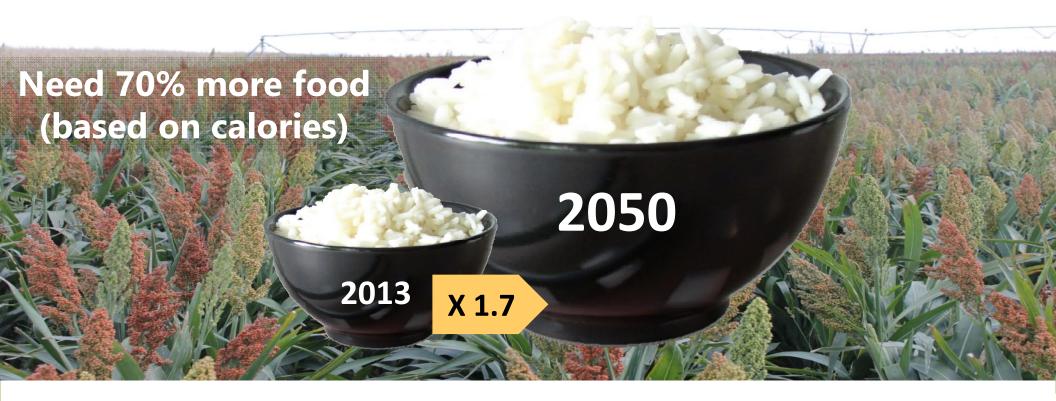






To feed a global population of 9.6 billion in 2050

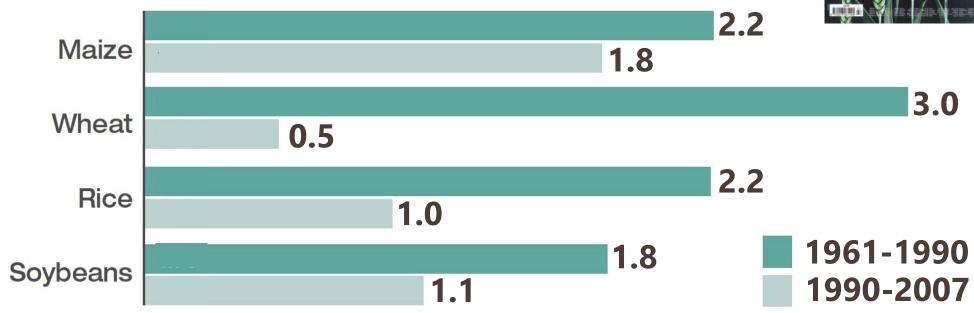


World Summit on Food Security (2013)

Doubling global crop production by 2050 will require ~2.4% increase per year in yields



GLOBAL YIELD GROWTH RATES (%)



SOURCE: ALSTON ET AL. 2009, SCIENCE 325:1209



Develop concepts that can contribute to doubling the amount of safe and nutritious food by 2050

→ Time is right for a systems approach

In the year 2050, the world population will require 70% more food.

