

Potatoes and Microbes: A Pathway to Productivity, Soil Health and Sustainability

Alexander Fotsch

Locus Agricultural Solutions

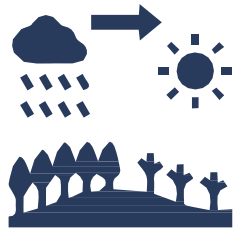
January 15, 2019



Major Challenges Impacting Today's Growers

Environmental Impacts

- Soil erosion and degradation
- Increasing climatic variability¹
- Drought conditions
- Runoff into waterways²



Declining Farm Incomes

- Increased operational costs³
- Variable yield and crop quality
- Abiotic stressors
- Decreased product efficacy



Regulatory Scrutiny

- Challenging regulatory hurdles
- GHG emissions
- Shift to organic (+10% CAGR)



1. KTVO, "Iowa DNR: Last 18 months the wettest on record," KHQA News, November 22, 2019, available at <https://khqa.com/news/state/iowa-dnr-last-18-months-the-wettest-on-record-11-22-2019>.

2. Daniel Hellerstein, Dennis Vilorio, and Marc Ribaud, "Agricultural Resources and Environmental Indicators, 2019" (Washington: U.S. Department of Agriculture Economic Research Service, 2019) available at https://www.ers.usda.gov/webdocs/publications/93026/eib-208_summary.pdf?v=2348.3


3. "Rising Wages Point to a Tighter Farm Labor Market in the United States." USDA ERS - Rising Wages Point to a Tighter Farm Labor Market in the United States, www.ers.usda.gov/amber-waves/2019/february/rising-wages-point-to-a-tighter-farm-labor-market-in-the-united-states/.



Soil Microbes Can Act As An Attractive Solution To Improve:

Soil Health

- Water-use efficiency
- Nutrient availability
- Soil structure
- Vigorous microbiome




Profitability

- Crop yields and quality
- Crop abiotic resistance
- IPM tools and approach



Sustainability

- Nutrient leaching and runoff
- Worker safety
- Carbon capture
- N₂O and Methane emissions



...and these benefits can be achieved **today**



Microbes: An Important Part of Our World

The world's functional chemistry is dictated by microbes



- **Probiotics for Humans:** “Good bacteria” to support gut bacteria and positively impact the digestive system
- **Probiotic Activity:** Microbes regulate much of the metabolic activity in our digestive systems that drive nutrient status, immune health and general vitality
- **Probiotic Benefits:** Increased nutrient absorption, protect gut from harmful bacteria, and preventing allergies and colds¹



