ANNUAL REPORT 2019

INTERNATIONAL ALLIANCE FOR PHYTOBIOMES RESEARCH

OPENING LETTER

In 2019, the Alliance continued to grow in size, depth, and scope with new members, new projects, new topics, new partners, and new sponsors.

The Alliance Board was strengthened with the addition of four new members (Natalie Breakfield, Matthew Ryan, Emmanuel Maguin and Angela Sessistch), solidifying the international scope of our mission and vision. Eleven new members joined the scientific Coordinating Committee as project leaders or representatives of the seven new financial sponsors. These new members and sponsors are extending the breadth of our activities at a critical time. While during the first couple of years of our existence, we were focused solely on building the science related to microbiome components of agriculturally relevant phytobiomes and explaining the term "phytobiome", in 2019, we moved decisively into project themes that will help to establish new paradigms for understanding and integrating knowledge of all of the complex interactions within phytobiomes (e.g., agricultural management practices, controlled environment agriculture, variable rate seeding and nutrient management, the use of biostimulants...) and launching regulatory science projects designed to facilitate the rapid adoption of sustainable technologies and practices.

Several project proposals were submitted to funding agencies worldwide in 2019. While some were not successful, and others are still pending, it provided opportunities for us to build collaborative, international, and interdisciplinary projects designed to address knowledge gaps in the development and deployment of phytobiome-based management approaches. We also started our first funded Alliance-led project which is a collaboration between several universities and a regulatory agency.

To identify research gaps or priorities, and help develop collaborative projects, three Working Groups were established (Regulatory Science, Controlled Environment Agriculture, and Food Safety & Quality). These working groups will serve as a focal point for these topics and a resource for industry, the academic community, and governmental agencies. These groups work under the auspices of the scientific Coordinating Committee.

Beyond our internal activities, in 2019, the Alliance strengthened its ties to the international research community by becoming formal partners in several EU projects and in one Australian-led project. Further, in the development of research and regulatory standards, protocols, and check-lists for microbial or metagenomic sequencing projects and microbial products, the Alliance is serving as the interface between multiple activities ongoing at the EU and US levels.

Over the next year the Alliance will continue to increase its visibility, promote pre-competitive research, and engage in activities and projects to advance our understanding of all components of the phytobiome system and particularly the interactions of such components.

Building on the highly successful 2018 conference organized by the Alliance and other partners, the next International Phytobiomes Conferences will be held in Denver, Colorado, USA from 1-4 December 2020. This will provide an opportunity to see the full breadth of topics and disciplines that need to be integrated and coordinated if we are to achieve our vision of providing farmers, growers, ranchers, and foresters phytobiome-based knowledge that empowers site-specific, sustainable production of food, feed, and fiber.

We look forward to working with all of you in the coming year and welcome the opportunity to forge new partnerships, projects, collaborations, and sound regulatory policies for enhanced sustainability and profitability within the agricultural and food enterprise.

I hope to see you all at events throughout the year but most especially at our conference in December.

