Microbials

Impact on agriculture and the seed industry

Marcus Meadows-Smith

BioConsortia, Inc.

Seed Central, UC Davis, 9 February 2017

Agenda

1) Introduction to Microbials	- Marcus Meadows-Smith, CEO, BioConsortia
2) Agrinos	- Dr. Mylavarapu Venkatramesh, VP Discovery Research
3) UC Davis	- Dr. Venkatesan Sundaresan - Professor, Plant Biology & Plant Sciences
4) Novozymes	- Dr. Matthew DiLeo, Application Development Group Leader
4) Bayer CropSciences	- Dr. Varghese P. Thomas, Principal Scientist, Microbiology & Crop Efficiency, Biologics

Microbials - why should you be interested?

Impact on and Opportunities for the Seed Industry:

#1 selling seed treatment in the USA contains a microbe
- PonchoVotivo from Bayer CropScience

Monsanto spends $50million on microbial R&D field testing 2,000 microbes per year
- adding microbial seed treatment to **all new 2017 corn hybrids**

New microbial on 50,000 acres cotton demonstrated an **11% yield** increase
- Indigo Cotton – improving yields under water stressed conditions

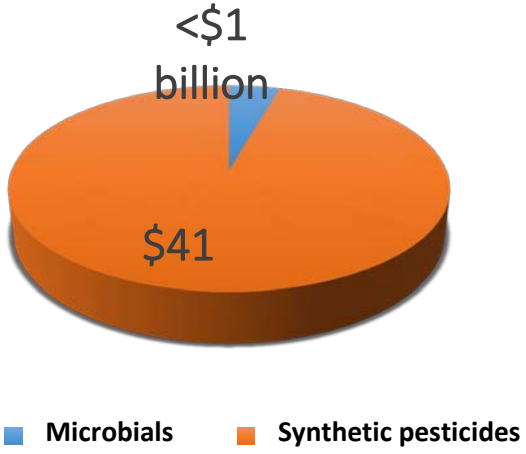
Microbes can impact almost **any trait** on most crops
- BioConsortia's AMS process has demonstrated increase in % sugar content

Historic Market

Perceptions

- Less effective
- Inconsistent
- Hard to use

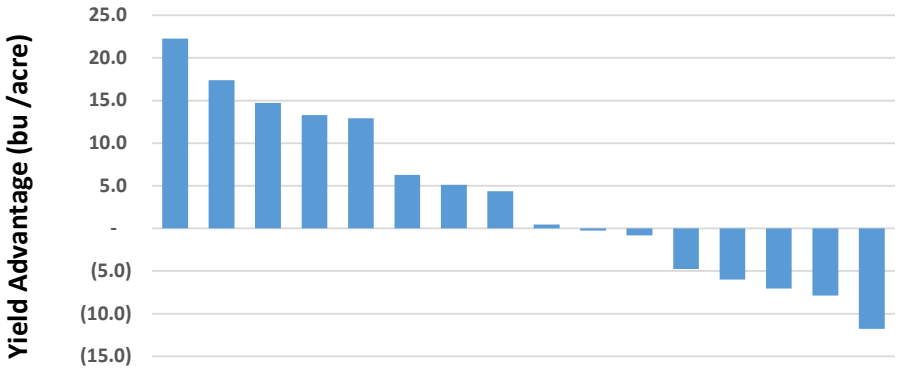
Global Pesticides Market 2009 (1)



Limited Markets

- Organic food
- Residue management on F&V
- Dominated by small companies
- Bt - the only significant product

Yield Effect - Microbial Seed Treatment



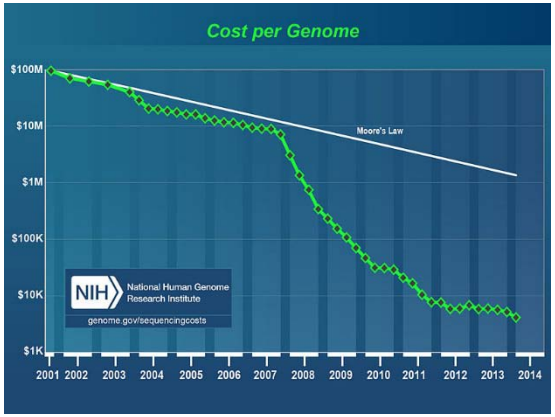
Year & source of market estimates: (1) BCC Research 2010

Growing Understanding – Microbes & Microbiome

"People are not just people. They are an awful lot of microbes too."