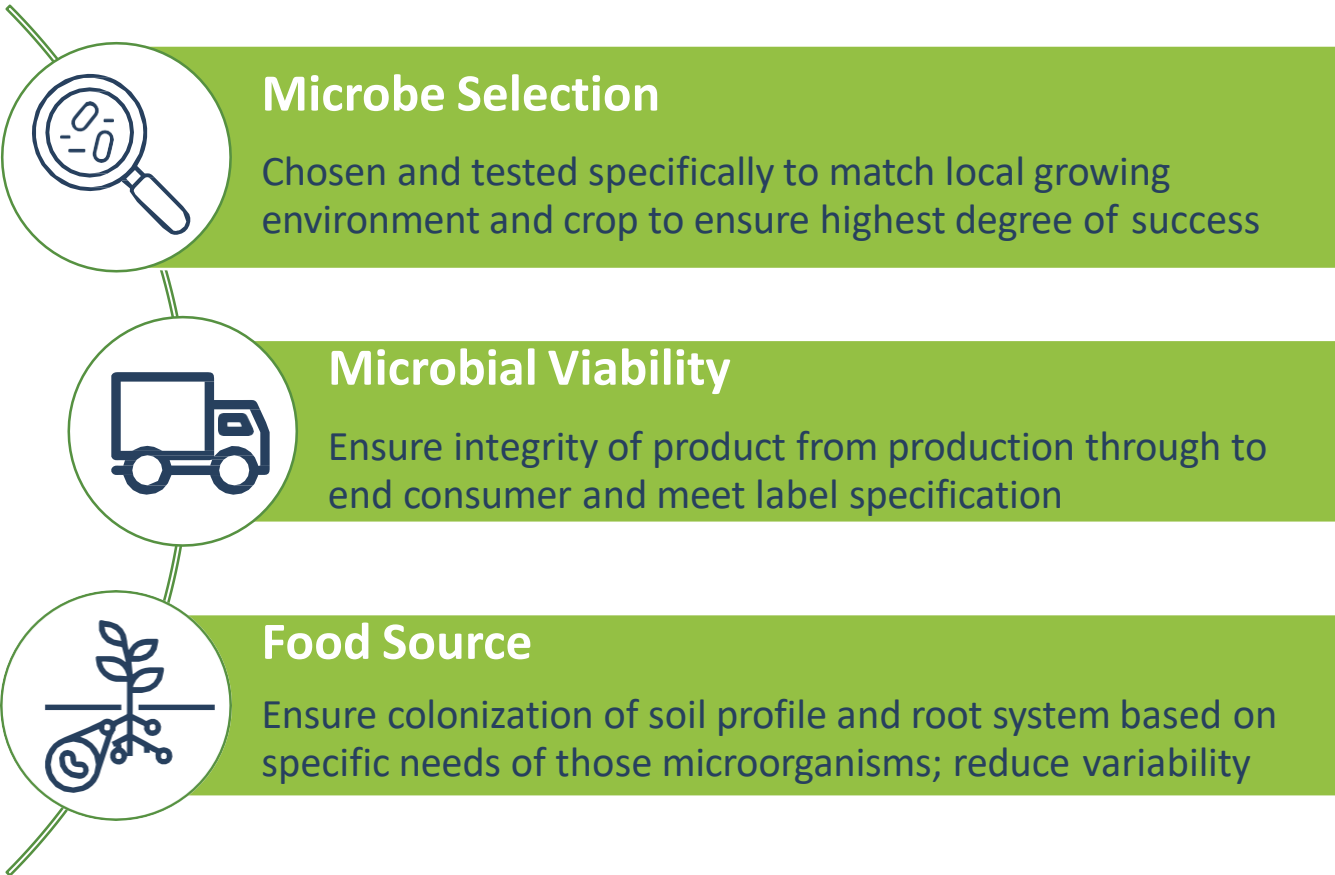
- **Plant Probiotics:** Beneficial microbes which interact with plant and soil especially in rhizosphere
- **Plant Probiotics Activity:** Decades-long research from private and public institutions has shown soil microbes support soil health and plant productivity
- **Plant Probiotics Benefits:** Improvements to nutrient availability, soil compaction and water retention, and regulation of GHG emissions

1. <https://www.webmd.com/digestive-disorders/what-are-probiotics#1>



Recent Microbial Innovations

Innovations in microbial production and development mitigate variability and challenges of previous products