Warmest regards,

Kellye Eversole, Alliance Executive Director

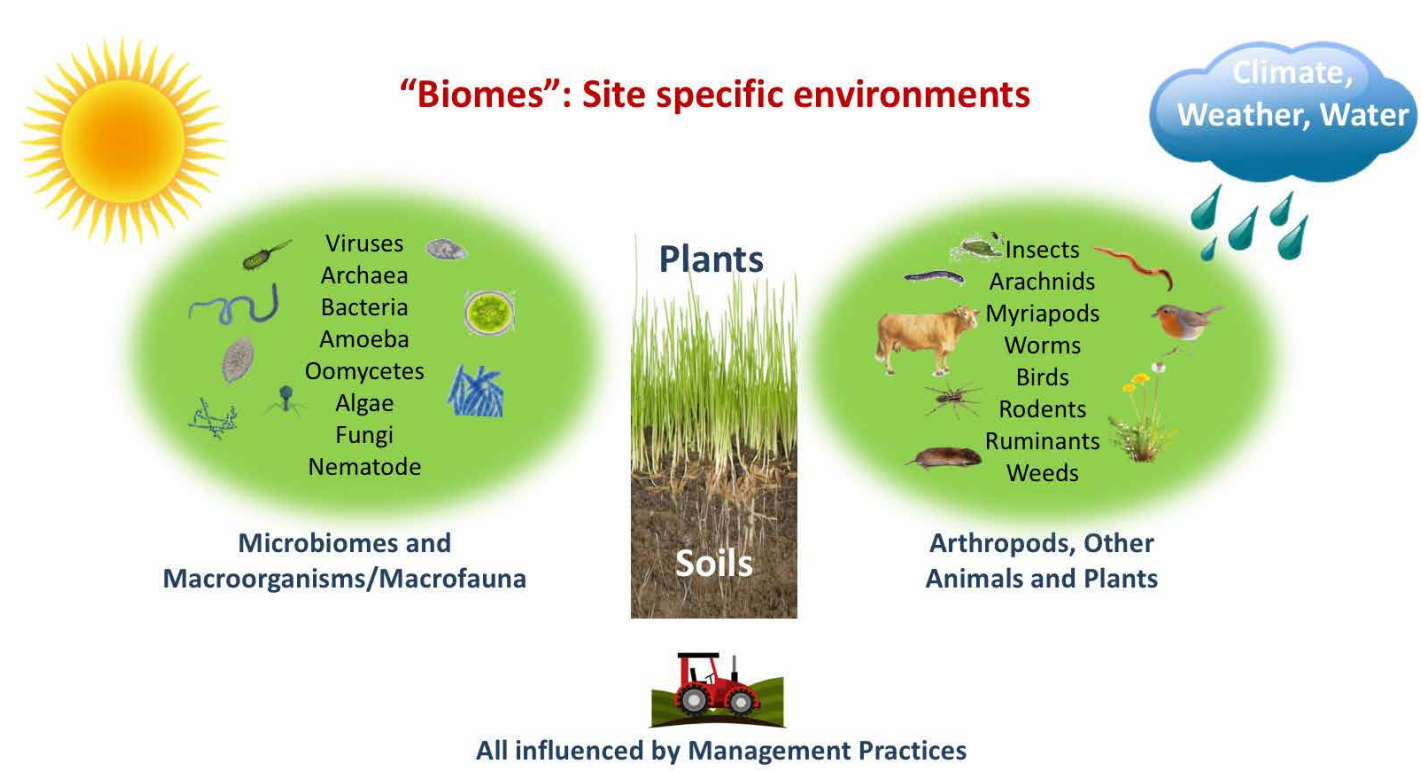
"In 2019, we moved decisively into project themes that will help to establish new paradigms for understanding and integrating knowledge of all of the complex interactions within phytobiomes."

THE PHYTOBIOME 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 macroorganisms 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 have an important role in ensuring the sustained health and productivity of plants and plant ecosystems.



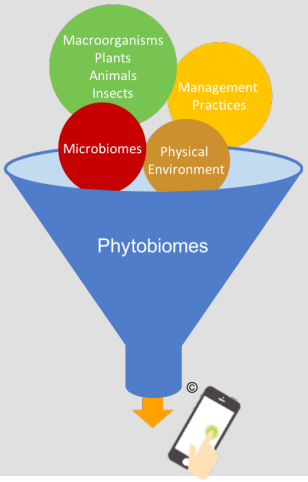
PHYTOBIOMES RESEARCH

Because interactions within phytobiomes are dynamic and complex, there is a need to build a foundation of systems-level knowledge of various phytobiomes. This includes an understanding of how the different components interact with and influence each other which can then be used to empower the development of predictive and prescriptive analytics for next generation precision and digital agricultural systems.

Establishing a foundation of knowledge on how phytobiome components interact and affect each other will be critical to ensuring sustainable global food security in the next decades as we face the effects of climate change on plant diseases, health, and productivity, as well as the necessity to preserve biodiversity and our natural resources.

VISION

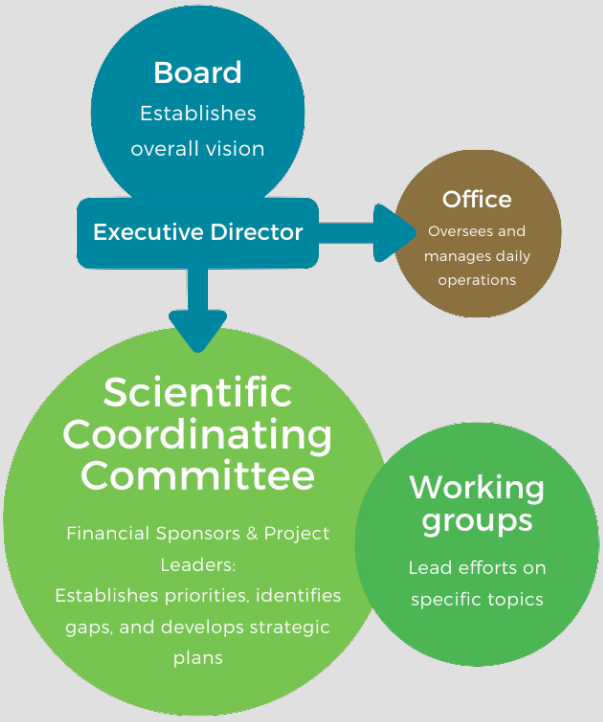
By 2050, all farmers have the ability to use predictive and prescriptive analytics based on geophysical and biological conditions for determining the best combination of crops, management practices, and inputs for a specific field in a given year.



