



Harnessing Phytobiomes Research to Support Regulatory Science

17 January 2024

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Project Manager

Plant & Animal Genome Conference
San Diego, CA, USA

International Alliance for Phytobiomes Research



- Nonprofit, precompetitive research consortium
- Industry, academia, and government
- Paradigm shift in agricultural research & 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 any given year.

Strategy: Identify gaps in research, tools, and technologies and develop projects to address them.

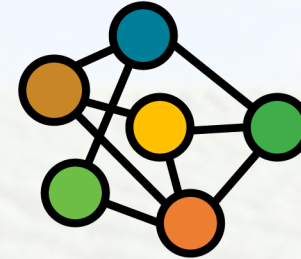
Moving From Simple to Complex

Traditional Science Approach



- Linear
- Reductionist
- Can be understood by focusing on individual components
(Soils, Plant genetics, Microbiomes, or Weather)

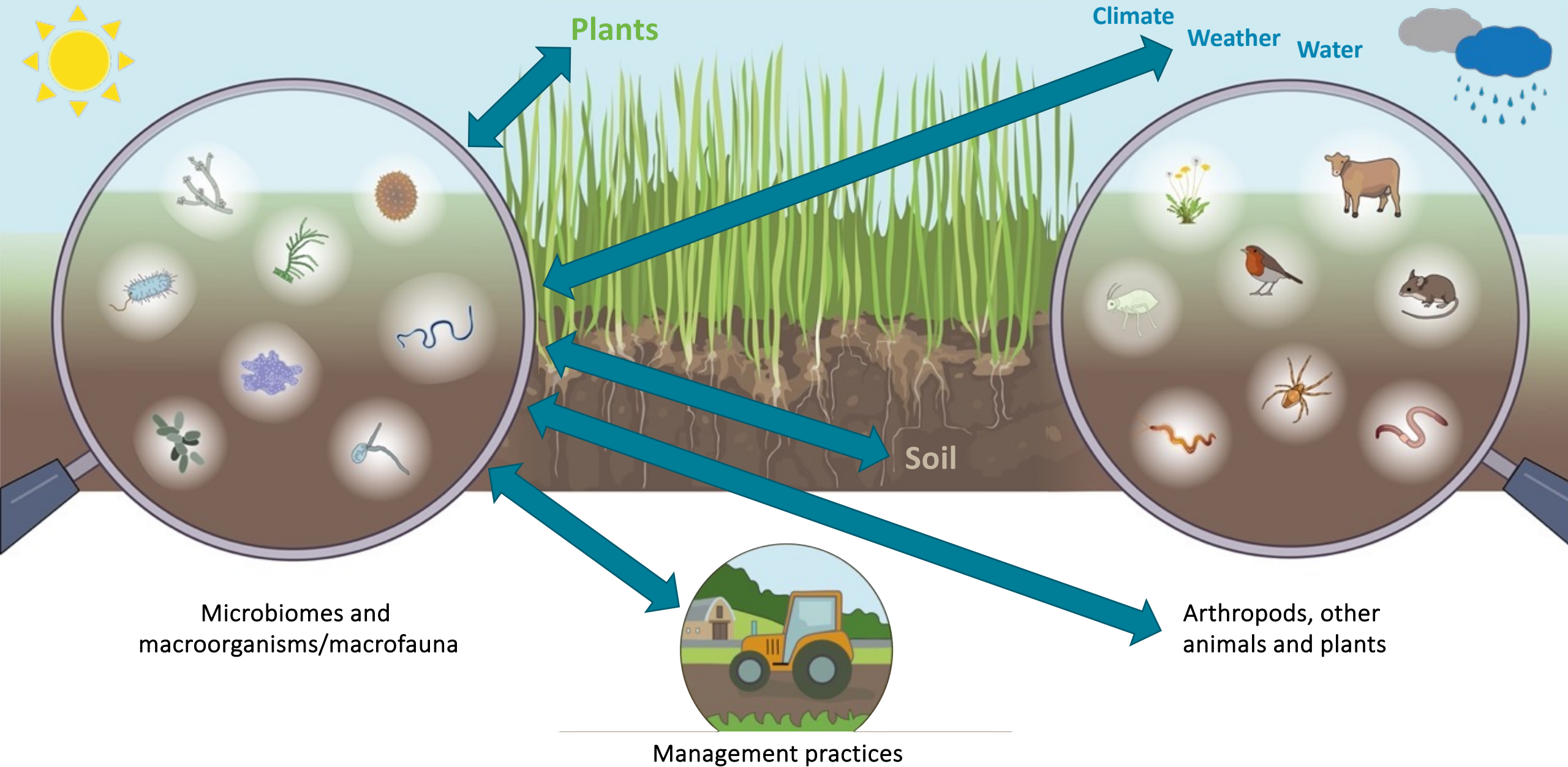
Agriculture is a Complex System



- Non-linear
- Multiple interactions and variables
- Adapts via learning or evolution
- Can be influenced

