Culture Collection Network (USCCN). The network supports and promotes the safe and responsible use of living microbial resources by connecting collection managers and users around the globe. Given the increasing importance of microbes and microbial-based products in agriculture, the USCCN has a key role in increasing access to and preservation of essential microbes.

At the organizational level, the Alliance identified leaders and experts within specific disciplines and brought them together to form four Working Groups – Microbiomes, Animal Microbiomes, Controlled Environment Agriculture, and Regulatory. These groups were tasked with identifying knowledge and resource gaps within these disciplines to further advance understanding of phytobiomes systems and to expedite the commercialization of solutions that will increase the sustainability of agricultural production. Over the next year, these working groups will develop white papers and strategic roadmaps aimed at defining areas that should be targeted for funding and elucidating progress.

In September 2022, we held the International Phytobiomes Conference, an event that embodies what the Phytobiomes Alliance is striving for – bringing together publicly funded and industry experts and scientists from disciples that rarely cross paths at conferences and providing them with the opportunity to learn about each other's research, network, and build cross-disciplinary and public-private collaborations. The diversity of topics and attendees made this conference truly special, and we received very positive feedback from participants who praised the diversity of topics, the quality of speakers and talks, the diversity of disciplines represented, as well as the size of the event, which ensured sufficient networking opportunities and an overall friendly atmosphere. It was a huge success, and I cannot wait to see you at the next edition in Europe in 2024!

> "I look forward to working with all of you in the coming year as we lead global efforts in phytobiomes research and work toward developing and ensuring the commercialization of sustainable solutions for food, feed, and fiber production.

About the Alliance

The Phytobiomes Alliance is an international, nonprofit alliance of industry, academic, and governmental scientists. The Alliance facilitates and coordinates international efforts toward expanding phytobiomes research.

Mission

Establish a science and technology foundation for site-specific, phytobiome-based enhancement of sustainable food, feed, and fiber production.

Vision

By 2050, all farmers have the ability to use predictive and prescriptive analytics based on geophysical and biological conditions for determining the best combination of crops, management practices, and inputs for a specific site in a given year.

The Alliance is a 501(c)(3) nonprofit organization registered in the United States.

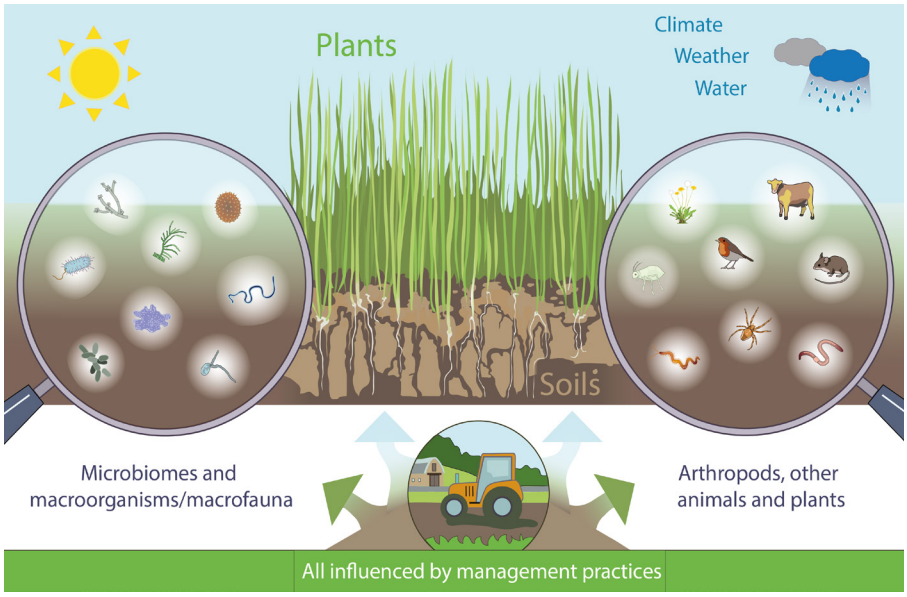
Overarching Research Priorities

- Microbiome-knowledge generation
- Standards & protocols
- Regulatory framework
- Data generation & management
- Multi-disciplinary capacity building
- Precision/digital Ag integration

The Phytobiomes Concept

Plants grow in association and interaction with complex communities of organisms, environmental conditions, and management practices. The term "Phytobiomes" encompasses all of this complexity.