MISSION

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

STRUCTURE



SHORT-TERM PRIORITIES

The concept of enabling phytobiome-based enhancement of agricultural production requires understanding the interactions between all system components (i.e., plants, soils, microbiomes, microbes, climate, weather, environment, management practices…) and using this information to design a foundation for tomorrow's next generation, site-specific, sustainable agriculture and forestry. The Alliance has identified several short-term priorities to put us on the path towards building this foundation. These include the following activities over the next few years:

- Develop national and international research projects that enhance our understanding of the interactions between plants, microbiomes, and other components of phytobiome systems
- Design databases that support correlation and network studies of site-specific and temporal geophysical and biological data, including the identification of microbes by state, province, region, and country
- Establish at least one microbial genome and metagenome sequencing repository
- Draft standards, protocols, check-lists (minimum information, sampling, reference datasets, regulatory requirements…) for phytobiomes studies
- Advance the development of a genome sequence-based classification system and risk prediction method for microbes
- Further develop a draft regulatory science roadmap for microbials
- Expand industry and academic partnerships within the microbial products, sequencing, and metagenomics arena
- Establish industry and academic partnerships within the broader precision agriculture and digital agricultural fields to further expand the interdisciplinary and multidisciplinary scope of the Alliance.

BOARD OF DIRECTORS

The Board of Directors is in charge of setting the overall vision and mission of the Alliance and provides general oversight for the Alliance operations.

Kellye Eversole
Chair of the Board

Gwyn Beattie
Iowa State University

Natalie Breakfield
Newleaf Symbiotics

Magalie Guilhabert
Bayer Crop Science

Jan Leach
Colorado State University

Emmanuelle Maguin
INRAE

Matthew Ryan
CABI

Angela Sessitsch
AIT Austrian Institute of Technology

COORDINATING COMMITTEE & WORKING GROUPS

The Scientific Coordinating Committee consists of representatives of financial sponsors and leaders of projects and working groups. The role of the 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. As of end 2019, the Alliance Coordinating Committee comprised 39 members.

Three working groups operate under the auspices of the committee with each chaired by a member of the coordinating committee and membership comprised of representatives of sponsors and team members of Alliance-led or supported projects. These working groups are:

Regulatory Science

To support or facilitate regulatory approvals and commercialization of sustainable microbial products, the Alliance regulatory science working group focused on identifying research priorities and began the development of a regulatory science roadmap. The Alliance Regulatory Working group is establishing direct linkages with officials from state, national, and international regulatory agencies and working with industry and academic partners to determine research needs. This group is chaired by Kellye Eversole, Eversole Associates & Phytobiomes Alliance.

Controlled Environment Agriculture

In 2019, the Alliance established a Controlled Environment Agriculture working group with the aim of developing collaborative projects to study the impact of microbes on productivity and the possibilities of developing microbial biological products that could enhance the productivity of plants grown in indoor or controlled environments. This group is chaired by Trevor Charles, Waterloo Center for Microbial Research and Metagenom Bio.

Food Safety & Quality

At the end of 2019, a new working group focused on Food Safety & Quality was established as the committee felt this would be an excellent arena in which to examine the full scope of a phytobiome system, especially as it relates to produce. A key consideration for this group will be to identify research priorities that could enhance our understanding of the relationship between phytobiome system components and human pathogens on plants and to develop diagnostic tools and resources that can accelerate the identification of microbes in the field. The group may also focus on research needs to ensure the quality of agricultural food, feed, and fiber products. This group is co-chaired by Farhad Ghavami & Greg Siragusa, Eurofins BioDiagnostics.