Paradigm shift to a complex systems approach

Phytobiomes: Major Research Gaps



Examples of Phytobiomes



Crop Field

A wide-angle photograph of a vast, golden-brown field of mature grain, likely wheat or corn, under a clear blue sky. A small yellow tractor is visible in the distance on the left side of the field.



Pasture

A photograph of a lush green pasture with several black and white cows grazing. The sky is bright blue with scattered white clouds.



Vegetable Garden

A photograph of a rooftop vegetable garden with numerous raised beds filled with green leafy vegetables. In the background, a city skyline with several buildings is visible under a clear sky.



Forest

A photograph of a forest with tall, thin trees, likely birches, showing vibrant autumn foliage in shades of yellow and orange. The ground is covered with fallen leaves.



Grassland

A photograph of a wide, open grassland with green grass and scattered trees. In the background, there are rolling green hills under a blue sky with white clouds.

Controlled Environment Phytobiomes

Greenhouse Farming



Vertical Farming



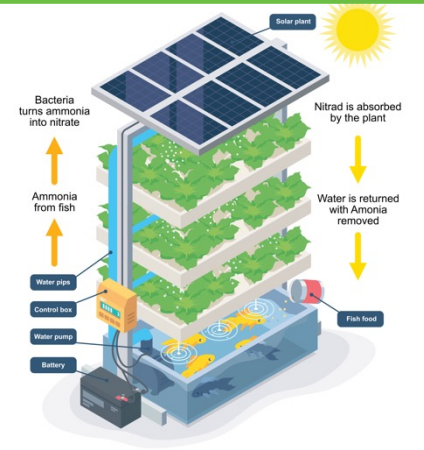
Hydroponic



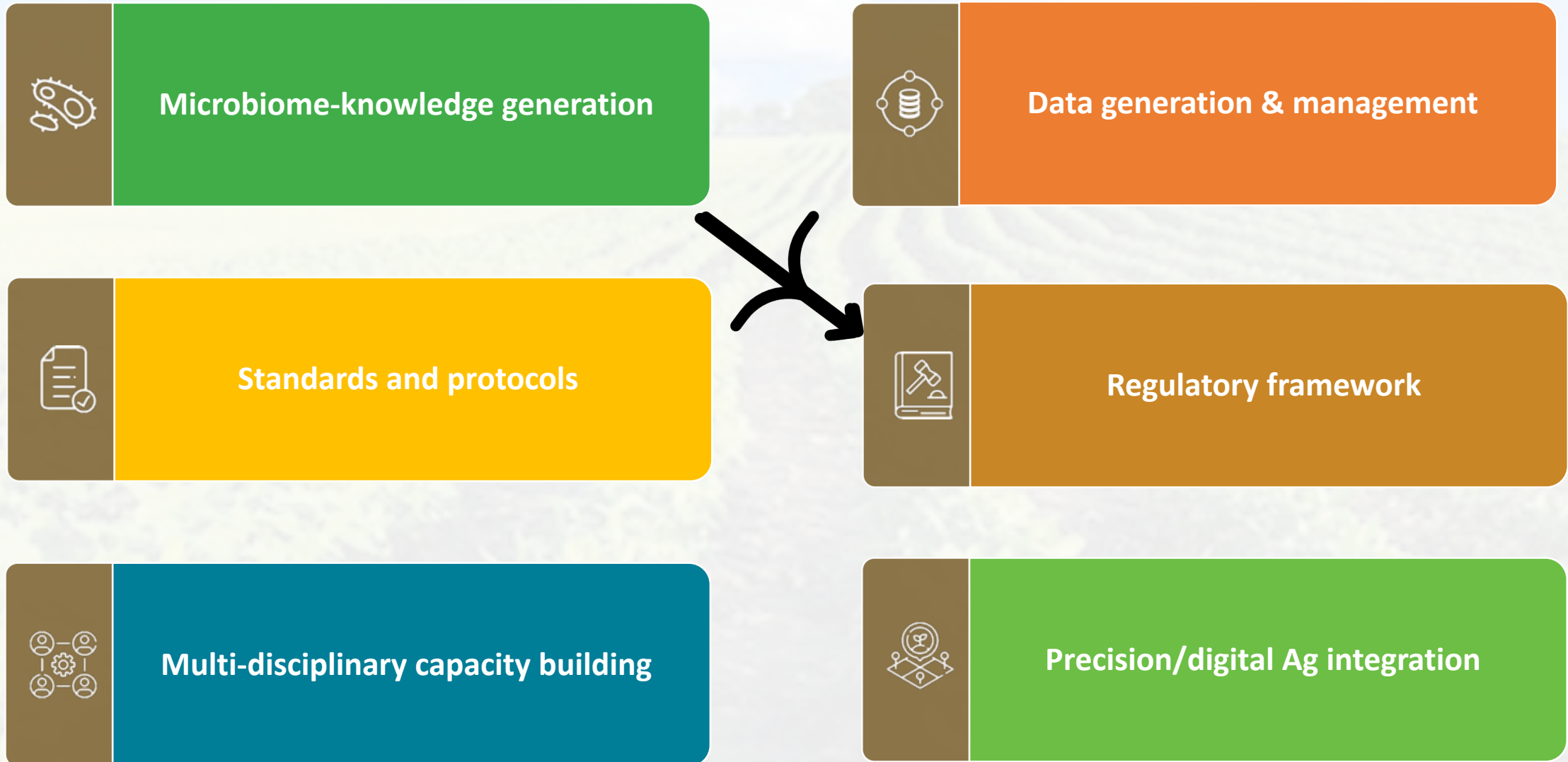
Container Farming



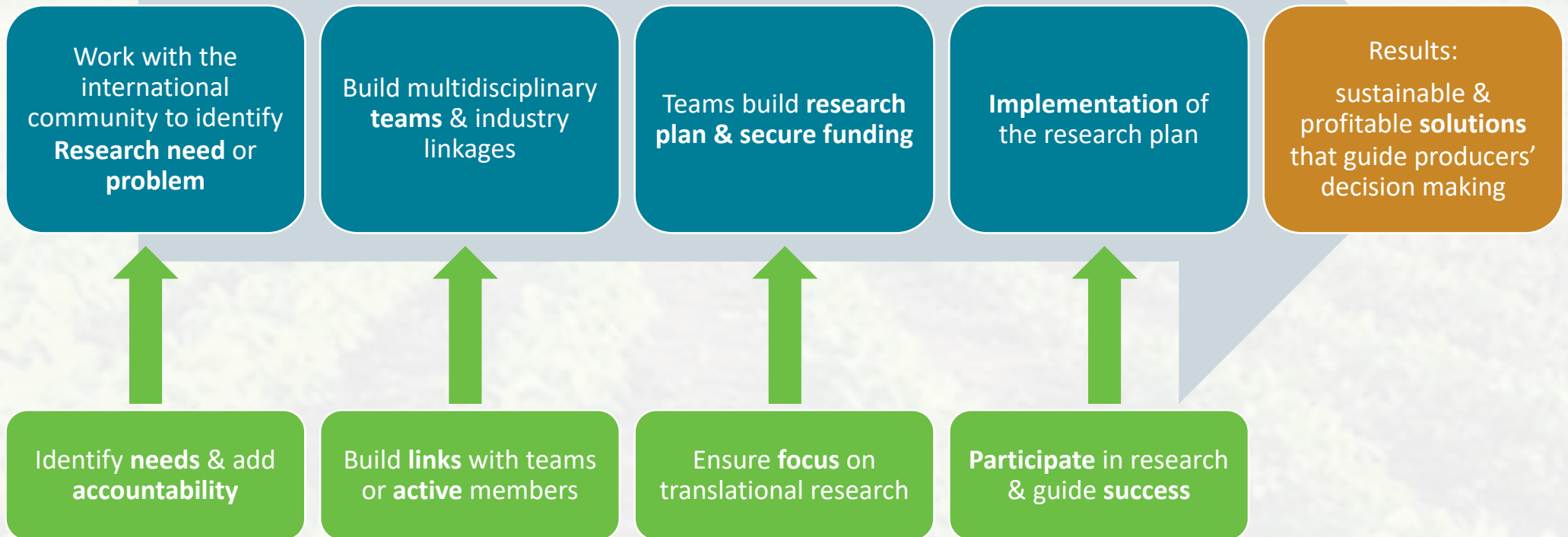
Aquaponic



Goal: Optimal Sustainability and Productivity



Translating Research Outcomes into Results



Industry Sponsor Participation

Major Efforts Underway



Projects that Link Components Within the Entire Phytobiomes Network



Sequence-based Classification System for Microbes