Other industries have helped to underwrite advancements in ag sector:

- Genome sequencing
- Big data management modeling
- Systems Biology
- Microbiome / community analysis
- Metagenomics
- Transcriptomics (RNA of community)
- Proteomics (protein expression)
- Pharmaceuticals
- Industrial Biotech



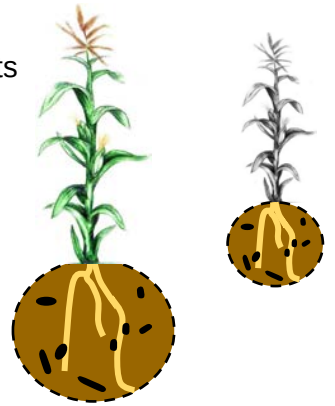
DSM BRIGHT SCIENCE. BRIGHTER LIVING. DANISCO novozymes Rethink Tomorrow CHR. HANSEN

Benefit plants by providing:

- Access to macro and micronutrients
- Pathogen and pest resistance
- Plant growth hormones
- Stress protection

Modify plant functions:

- Structure and growth
- Metabolite production



Harmful to plants:

- Pathogens
- Growth suppression

Drivers for growth & adoption

Macro Drivers

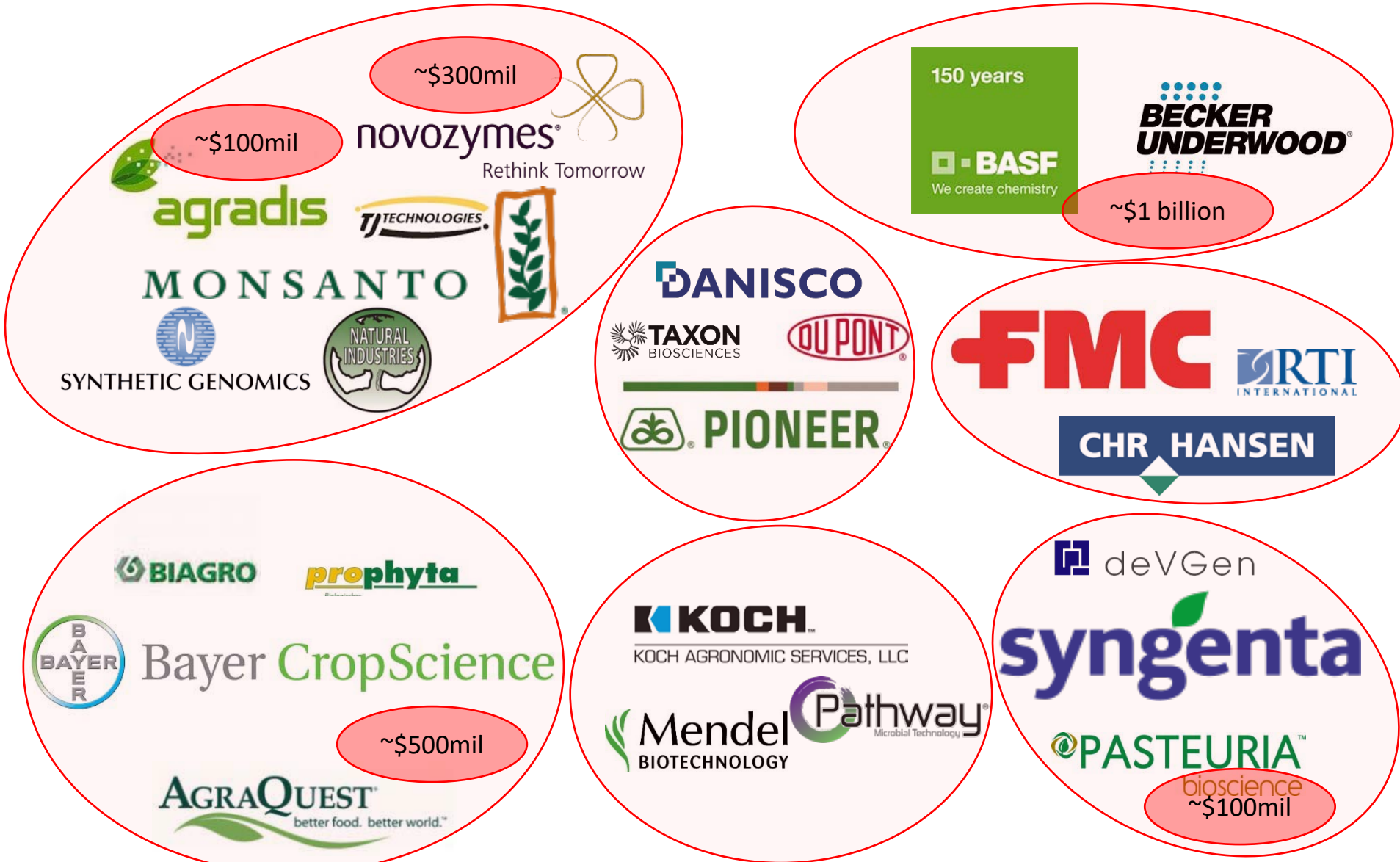
- Pesticide residues
- Resistance Management
- Fertilizer run-off & leaching
- Regulatory pressures/Delisting of many Pesticides
- Climate volatility: droughts, flooding
- “Green” pressure from Food Value Chain & consumers