OFFICE

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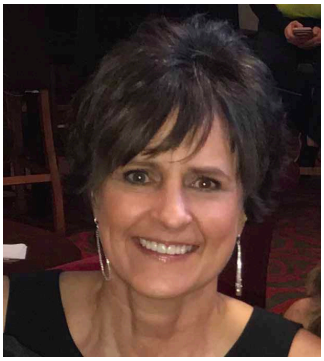

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PROJECTS

Genome Sequence-Based Classification System for Microbes: Pilot Phase, Funded.

In August 2019, the Alliance began a project funded by and in collaboration with the USDA Animal Plant Health Inspection Service (APHIS) to develop a genome sequence-based method of circumscribing and phenotyping regulated microbes beginning initially with the Select Agent Ralstonia solanacearum (Rs) as the pilot. In this project, a classification system, based on whole genome sequences, will be used to precisely identify microbes and conclusively distinguish pathogenic and non-pathogenic microbes. Over the long term, it is hoped that this method will be beneficial for accelerating the regulatory pathway for international and interstate shipments as well as commercialization of microbial products.

Classification System for Risk Prediction: Submitted

In August, the Alliance submitted a proposal to USDA-APHIS to develop a "risk prediction" method for beneficial plant bacteria by integrating genome-based circumscription and phenotypic data. The focus would be on three major genera that contain both plant beneficial and animal/plant pathogens, namely Bacillus, Pseudomonas, and Burkholderia. If approved, this project will be a first step in the development of a standardized, genome-based microbial risk assessment tool for plant beneficial bacteria. As with the sequence-based classification system, our goal is to develop a framework that will enable regulatory agencies to implement policies to more reliably and rapidly assess the risk associated with environmental releases.

Database for Rapid Assessment of Geographic Distribution of Microbes

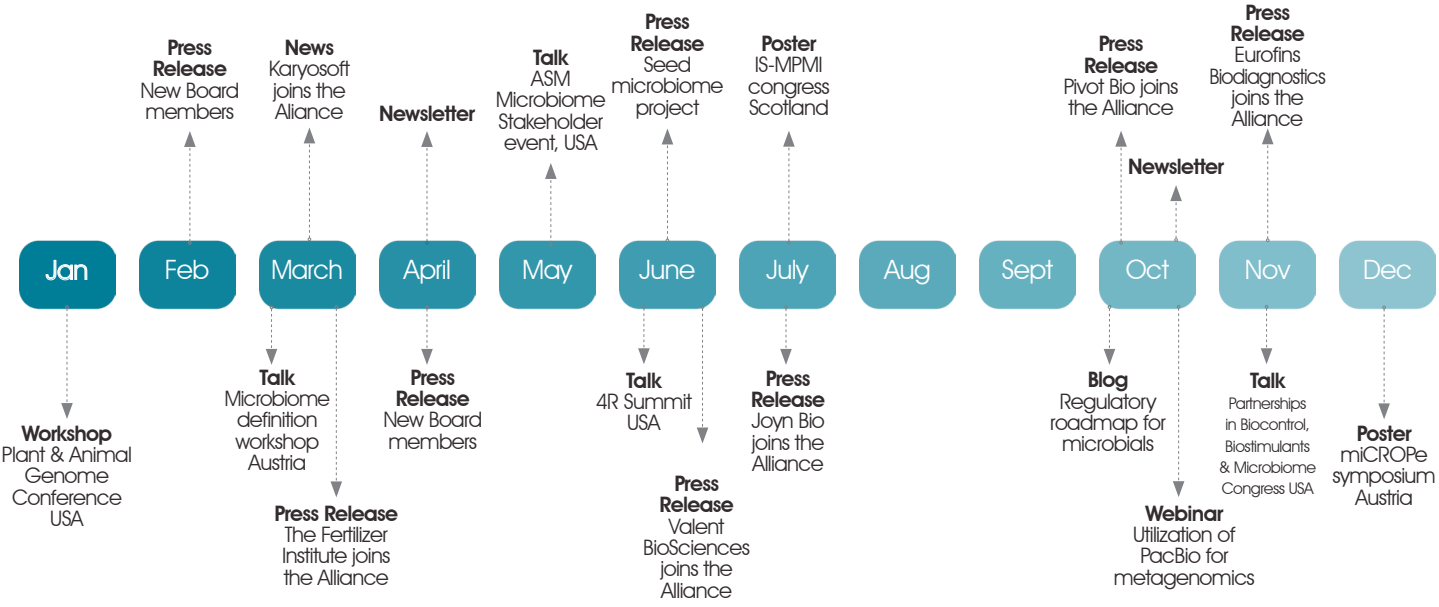
The Alliance began efforts to establish a database to support correlation studies between biological and geophysical phytobiome components. The funded microbial classification system project includes a component to pull together sequences with phenotypic information. The Alliance is also coordinating with various efforts designed to enhance or build such infrastructure(s). In particular, the Alliance is trying to ensure that the various projects for which databases are developed will complement and not duplicate other efforts.