Coordination of Microbial Collections and Networks: Public & Private



Facilitate Regulatory Compliance



Microbiome Standards – International Microbiome & Multi’omics Standards Alliance



Establish Linkages with Human and Animal Health & Nutrition

Project: Sequenced Based Classification of Microbes

Objective: Enable rapid and precise taxonomic identification of microbes

Model: *Ralstonia solanacearum*



Database of sequences coupled to pathogenicity data



Precisely circumscribe the strains that should be designated as “Select Agents”



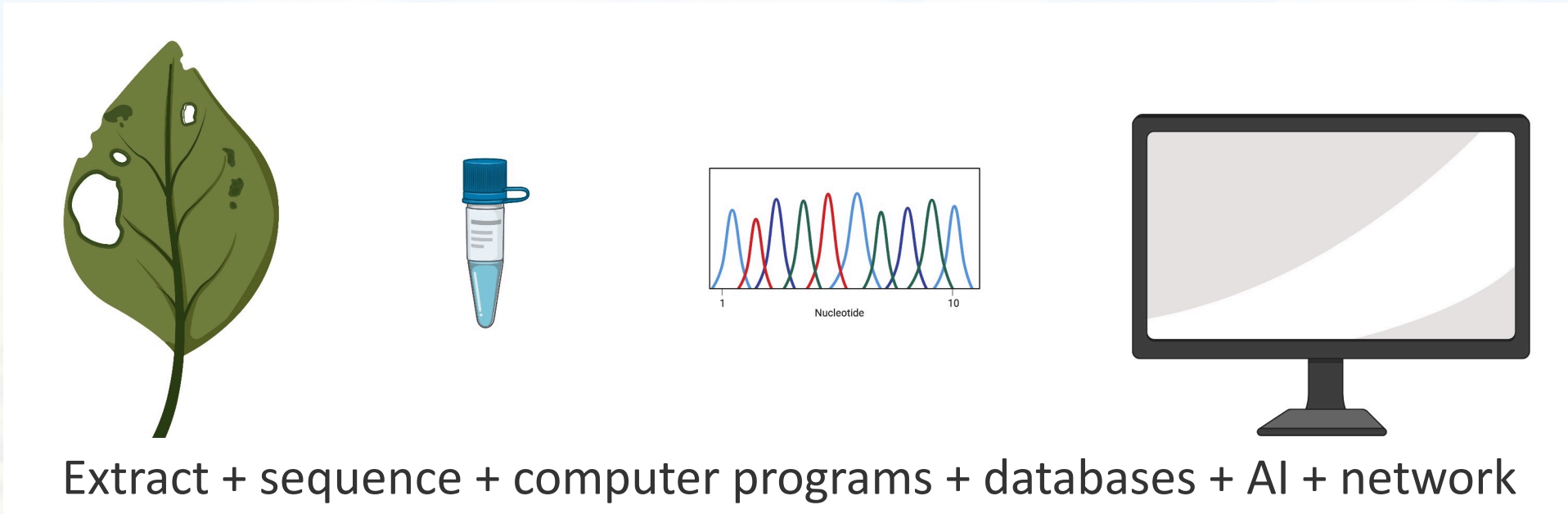
Expand model to other agriculturally relevant bacteria



Expand to other microbial plant pest agents

Project: Sequenced Based Classification of Microbes

Plant pathogen identification of the future



hours ... maybe minutes?

