From Simple to Complex – Phytobiomes and the 2050 Vision for Agriculture

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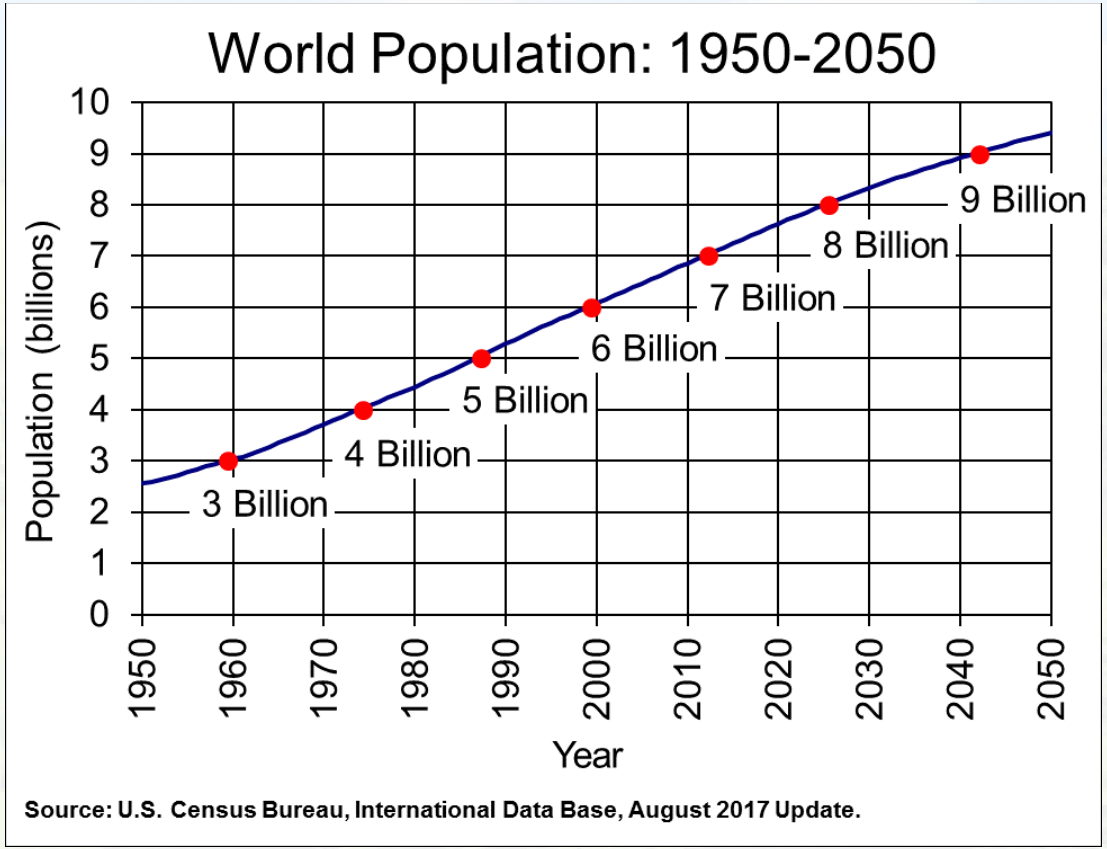
Partnerships in Bicontrol, Biostimulants & Microbiome Conference