Standards Development

In the projects funded by or submitted to USDA-APHIS, the Alliance will develop recommendations for standard operating procedures and metadata checklists that could be used to speed the regulatory process, enable collaborative and comparative analyses of data, ensure interoperability of various datasets, and facilitate future deployment of artificial intelligence. Various community activities at national and international levels are also underway to develop guidelines for research to allow for increased collaboration and interoperability among the academic and industry scientific communities. Alliance leadership and members of the coordinating committee have participated in these activities and the Alliance serves as a general bridge between the various efforts.

COMMUNICATION ACTIVITIES

The Alliance uses its website and social media accounts to increase its visibility, and disseminate news about its activities and its partners.



Website

www.phytobiomesalliance.org

4,400 visits

3,500 users

8,200 page views

Twitter

@phytobiomes

2,600 followers

83 tweets

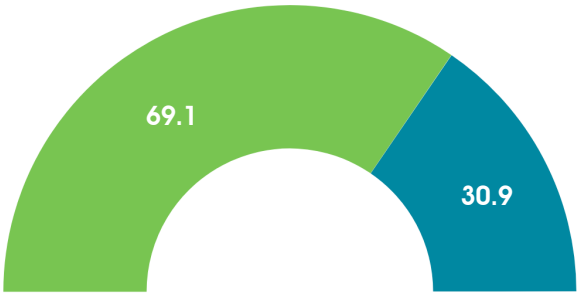
162.5k impressions

Icons made by Freepik from www.flaticon.com

2019 FINANCES

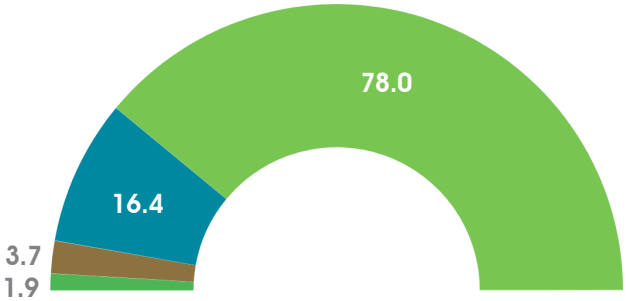
The Alliance is financially supported by sponsors, private companies and research institutions, that support the Alliance vision and contribute to the establishment of the Alliance priorities and strategies through the Coordinating Committee.

Ressources



- Industry (69.1%)
- Research Institute/university (30.9%)

Expenses



- Communication and Promotion (1.9%)
- Operating Expenses (3.7%)
- Meetings/Workshops/Travel (16.4 %)
- Staffing and Professional Services (78.0%)

2019 SPONSORS

In 2019, the Alliance welcomed 7 new sponsors: Karyosoft, The Fertilizer Institute, Valent BioSciences, Joyn Bio, Pivot Bio, Eurofins BioDiagnostics, and Biovante.

BAYER

Eversole Associates
Enabling Science & Technology

INRAE

novozymes

VALENT BIOSCIENCES

biovante

Colorado State University

eurofins | BioDiagnostics

indigo

IRD
Institut de Recherche pour le Développement
FRANCE

JOYN BIO

UNIVERSITY OF MARYLAND

UNIVERSITY of NEBRASKA LINCOLN

NewLeaf symbiotics

NOBLE RESEARCH INSTITUTE
Science Serving Agriculture

PennState College of Agricultural Sciences

PIVOT BIO

THE FERTILIZER INSTITUTE

WCMR
WATERLOO CENTRE FOR MICROBIAL RESEARCH

APS
Healthy Plants • Healthy World

BioConsortia

PRIME DISCOVERIES

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

Karyosoft
Augmented Innovations

INTERNATIONAL ALLIANCE FOR PHYTOBIOMES RESEARCH

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INTERNATIONAL PHYTOBIOMES CONFERENCE 2020

1-4 DECEMBER 2020

Cable Center
Denver, Colorado
USA

www.phytobiomesconference.org