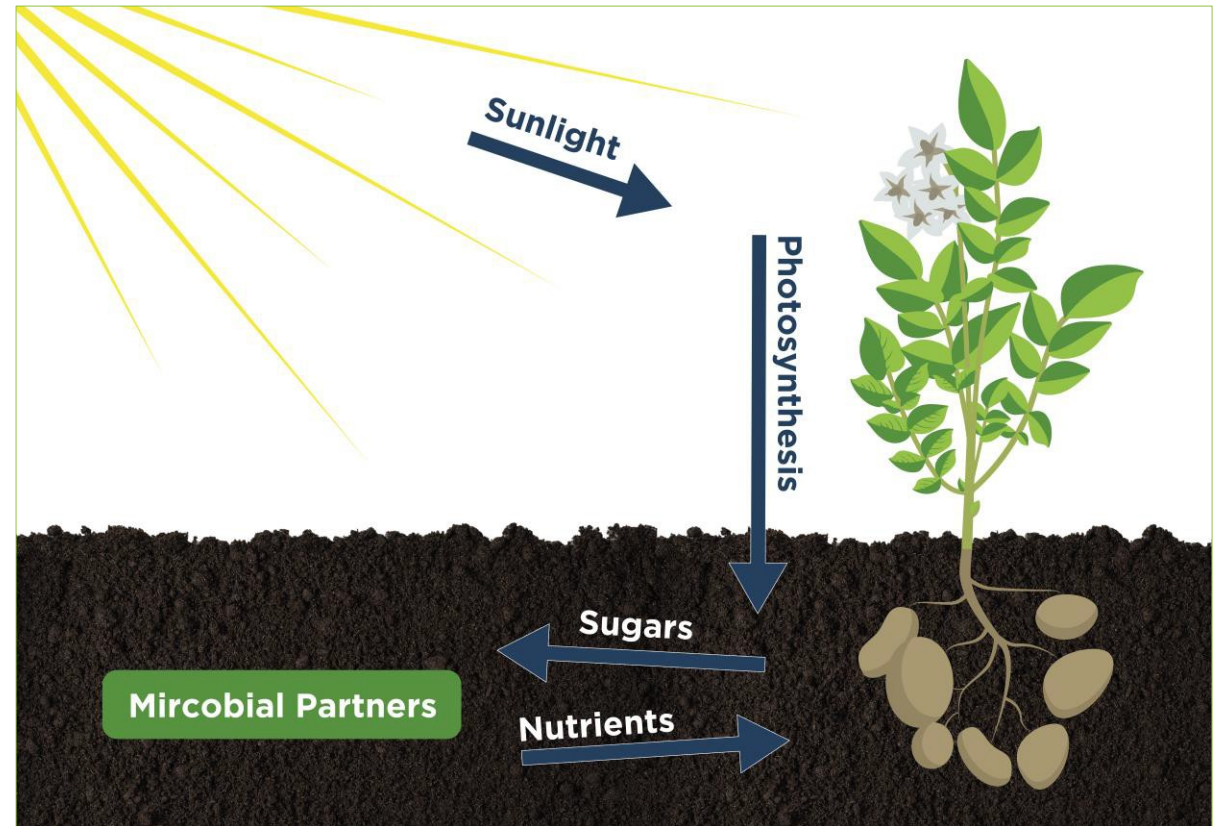


- ✓ Growers already realizing benefits
- ✓ Fits into grower's existing production practices
- ✓ Performs in a variety of growing environments
- ✓ Additional tools for growers



Soil Microbes: Symbiotic Relationship with Plants

1. Plants fix sugars through photosynthesis in their leaves
2. Sugars are translocated throughout the plant
3. Up to **20% of sugars are exuded through root system** to attract and feed beneficial microbial partners
4. Microbes provide plant with nutrients, extend root system, and improve soil quality



Walker, Travis S., et al. "Root Exudation and Rhizosphere Biology." *Plant Physiology*, American Society of Plant Biologists, 1 May 2003, www.plantphysiol.org/content/132/1/44.

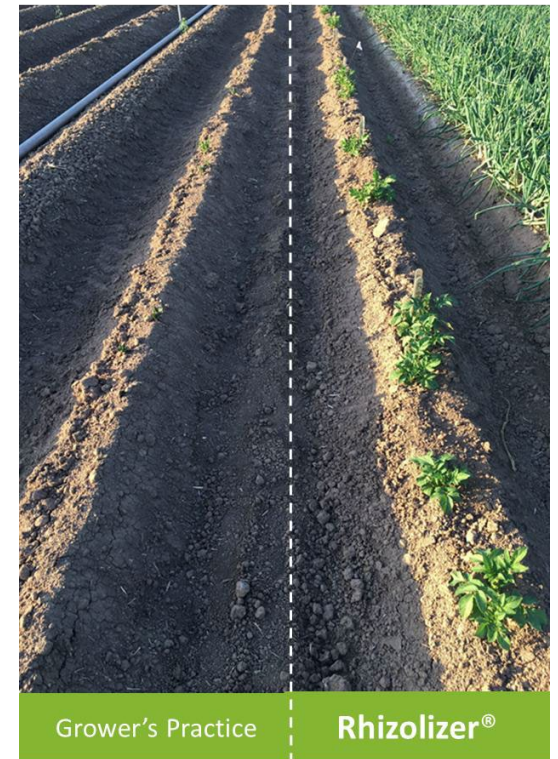
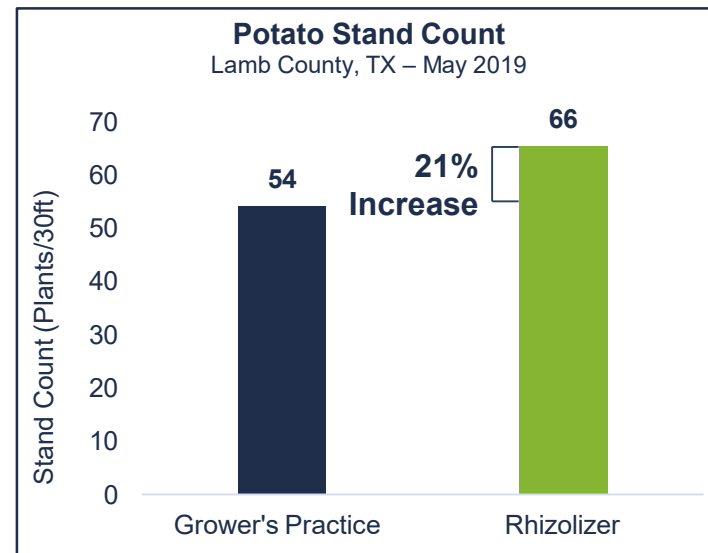
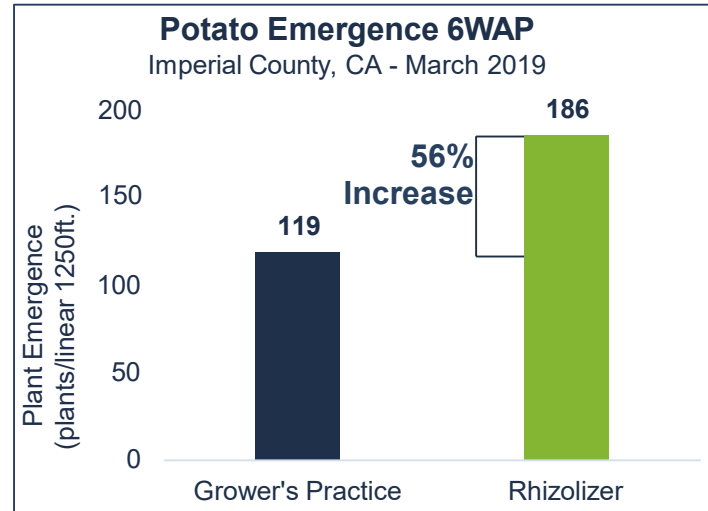
Guyonnet, Julien P, et al. "Root Exudation Rate as Functional Trait Involved in Plant Nutrient-Use Strategy Classification." *Ecology and Evolution*, John Wiley and Sons Inc., 30 July 2018, www.ncbi.nlm.nih.gov/pmc/articles/PMC6144958/.