Philadelphia, Pennsylvania

The Global Challenge



32 Growing Seasons

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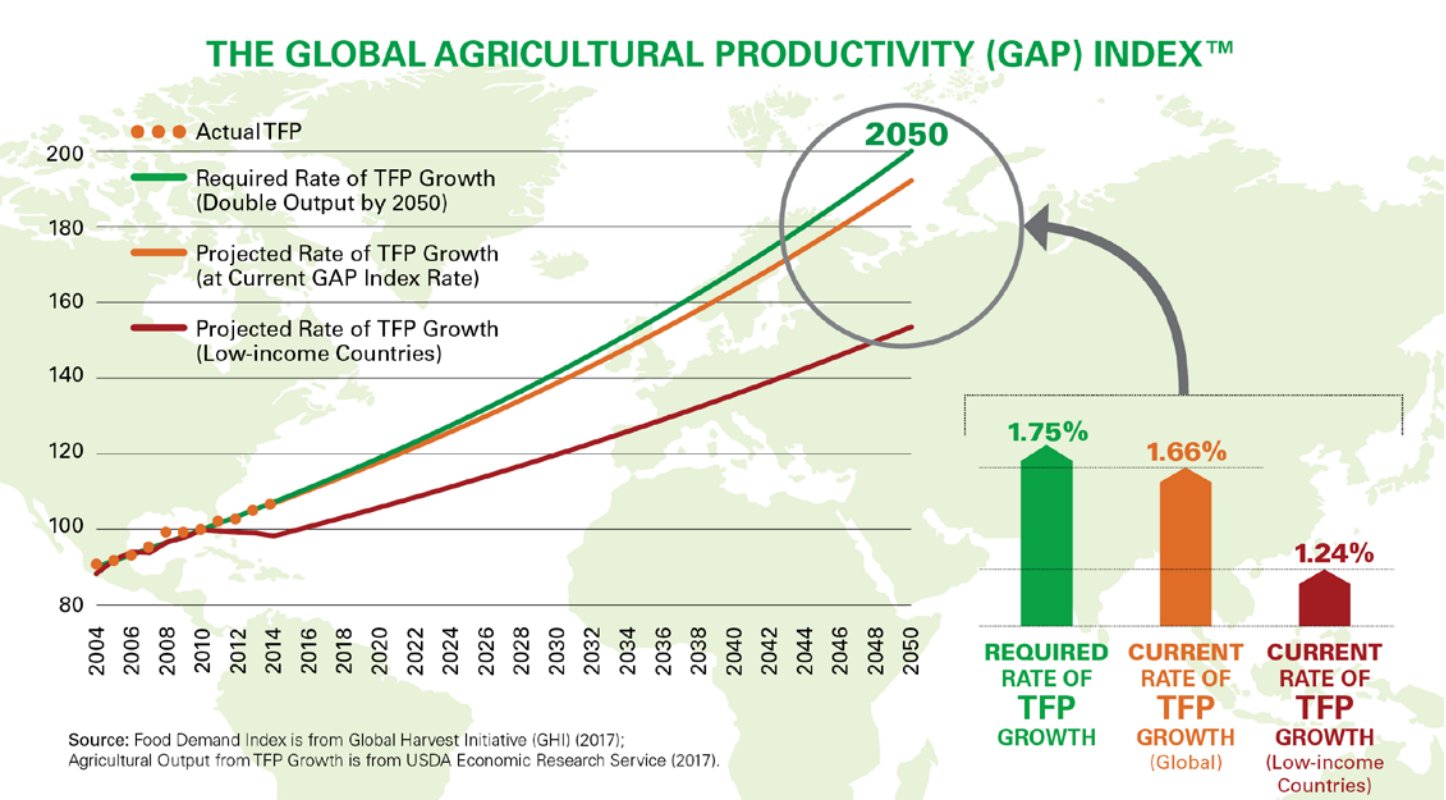


TFP= Total Factor Productivity – the ratio of outputs to inputs

2017 GAP REPORT GLOBAL AGRICULTURAL PRODUCTIVITY REPORT

Agricultural Productivity is not rising fast enough to sustainably feed the world in 2050

#GAPReport
@Harvest2050

Moving From Simple to Complex

Traditional science approach

- Reductionism
- World is linear – focus on individual components
  - Soils
  - Plant genetics
  - Microbiomes or
  - Weather

Reality – agriculture is a **complex** system

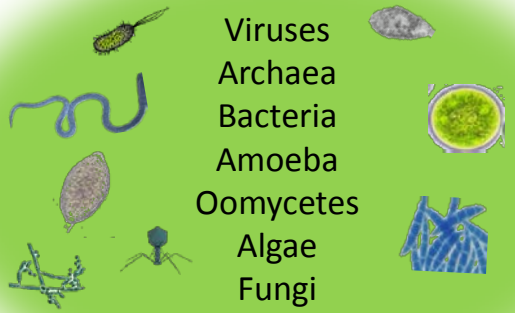
- non-linear organization
- governed by multiple non-linear interactions and environmental variables
- adaptation via learning or evolution
- it can be influenced