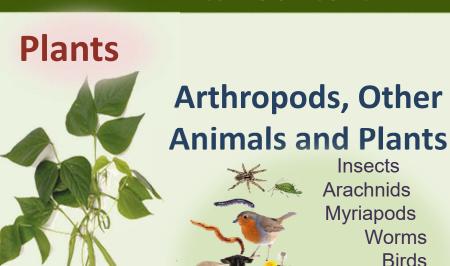
Phytobiomes: Systems in Context

Biological and Environmental Context



Viruses
Archaea
Bacteria
Amoeba
Oomycetes
Fungi
Algae
Nematodes

Their environment





All of the associated organisms

Rodents

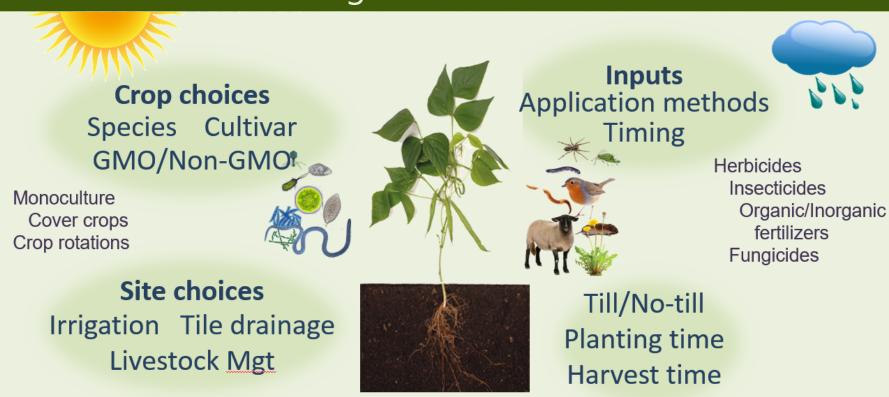
Ruminants

Weeds

Climate

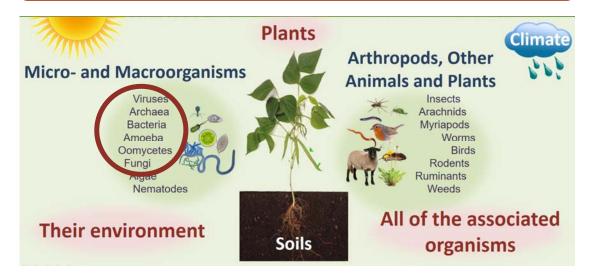
Phytobiomes: Systems in Context

Management Context



Conceptual development of "Phytobiomes"

Phytobiome vs. plant microbiome

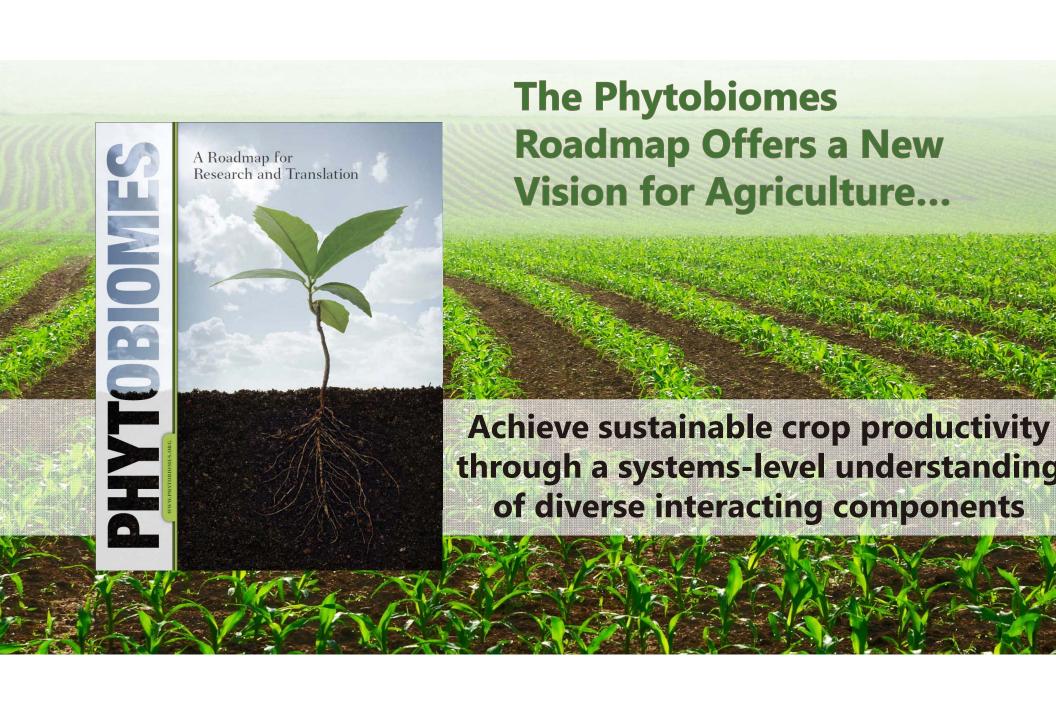


Phytobiomes - plants, their associated organisms, and their environment

Conceptual development of "Phytobiomes"

Plant systems vs. **Phytobiomes**

- Plant systems focus on a plant and then determine the interactions of that plant with all other components
- **Phytobiomes** focus on a plant ecosystem that may involve any number of different types of plants, organisms, and environmental components.
 - →use information on all components and their interactions to identify the best plant(s) to grow at a given site in a given period