Other Key Factors

- R&D costs for synthetic pesticides
  - Synthetic > $ 230 million, 8-10 years
  - **GM Trait $ 130 million, 12-14 years**
  - Biopesticide $ 25 million, 5-6 years
- Mind set change in Ag leadership
- Enhanced credibility
- Superior products

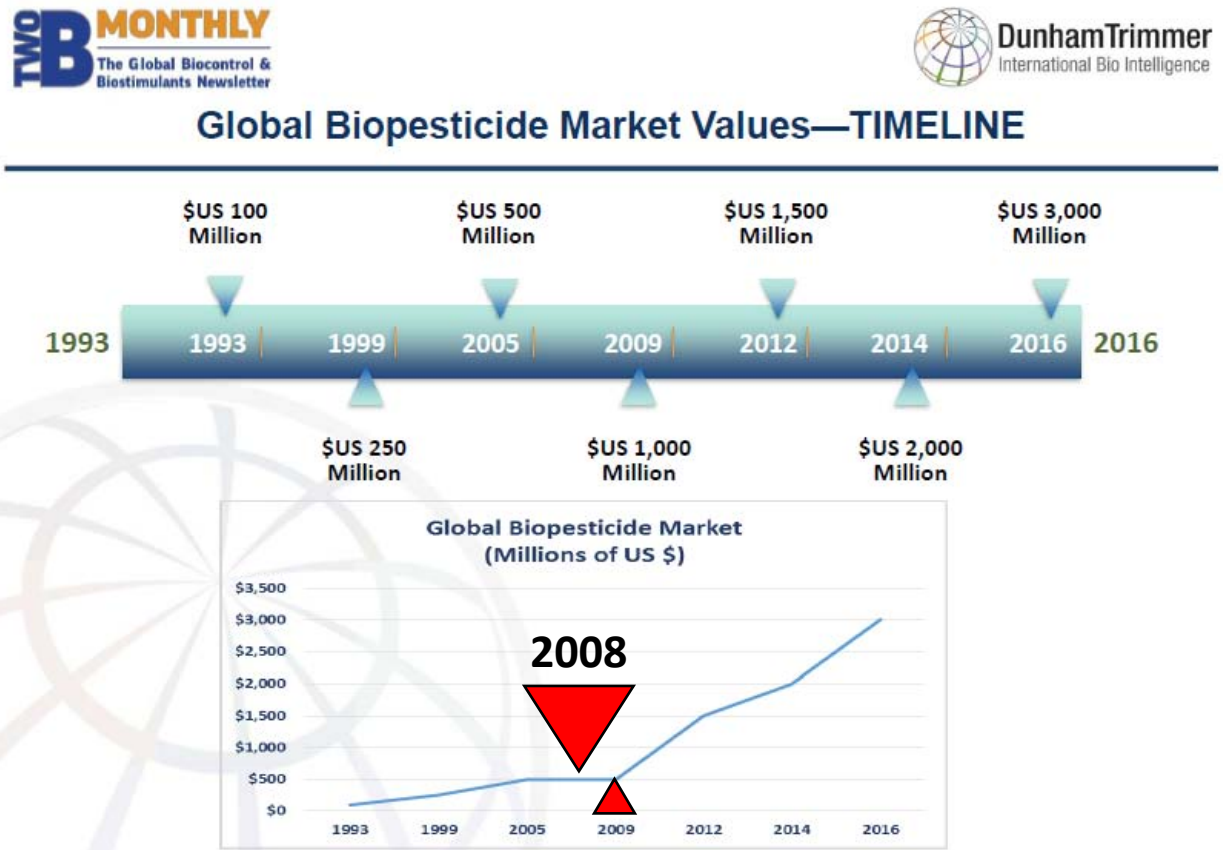
Industry 2008 … 100's small players

Focus & Investment in Microbials



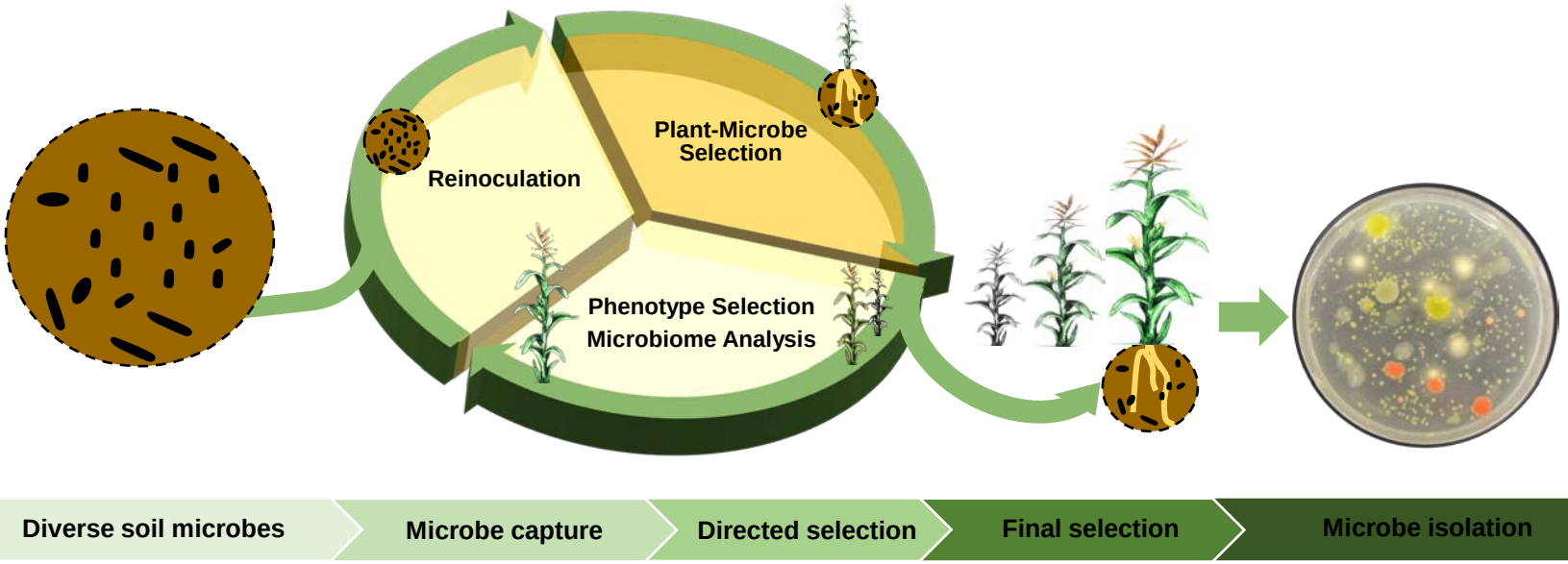
Market Growth

Projected CAGR of 15.3% reaching $4.5 Billion by 2019



Advanced Microbial Selection (AMS)

Directed selection of the microbiome to identify teams of beneficial microbes



Selection of superior plants
Plant phenotyping used to identify superior plants and potentially beneficial microbiomes