Paradigm shift to a systems approach – the phytobiome

Phytobiome: A Complex System

Climate and Weather

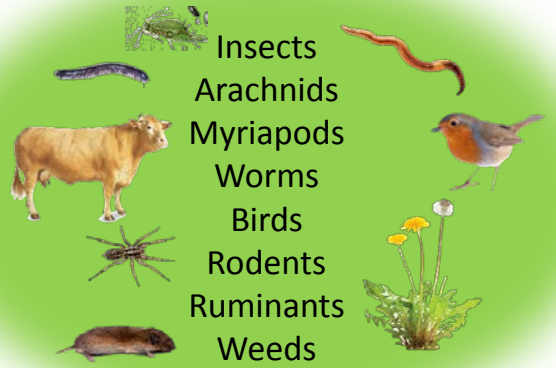
Micro- and Macro-organisms



“Biome” – Site specific environment

Plants

Arthropods, Other Animals and Plants



Associated organisms

Holy Grail for Phytobiomics

To understand, predict, and control emergent phenotypes within specific phytobiomes for the sustainable production of food, feed, and fiber

How do we get there?

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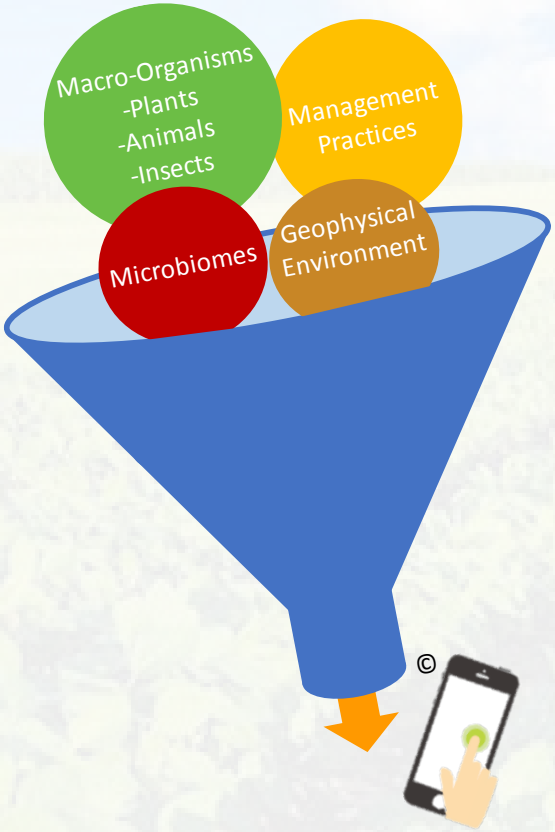
INTERNATIONAL ALLIANCE
FOR PHYTOBIOMES RESEARCH

A nonprofit consortium of industry, academic, and governmental scientists

Phytobiomes Alliance

Our **mission** is to establish a science and technology foundation for site-specific, phytobiome-based enhancement of sustainable food, feed, and fiber production

Phytobiomes Alliance 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.

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Strategies

- Focus on pre-competitive science
- Determine research, resource, and technology gaps
- Coordinate and manage projects to address gaps
- Facilitate linkages within and between industry and academia
- Empower industry growth and profitability

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Short-term Priorities

- Databases that support correlation studies between biological and geophysical phytobiome components
  - Whole genome & 16S microbe sequences, metagenomics
  - **Metadata** to include crop, variety, soil characteristics, weather and climate, management practices
- Standards (minimum information, sampling, reference datasets…)
- Genome sequence-based classification system for microbes
- Preliminary crop models for several agroecosystems (cereals, vegetables, forage, trees…)
- Regulatory science roadmap for microbials
- Research that links site-specific and temporal physical and biological data

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Fundamental Research Areas

- Universal, common, and environment-specific trends in phytobiome composition
- Mechanisms by which distinct phytobiome components interact
- Genetic linkages that connect phytobiome components
- Impacts of phytobiome components on plant health
- Multidirectional feedbacks that influence phytobiome components

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Longer-term Targets

- Simple, simulation models that are functionally accurate to real world complex conditions – e.g., greenhouse studies that reflect field conditions
- Validated & optimized models
- Systems level predictive and prescriptive analytics for on-farm implementation

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Thanks to International Alliance for Phytobiomes Research Sponsors

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Thank you for your attention!

www.phytobiomesalliance.org