Early Season Benefits From Microbial Soil Amendments

At plant applications or during early season growth microbes promote:

- ✓ Quicker and improved germination
- ✓ Better stand count
- ✓ Increase yield potential
- ✓ Reduce time to market

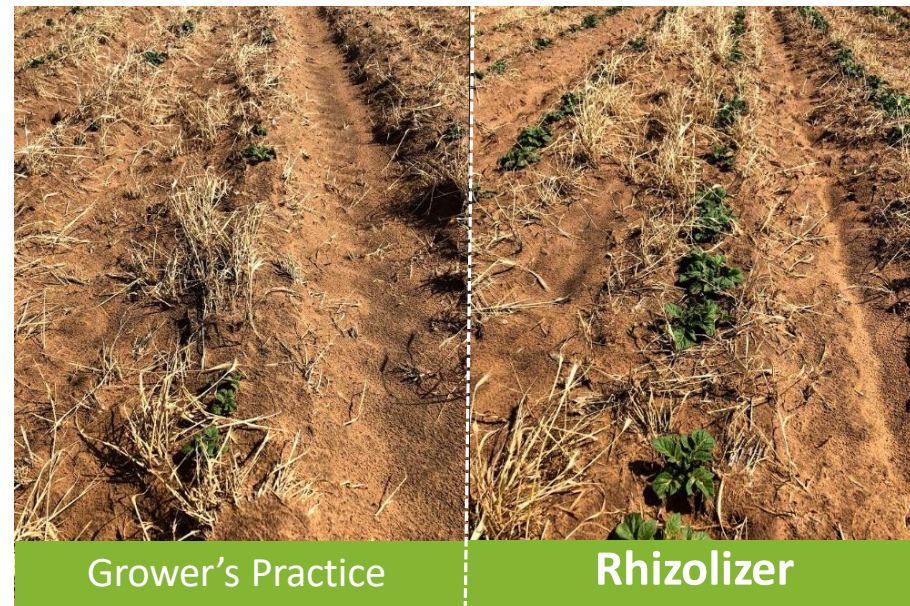
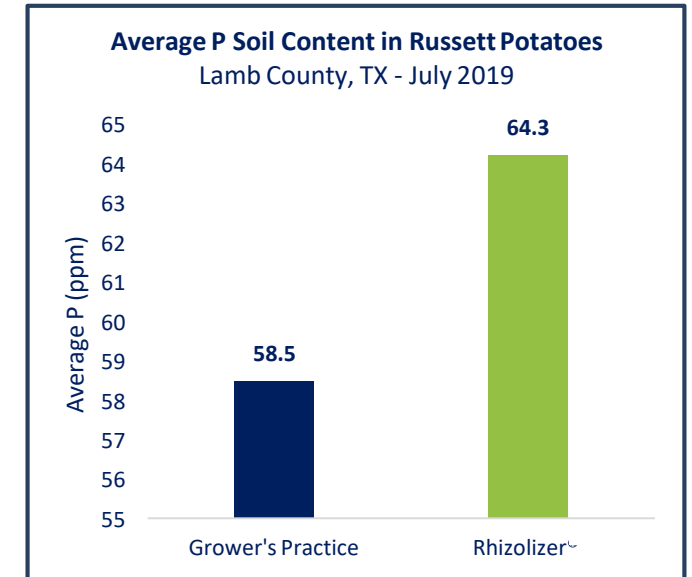
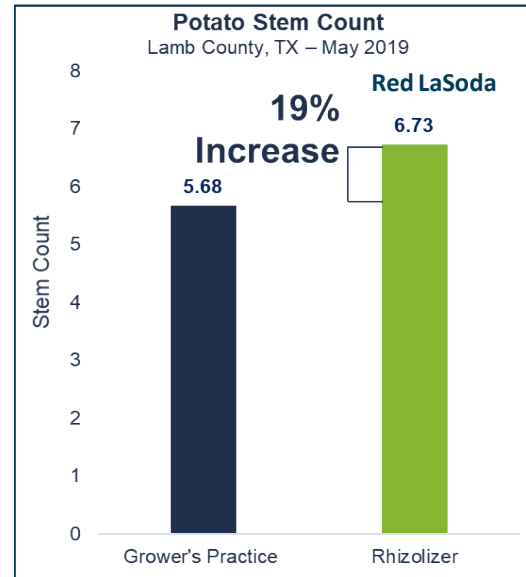