A phytobiome is a plant ("phyto") in a distinct geographical unit ("biome") – a field, grassland, greenhouse, garden, or forest. A phytobiome includes the plant itself, all micro- and macro-organisms living in, on, or around the plant – such as microbes, animals, insects, and other plants – and the environment, including soil, air, water, weather, and climate. All these interactions are influenced by management practices.



Phytobiomes play an important role in ensuring the sustained health and productivity of plants and plant ecosystems.

Board of Directors

The Board of Directors sets the overall vision and mission of the Alliance and provides general oversight for the Alliance operations.

Kellye Eversole

Executive Director & Chair of the Board

Gwyn Beattie

Iowa State University

Natalie Breakfield

Newleaf Symbiotics

Magalie Guilhabert

Ginkgo Bioworks

Jan Leach

Colorado State University

Emmanuelle Maguin

INRAE

Matthew Ryan

CABI

Angela Sessitsch

AIT Austrian Institute of Technology

Coordinating Committee

The role of the Scientific Coordinating Committee is to establish Alliance priorities, identify research, resource and technology gaps, develop strategies to fill these gaps, and create working groups to lead efforts focused on specific topics. The Coordinating Committee consists of project leaders and representatives of financial sponsors. At the end of 2022, the Alliance Coordinating Committee comprised 39 members from 8 countries.

Working Groups

Working Groups are the implementation arm of the Alliance. They lead efforts and develop priorities on specific topic, disciplines, and technologies.

Microbiomes

The group focuses on identifying knowledge and resource gaps that need to be addressed to advance understanding of the role that microbes play within the broad phytobiome systems and how this can be used to improve agricultural sustainability.

Animal Microbiomes

The group works on identifying knowledge and resource gaps that need to be addressed to advance our understanding of the role that the phytobiome plays in influencing the nutrition, health, and net carbon emissions of livestock and poultry.

Regulatory

The group focuses on the development of a regulatory science roadmap to facilitate the commercialization of agricultural biologicals and microbial products.

Controlled Environment Agriculture

The aim of the group is to identify major controlled environment agriculture challenges that could be addressed by phytobiomes research.

Projects & Activities

The Alliance initiates, participates in, and supports collaborative research projects and activities to address the short-term priorities identified by the scientific Coordinating Committee to build a foundation of systems-level knowledge of various phytobiomes.

Novel Microbiome Technologies to Increase Profitability for Australian Horticulture (Funded by Hort Innovation, Australia)

The project started in March 2022 under the leadership of Kirsty Bayliss (Murdoch University, Australia), in collaboration with Hort Innovation Australia, the Cooperative Research Centre for Future Food Systems, Ecogrowth, Melville Park, and the Phytobiome Alliance.

The objective is to develop and deploy new microbiome-based products that increase the yield and profitability of annual and perennial Australian horticultural crops, including those under protected cropping. The products will be developed by analyzing the microbiomes associated with the life cycle of the crop, from seed to harvest. In particular, how these microbiomes change when exposed to biotic or abiotic stresses will be assessed. The aim is to select consortia of microorganisms associated with crops that exhibit higher tolerance to these stresses, and then develop these into new products that increase crop yield.

The first phase of the project – a situation analysis – was completed in October 2022 and field studies of three biological products started subsequently on two plots of tomatoes and one avocado plantation.

Genome Sequence-Based Classification System for Microbes (funded by the USDA Animal Plant Health Inspection Service – APHIS)

The Alliance-coordinated project began in August 2019 and focused on the select agent *Ralstonia solanacearum* (*Rs*). In this project, a classification system based on whole genome sequences was used to precisely identify microbes and conclusively distinguish between *Rs* strains of high impact and biosecurity concern and those that are not. The first phase of the project was completed in August 2021.

The new project started in July 2022, again with funding from USDA-APHIS, with a goal of complementing and extending results from the phenotypic and genomic research obtained in the first phase. The purpose of this new project is to precisely circumscribe the authentically threatening *Rs* strains that are highly aggressive on potato at cool temperatures using a combination of phenotypic assays and bioinformatics to develop diagnostic markers that reliably and specifically identify these threatening strains. The project will be completed in 2024 and manuscripts, covering both phases, are currently in preparation.