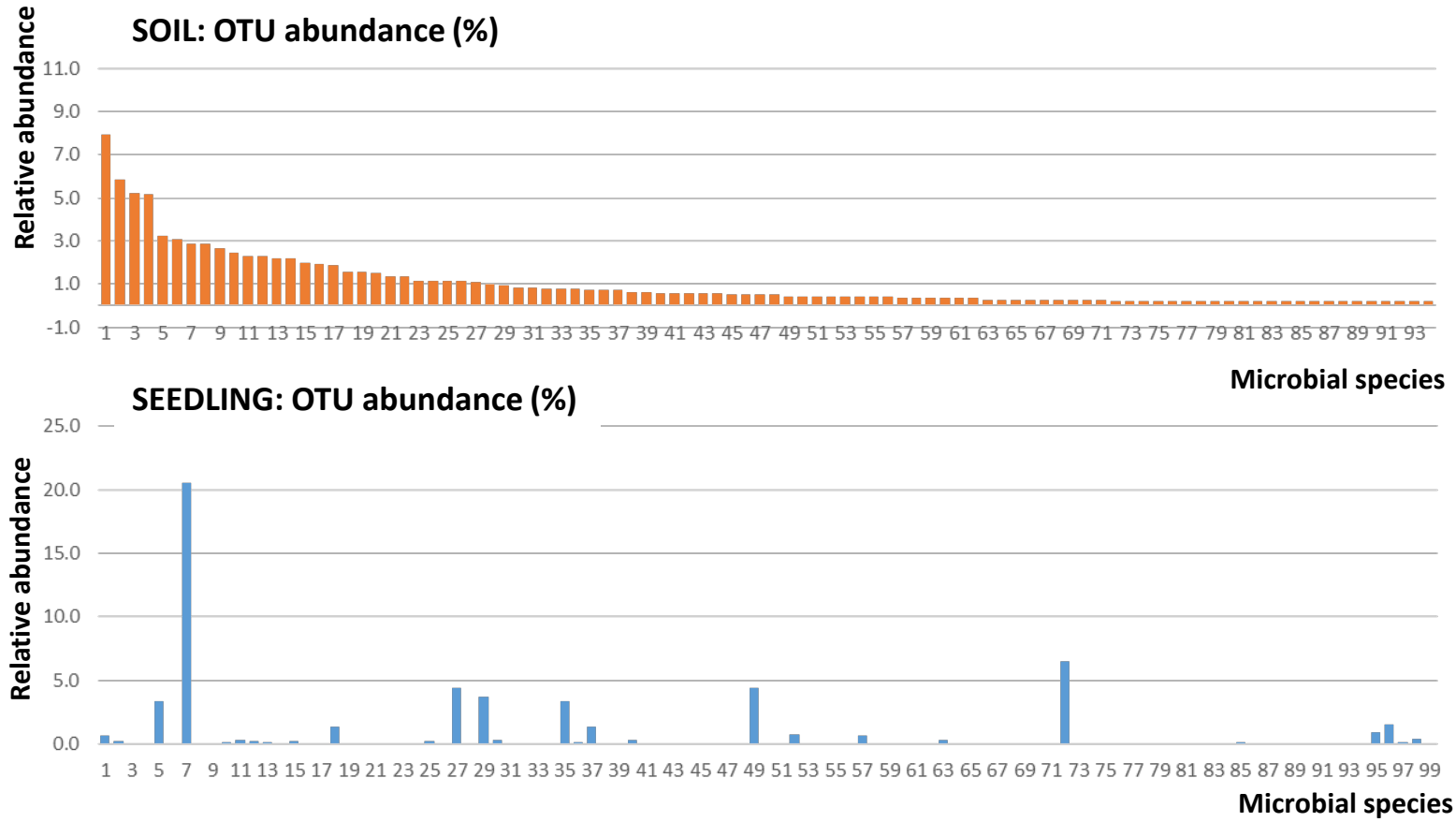
Evolving the microbiome
Iterative selection and advancement of beneficial microbiomes from superior plants

Improving plant trait performance
Isolation of microbes and construction of key consortia from superior plant microbiomes