Origin of the Phytobiomes Roadmap

- American Phytopathological Society meetings (2014-15)
- Interdisciplinary participants from academia, industry and government in
 - Workshop: Phytobiomes 2015 Designing a new paradigm for crop improvement (>200 participants)
 - Interdisciplinary writing team
- Comments from the public and organizations endorsing the Roadmap

The Phytobiomes Roadmap has been endorsed by:













































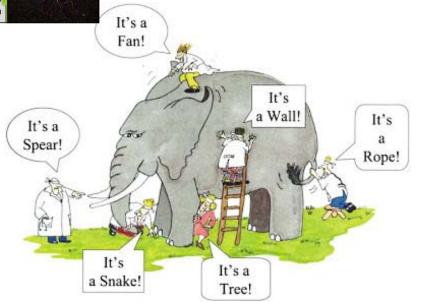
United States Culture Collection Network





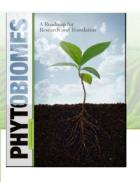
Embracing Complexity

Roadmap Theme



Reductionist approach to biology and agricultural science: Understand each component individually

Reality: biological systems are complex and non-linear in their organization and regulation



Roadmap Theme

Interdisciplinary, systems-level approaches are critical

Develop a foundation of knowledge

Public & Private sector scientists

Molecular biologists Soil scientists Growers

Organismal biologists Extension Crop consultants

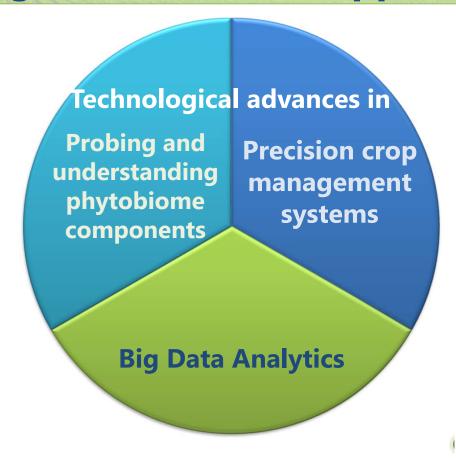
Chemists Ecologists Agronomists Statisticians

Computational scientists Plant breeders Agribusiness

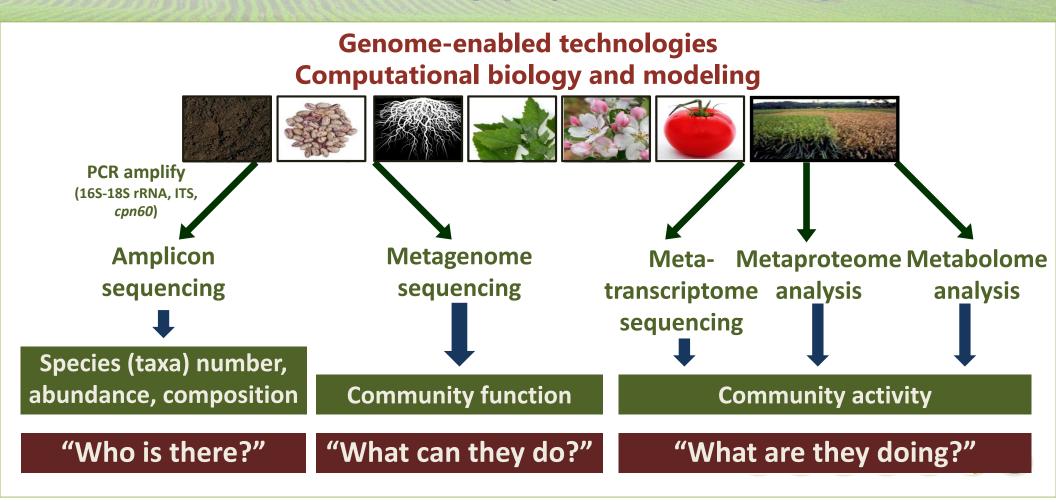
Atmospheric scientists Engineers Consumers

Translate that knowledge into application

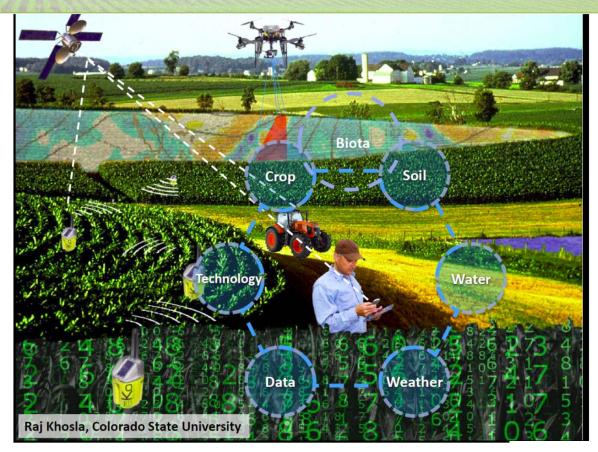
Why now? Convergence of need & opportunities