United States Culture Collection Network – USCCN (funded by the National Science Foundation – NSF)

The five-year Alliance-coordinated project started in April 2022. It brings together scientists working with laboratory-based living collections of microbes. The mission of the network is to facilitate the safe and responsible utilization of microbial resources for research, education, industry, medicine, and agriculture for the betterment of humankind.

USCCN objectives for the next five-year are to build relationships with current and new sources of culture and living collections, and to engage scientists across multiple disciplines to work toward addressing challenges and needs shared by all types of microbial collection managers and users.

Projects & Activities

Participation to International Networks

The Alliance is participating to various Task Forces and Initiatives in the EU, the UK and the US:

- The Alliance is a member of the Agricultural Genome to Phenome Initiative (AG2PI). The goal is to identify shared problems and collaborate on solutions in genome-to-phenome science. This initiative connects crop and livestock/poultry scientists to each other and to scientists working in data, statistics, engineering, and social sciences.
- The Alliance Executive Director, Kellye Eversole, is a member of the scientific advisory board of the World Bioprotection Forum, a UK-based, international, non-profit organization focused on improving regulatory frameworks for microbial products and encouraging collaboration between the biocontrol industry and academia in the AgriTech sector. Kellye Eversole presented the Phytobiomes Vision for Agriculture during the World BioProtection Summit in May 2022
- The Alliance is participating in the US-based AgBioData research coordination network which is focused on bringing together the international community to enhance genomics, genetics, and breeding research outcomes through standardization of practices and protocols across agricultural databases.
- The Alliance is a member of IMMSA (International Microbiome and Multi-Omics Standards Alliance), a consortium that focuses on coordinating cross-cutting efforts that address microbiome measurement challenges of all major microbiological ecosystems.

Support of Initiatives for Standards Development

In addition to participation in IMMSA, the Alliance is involved in multiple national and international efforts related to the development of standards for microbiome and systems approaches to agricultural research and production such as the US National Microbiome Data Collaborative.

The Alliance is also involved in several projects through which a variety of standards and guidelines are developed, including EU CIRCLES, EU MASTER, EU MicrobiomeSupport, Microbiome Centers Consortium, UK Crop Microbiome CryoBank (UK-CMCB), and the US Agricultural Microbiome Research Coordination Network.

Workshops

- January 2022: "Exploring Phytobiomes" Workshop, held virtually during the Plant and Animal genome Conference 2022. The talks covered various aspects of research aiming at understanding phytobiomes, such as the impact of protist on bacterial microbiome, studies of root system functional and spatial heterogeneity, maize diversity and microbial interactions, and how studying the Aerobiome could provide insight on its impact on terrestrial ecosystems.
- February 2022: The Future of Microbial Biotechnology: From Research to Regulation.
  Organized in collaboration with the Innovative Genomics Institute (IGI) and the U.S. Department of Agriculture (USDA), the two-day virtual workshop included panel discussions and presentations in which developers shared their cutting-edge research and US government officials discussed regulation of microorganisms developed with biotechnology. 924 individuals registered and 649 from 57 countries participated. Most participants (75%) were from the United States.
- July 2022: Phytobiomes session at miCROPe (Vienna, Austria). Kellye Eversole presented "Embracing Complexity: Phytobiomes and a New Vision for Agriculture".

Webinars

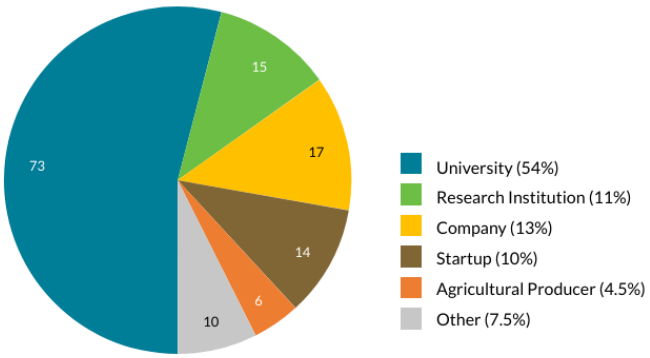
The Alliance continued its webinar series showcasing research results, tools, and resources from all disciplines involved in phytobiomes research. The free webinars are recorded and subsequently posted to the Alliance YouTube channel. In 2022, the Alliance organized six webinars covering topics such as measuring soil health, microfluid devices to study soil microbiomes, novel rhizosphere microbiome sampling methodologies, and frameworks for quality control of AMF inoculants.