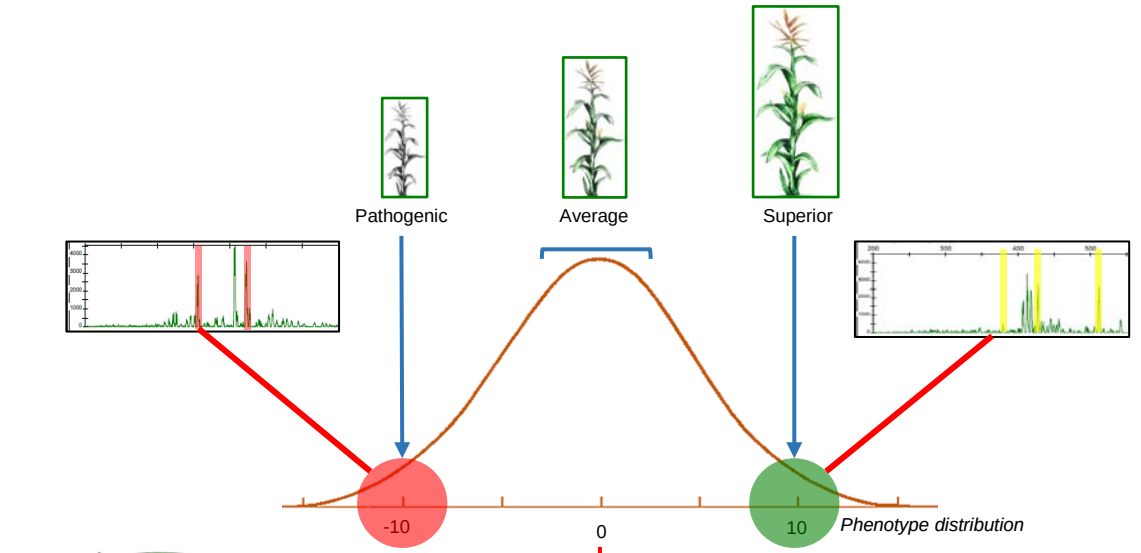
Proprietary, patented process

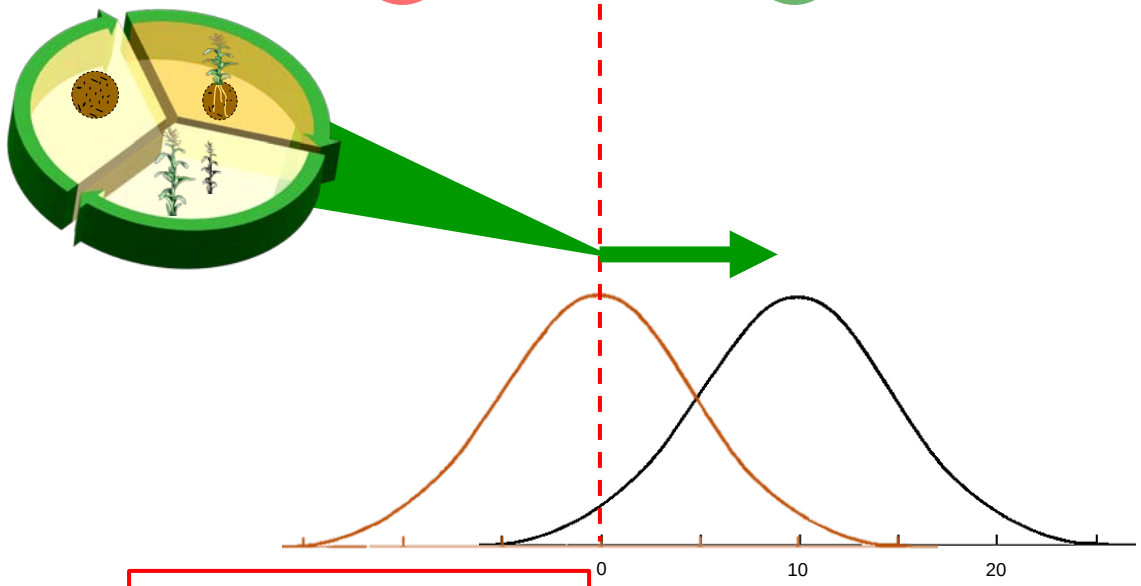
Soil vs Seedling Microbiome

Seedlings accumulate a different microbial community structure than that present in the soil