**Identification + characterization + outbreak investigation
for any and all pathogens everywhere**



Project: The U.S. Culture Collections Network

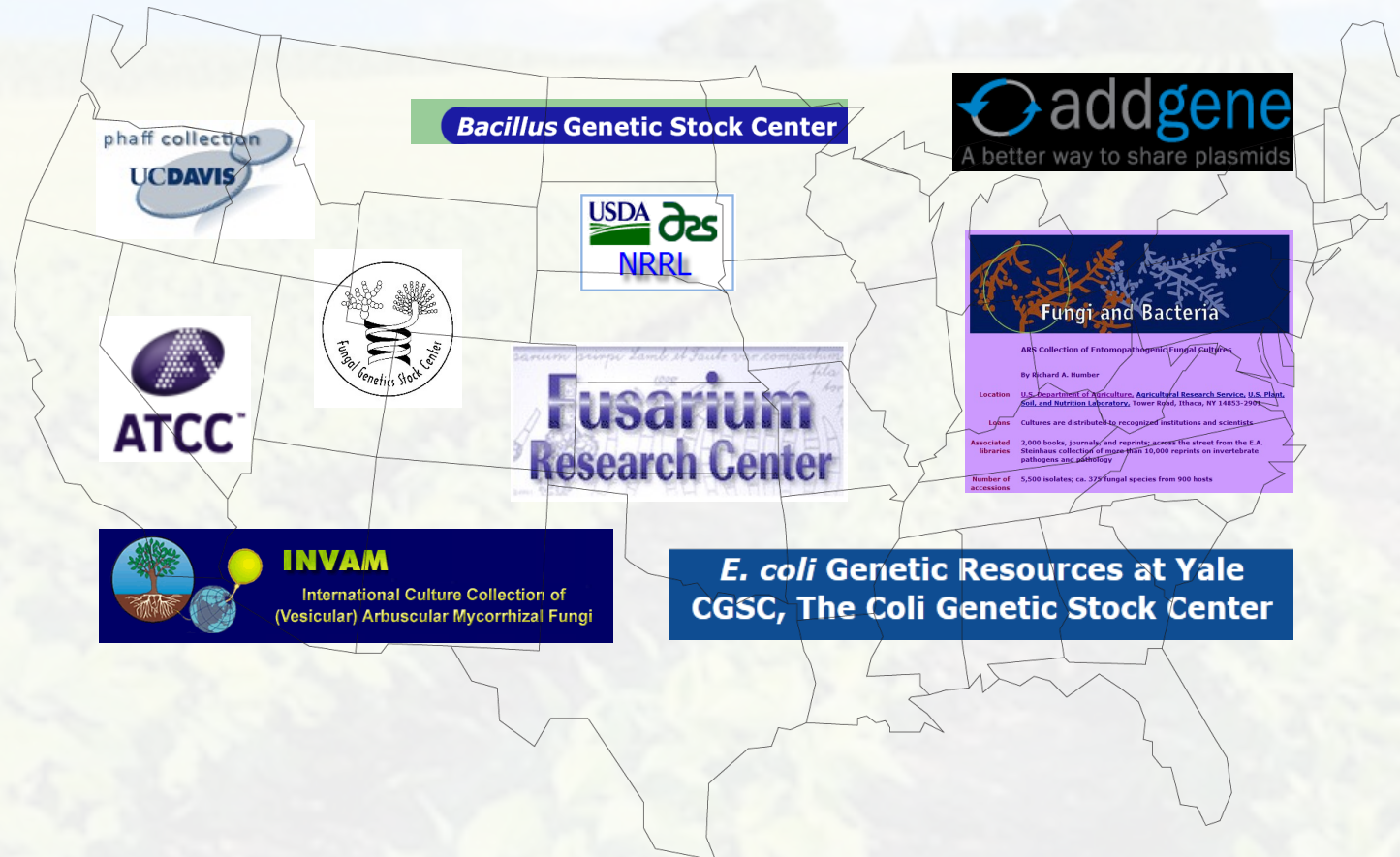
A NSF-funded Research Coordination Network

Bringing together scientists working with living microbe collections

A partnership with the International Phytobiomes Alliance for Research.



A snapshot of U.S. Culture Collections



While the U.S. has numerous collections, there is no uniform system for supporting microbial germplasm repositories

Create and Maintain a Public Registry & Database of U.S. Collections to Maximize Synergy and Minimize Duplication

- Crucial to document the location, size, and holdings of collections
- Registry is curated & updated
- Ensure collections of all types are well represented
- Includes small research collections at universities, governmental agencies and private for-profit and non-profit organizations