6	webinars
1131	participants
73	countries

International Phytobiomes Conference 2022

13-15 September, Denver, Colorado, US

Over 130 people representing a broad and diverse community of public and private US and international scientists and stakeholders were in attendance. The complete agricultural supply chain was represented, including agricultural producers, government representatives, private industry researchers, regulatory specialists, and university scientists – from students to late career professionals.



One highlight of the conference was the opening kickoff panel discussion with seven-year old Kendall Rae Johnson, Georgia's youngest farmer, who shared information about her farming operation and how science impacts her decision making. This session demonstrated how critical it is to conduct solution-based research and develop new and innovative applications to support the future of agriculture.

www.phytobiomesconference.org

The conference program provided attendees with an overview of the innovative science and research currently underway within the Phytobiomes space. To encourage professional development opportunities and trans-disciplinary connection among attendees, the conference program included not only lecture and research results presentation, but also ample time for networking and exchange of idea during panel discussions, open poster sessions, listening session and networking lunches.

In the post-conference survey, the participants gave the conference an overall score of 4.6 out of 5. They highly praised the diversity of topics, the quality of speakers and talks, the various types of presentations and the diversity of disciplines. They also praised the size of the event and the friendly atmosphere that enabled numerous formal and informal networking opportunities, especially with early career researchers and scientists from industry.

Looking forward to the next edition in 2024.

Online Presence

Website

+48% Visits

+46% Users

+47% Page Views

YouTube

27 Webinars in the library

+27% Views

+52% Subscribers

Twitter

145 Tweets

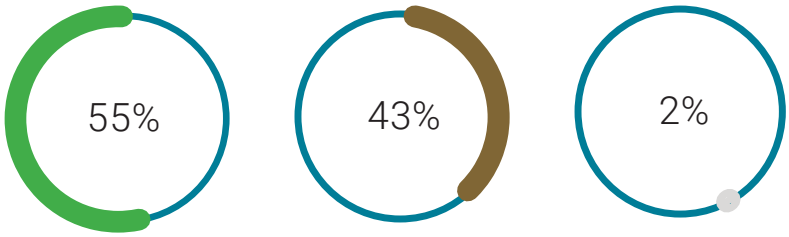
3,365 Followers

85,000 Impressions

Finances

The Alliance is financially supported by sponsors — private companies and research institutions. Sponsors contribute to the establishment of the Alliance priorities and strategies through the Coordinating Committee.

Sources of Funding

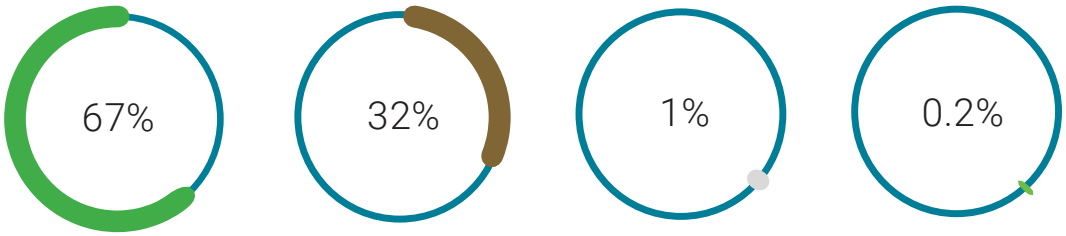


Research Institutes & Universities

Private Companies

Others

Expenses



Staffing & Professional Services

Conference, Workshops & Travel

Communication & Promotion

Operating Expenses

Thank you 2022 Sponsors

Interested in sponsoring the Alliance? Contact Us!

The Alliance is looking forward to welcoming new sponsors to help identify priorities and work toward solutions to the challenges facing plant-based food, feed, and fiber production.

Get in Touch!

Contact us if you would like to get involved in the Alliance. And follow us on social media to stay abreast of the latest news and activities in the phytobiomes science space.

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