Directed Selection





Proprietary, patent-pending process

The AMS Process

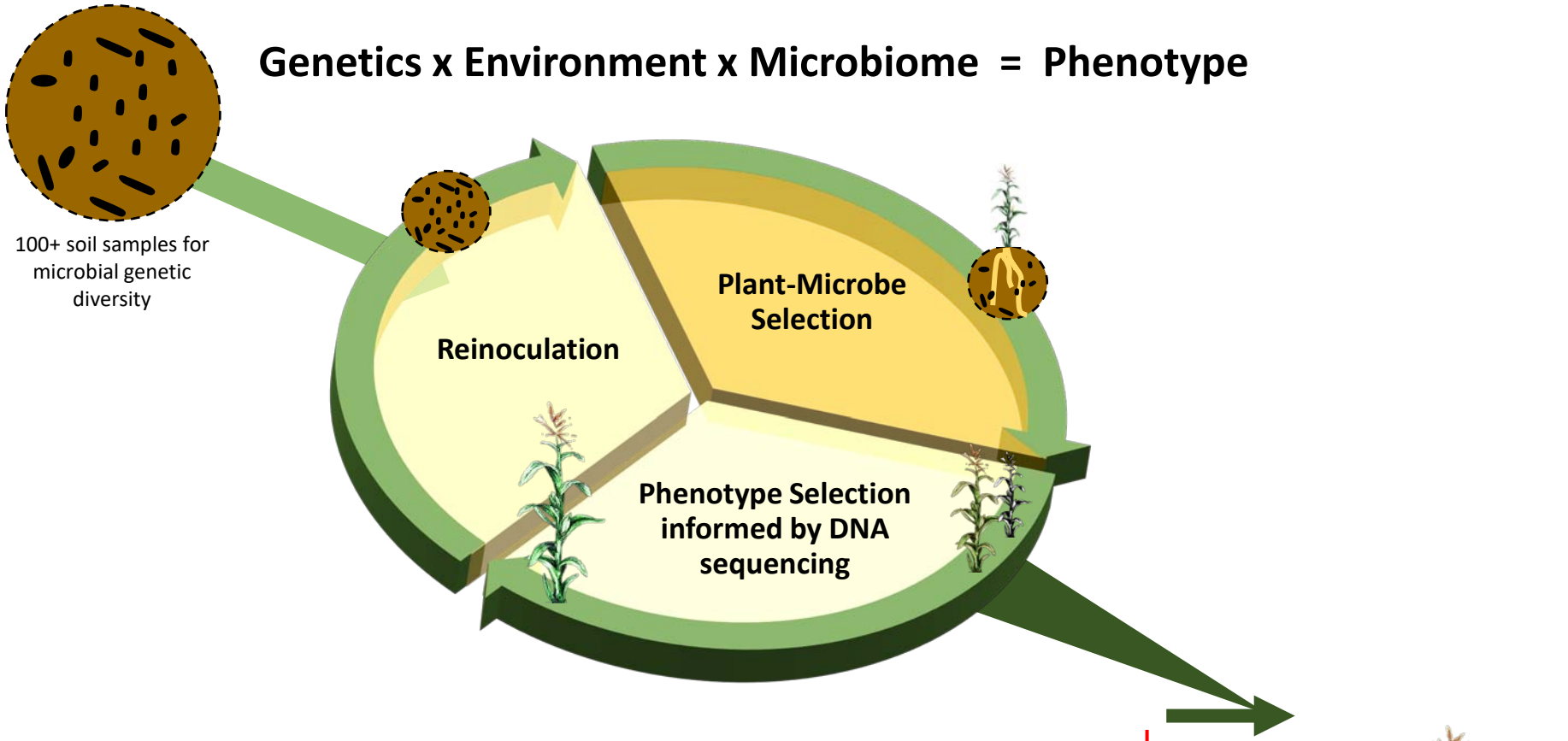
Selecting the superior phenotype
Selection in both ideal & stressed environments.