**Voluntary information in an open registry stored at usccn.org
Publicly available via an online searchable database**

Needed to Aid Industry & Regulatory Science

**What is Available & Where?
Genome Sequences?
Location of Isolation?
Ubiquitous or Prevalent?**



usccn.org/culture-collections

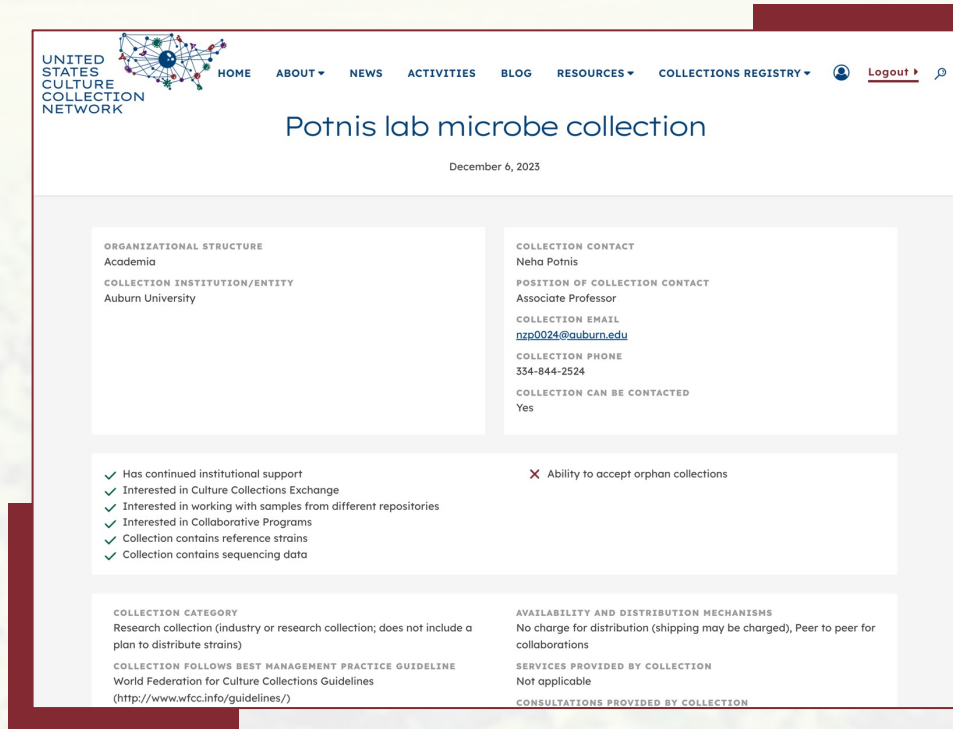
Who can register their collections?