Advances in assessing phytobiome components

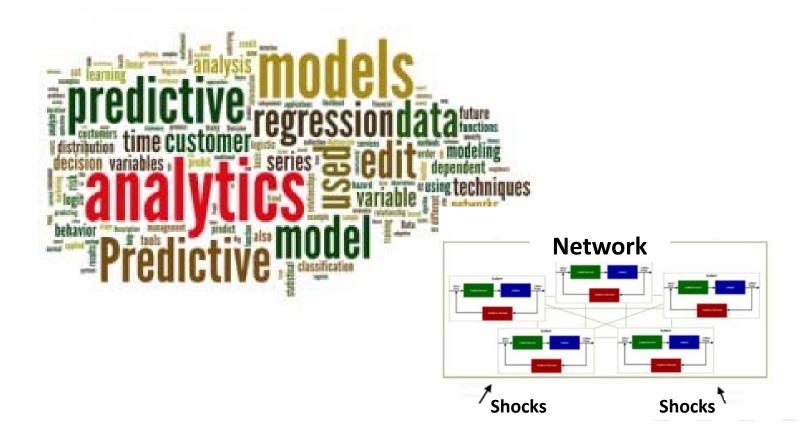


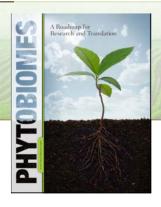
Advances in precision management strategies in agriculture



Mid-1990's: global positioning systems

Big data analytics





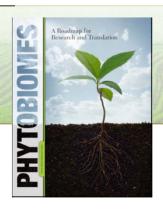
Vision

What genetic linkages connect phytobiome components?

→ Breed plants that select for beneficial communities

What constitutes a "healthy phytobiome"?

→ Develop biologicals and predictors of crop and soil health



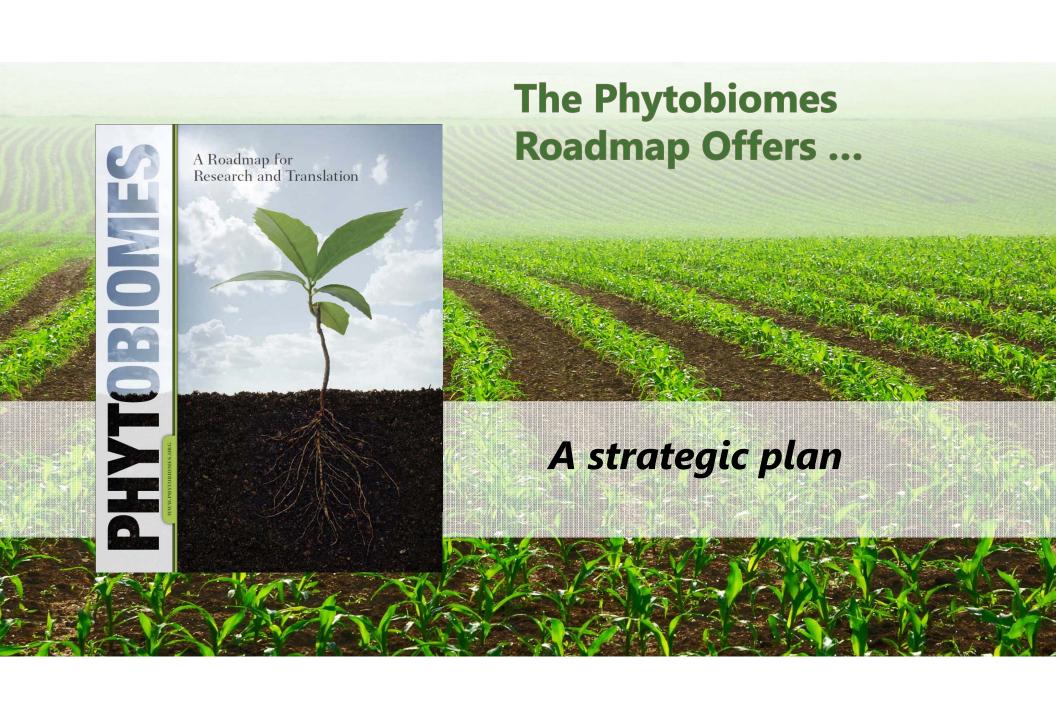
Vision

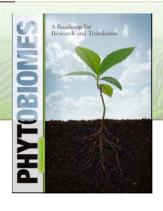
What are the mechanisms by which specific management practices promote ecosystem health?