Changing the microbial community
Advancement of the most beneficial microbes through iterative selection rounds.

Driving an improvement in trait performance
Accumulation of microbes responsible for enhanced targeted traits.

G x E x M = Phenotype

Evolving the Microbiome



BioConsortia rapidly evolves the microbiome through **directed selection**: causing beneficial changes in the plant's microbial community for superior crop phenotypes.

Proprietary, patented process

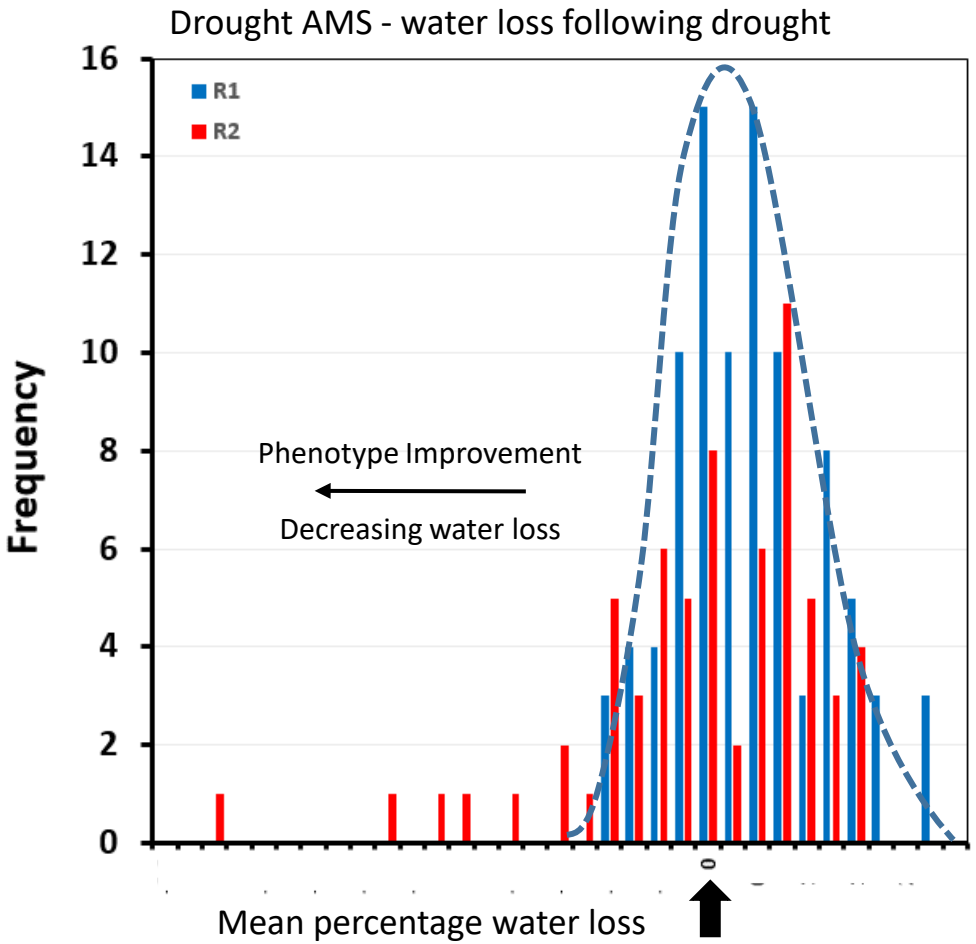
AMS Driving Trait Improvement

100 soils

Microbe capture