Researchers & scientists who maintain a collection they use for their research



Curators of university or federal collections



UNITED STATES CULTURE COLLECTION NETWORK

Potnis lab microbe collection

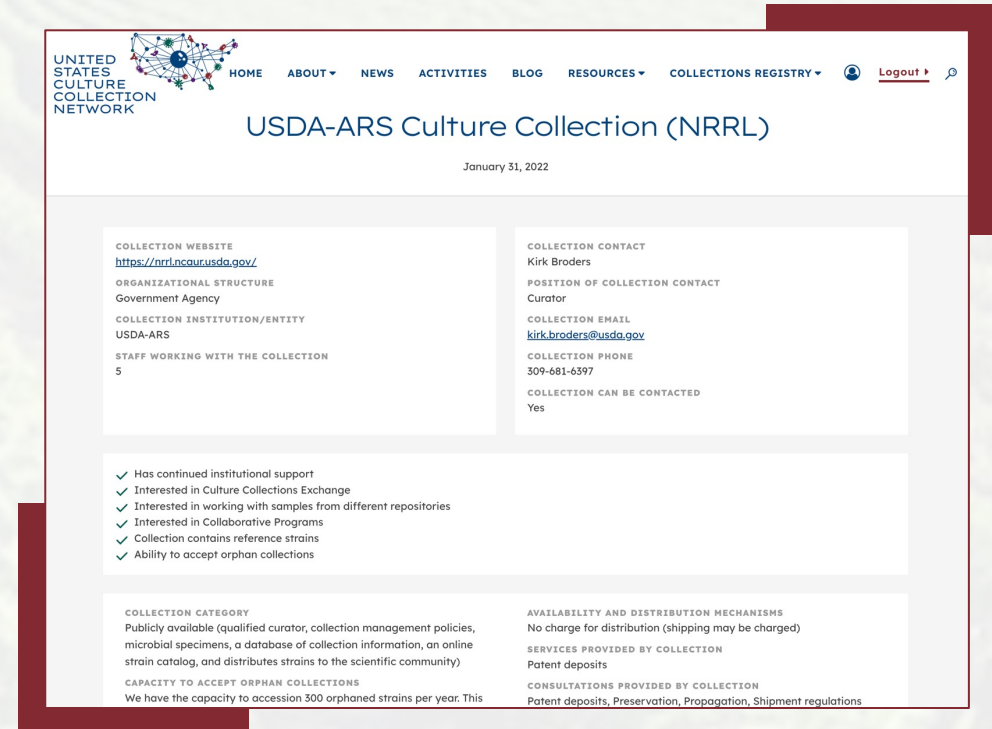
December 6, 2023

<p>ORGANIZATIONAL STRUCTURE Academia</p> <p>COLLECTION INSTITUTION/ENTITY Auburn University</p>	<p>COLLECTION CONTACT Neha Potnis</p> <p>POSITION OF COLLECTION CONTACT Associate Professor</p> <p>COLLECTION EMAIL nrp0024@auburn.edu</p> <p>COLLECTION PHONE 334-844-2524</p> <p>COLLECTION CAN BE CONTACTED Yes</p>
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- ✓ Has continued institutional support
- ✓ Interested in Culture Collections Exchange
- ✓ Interested in working with samples from different repositories
- ✓ Interested in Collaborative Programs
- ✓ Collection contains reference strains
- ✓ Collection contains sequencing data

✗ Ability to accept orphan collections

<p>COLLECTION CATEGORY Research collection (industry or research collection; does not include a plan to distribute strains)</p> <p>COLLECTION FOLLOWS BEST MANAGEMENT PRACTICE GUIDELINE World Federation for Culture Collections Guidelines (http://www.wfcc.info/guidelines/)</p>	<p>AVAILABILITY AND DISTRIBUTION MECHANISMS No charge for distribution (shipping may be charged), Peer to peer for collaborations</p> <p>SERVICES PROVIDED BY COLLECTION Not applicable</p> <p>CONSULTATIONS PROVIDED BY COLLECTION</p>
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UNITED STATES CULTURE COLLECTION NETWORK

USDA-ARS Culture Collection (NRRL)

January 31, 2022

<p>COLLECTION WEBSITE https://nrri.ncour.usda.gov/</p> <p>ORGANIZATIONAL STRUCTURE Government Agency</p> <p>COLLECTION INSTITUTION/ENTITY USDA-ARS</p> <p>STAFF WORKING WITH THE COLLECTION 5</p>	<p>COLLECTION CONTACT Kirk Broders</p> <p>POSITION OF COLLECTION CONTACT Curator</p> <p>COLLECTION EMAIL kirk.broders@usda.gov</p> <p>COLLECTION PHONE 309-681-6597</p> <p>COLLECTION CAN BE CONTACTED Yes</p>
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- ✓ Has continued institutional support
- ✓ Interested in Culture Collections Exchange
- ✓ Interested in working with samples from different repositories
- ✓ Interested in Collaborative Programs
- ✓ Collection contains reference strains
- ✓ Ability to accept orphan collections

<p>COLLECTION CATEGORY Publicly available (qualified curator, collection management policies, microbial specimens, a database of collection information, an online strain catalog, and distributes strains to the scientific community)</p> <p>CAPACITY TO ACCEPT ORPHAN COLLECTIONS We have the capacity to accession 300 orphaned strains per year. This</p>	<p>AVAILABILITY AND DISTRIBUTION MECHANISMS No charge for distribution (shipping may be charged)</p> <p>SERVICES PROVIDED BY COLLECTION Patent deposits</p> <p>CONSULTATIONS PROVIDED BY COLLECTION Patent deposits, Preservation, Propagation, Shipment regulations</p>
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➤ All types of collections are important

How to register your collection?