→ Design novel or improved management practices

Can we exploit predictive and prescriptive analytics to design site-specific solutions to environmental challenges?

→ Incorporate biological information into the next generation of precision agriculture technologies

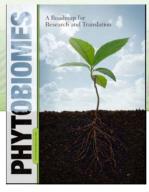




Phytobiomes Roadmap identifies:

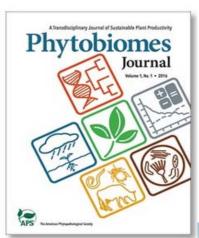
- Major gaps in
 - Knowledge
 - Technology
 - Infrastructure
- Challenges in educating and training a future workforce
- Short-, mid- and long-term actions and goals for the future

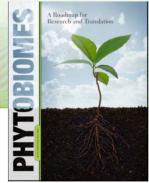




Actions

- Forming linkages among disciplines to recruit a broad base of expertise to the field of phytobiomes
- APS is launching a new, open-access journal
- Advocating for new support for phytobiome research





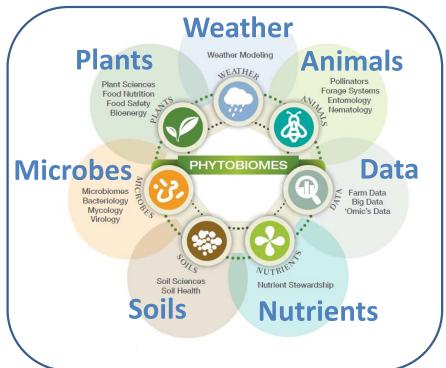
Actions

Establishing the International Alliance for Phytobiomes Research, a public-private alliance to enhance

interdisciplinary networks



Working to attract and strengthen a cross-trained workforce

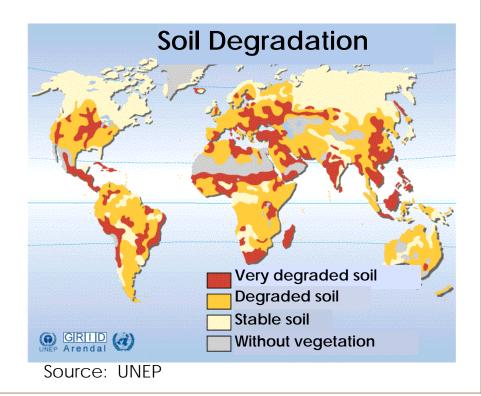


Outcomes of this new vision for agriculture

Managed or engineered phytobiomes that promote:

 Effective rehabilitation of degraded and depleted lands worldwide

*1.5 billion people depend on degraded lands for survival!



Outcomes of this new vision for agriculture

Managed or engineered phytobiomes that promote:

- Increased resilience of our cropping systems to pests, pathogens, water and nutrient limitation
- Pest control practices that are best suited for sustainable productivity
- Full integration of biologicals into site-specific crop management – moving us to the nextgeneration precision agriculture



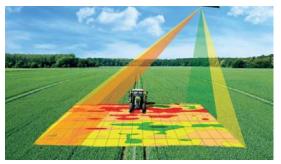
Outcomes of this new vision for agriculture

Adaptive, data-driven, on-farm systems for managing phytobiomes for optimal productivity





Audiencescapes



www.linkedin.com/pulse/foreign-affairs-precision-agriculture-revolution-ulrich-adam

Future Events



Join Us for the Conference on

Phytobiomes: From Microbes to Plant Ecosystems

November 8–12, 2016 | Santa Fe, New Mexico | USA

Organizers: Jan Leach | Kellye Eversole | Jonathan Eisen | Gwyn Beattie | Marcos Machado

http://www.keystonesymposia.org/17S2