Round 1 selection

After AMS selection



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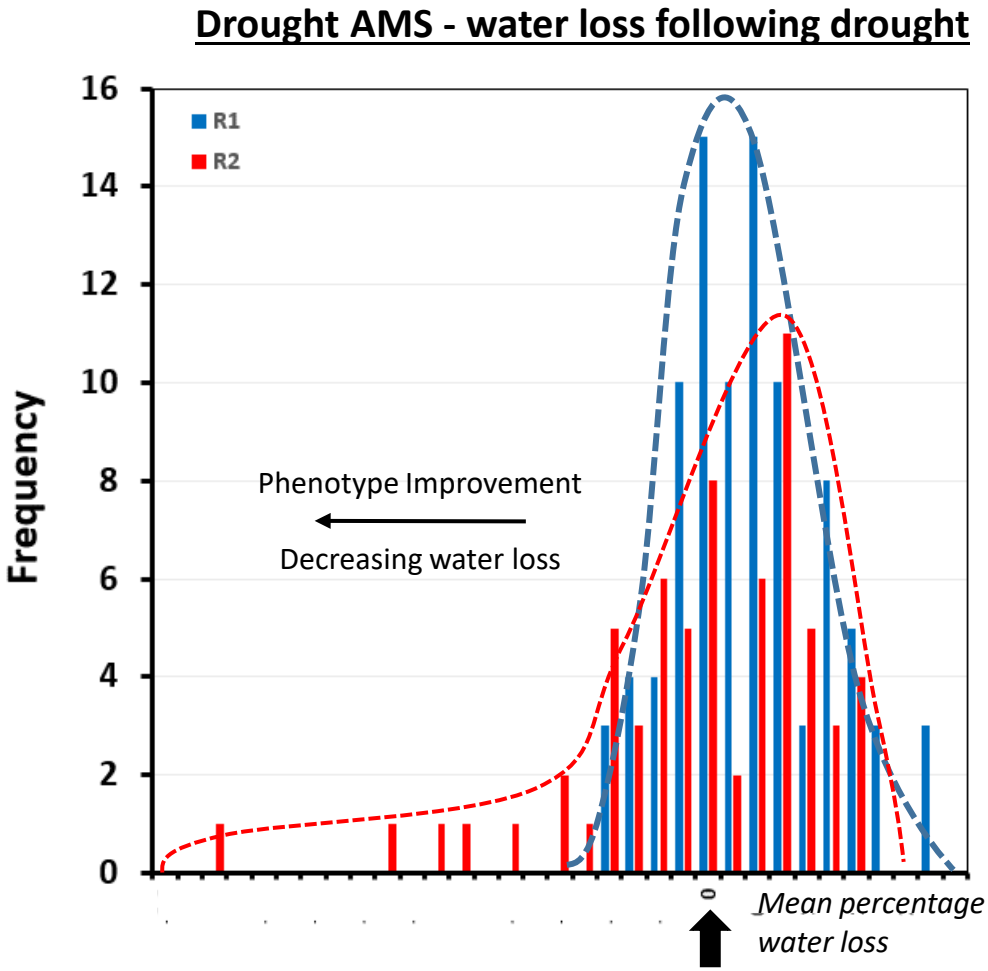

Improved Trait Performance

Corn 

Soybean 

Wheat 

Tomato 

Leafy Veg 

Pasture 

Fertilizer Use Efficiency

N, P, K

Abiotic Stress Tolerance

Drought & Salt Tolerance, Cold & Wet Tolerance

Biotic Stress Tolerance

Corn Root Worm, Nematodes, Soil and Early Season Pests & Disease

Metabolite Expression

Increased Sugar Content

Productivity

Emergence, Early Vigor, Root and Foliar biomass

Crop Yield

GM & Conventional Crops