Go to the
website
usscn.org



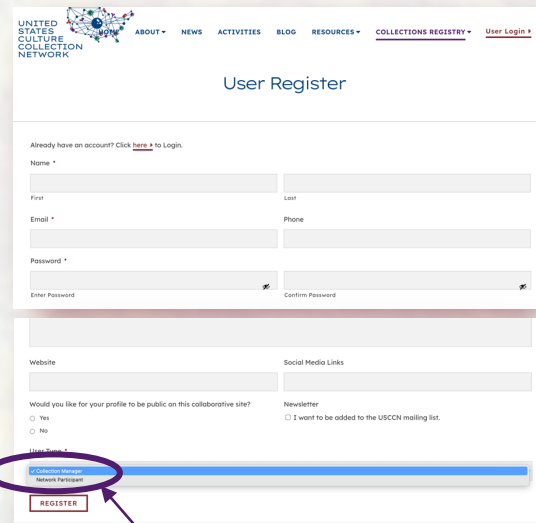
Create a profile



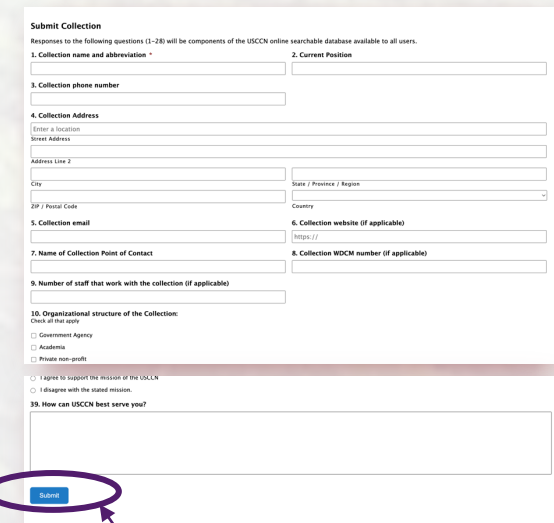
Describe &
submit
collection



Choose: "I have a collection
I wish to register"



User type: Choose
"Collection Manager"



Click "Submit"

Translating Research Outcomes Into Results

Sequenced Based Classification of Microbes Project

- Data-driven framework for regulation
- Identify select agents
- Develop diagnostic markers



Phytobiomes Alliance

- Multi-disciplinary, systems-based research strategy
- Public/Private partnerships
- Results focused projects
- Science based regulatory solutions
- Accelerate Commercialization of Technology & Innovation
- Sustainable solutions for growers

U.S. Culture Collections Network

- Network of microbial resources
- Online Registry & database
- Valuable Metadata



PhytoBiomes Alliance Sponsors & Affiliations





Get in Touch with Us



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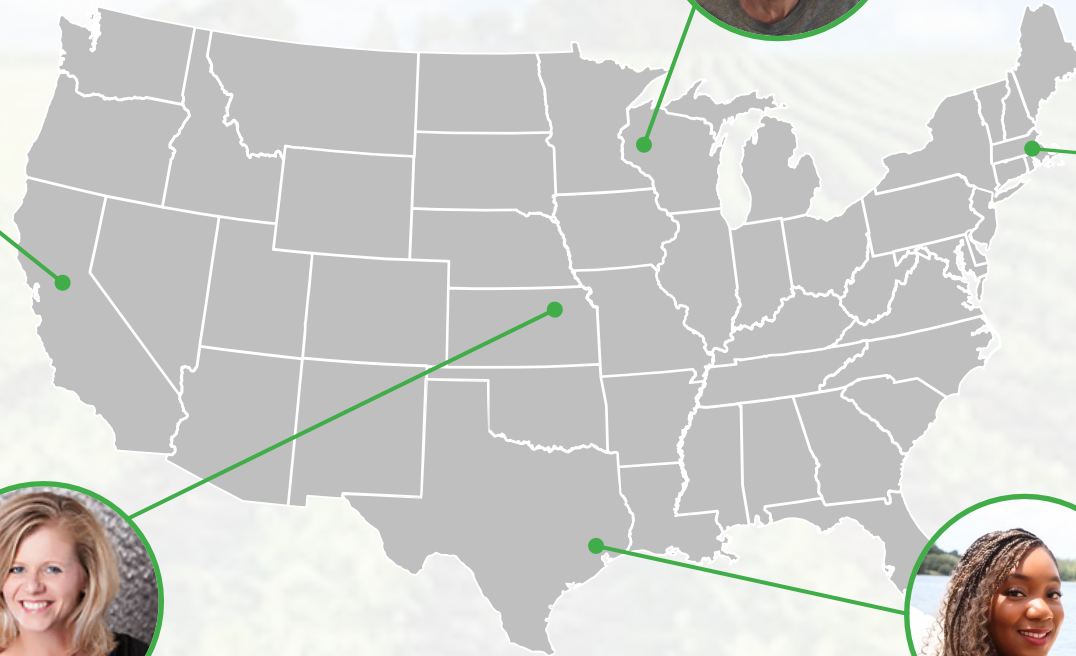
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www.phytobiomesalliance.org



internationalphytobiomesalliance



@phytobiomes



8-10 October 2024

St. Louis, MO, USA

www.phytobiomesconference.org

Main Scientific topics

- Climate/weather
- Environmental Data Set
- Plant fitness
- Microbial community assembly and function
- Network analyses within the phytobiome system
- Modeling
- Data – framework, tools and resources, big data
- Genetic linkages
- Carbon sequestration
- Interactions within phytobiomes for abiotic stress
- Engineering microbes and microbial communities
- Precision agriculture/digital Ag
- Fertilizer, nutrient, and chemical input efficiency
- Product development
- Regulatory requirements
- Greenhouse & Field trials
- Industry research needs