Red LaSoda
Data collected 28DAP

Mid-Season Benefits From Microbial Soil Amendments

More developed root system will form deep and fibrous root mass, which in turn can enhance the volume of available surface area for:

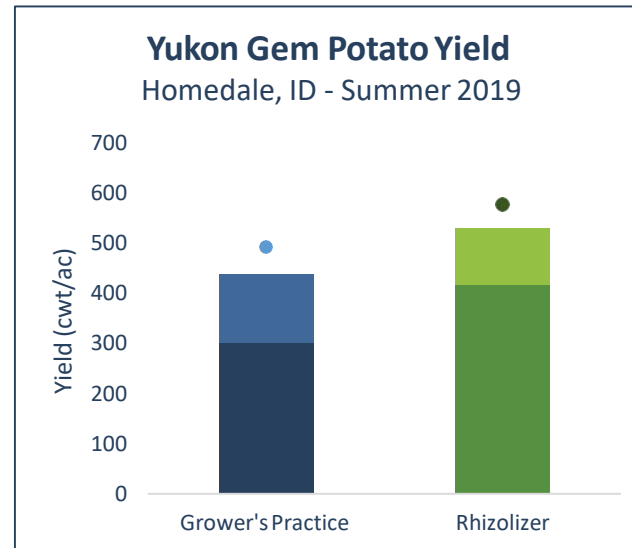
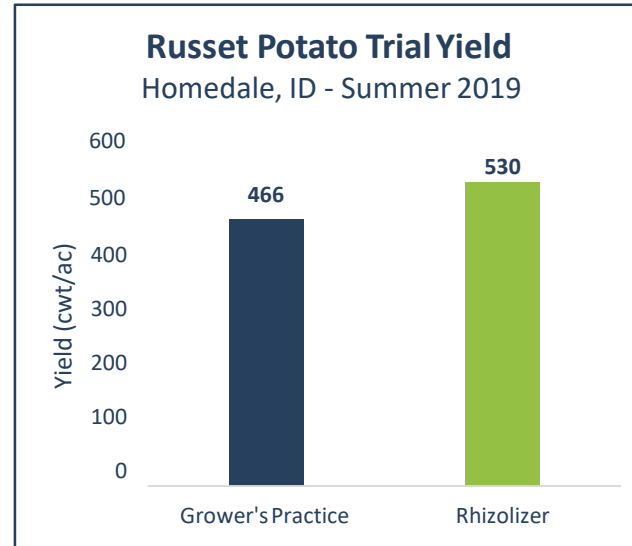
- ✓ Outcompete weeds through quicker canopy closure
- ✓ More efficient water utilization
- ✓ Improved nutrient uptake into the plant



Late Season Benefits From Microbial Soil Amendments

Late season crop performance benefits from microbial product applications:

- ✓ Improve yields through more vigorous growth throughout growing season
- ✓ Increase crop abiotic resistance and withstand stress
- ✓ Higher proportion of marketable crop, less culls

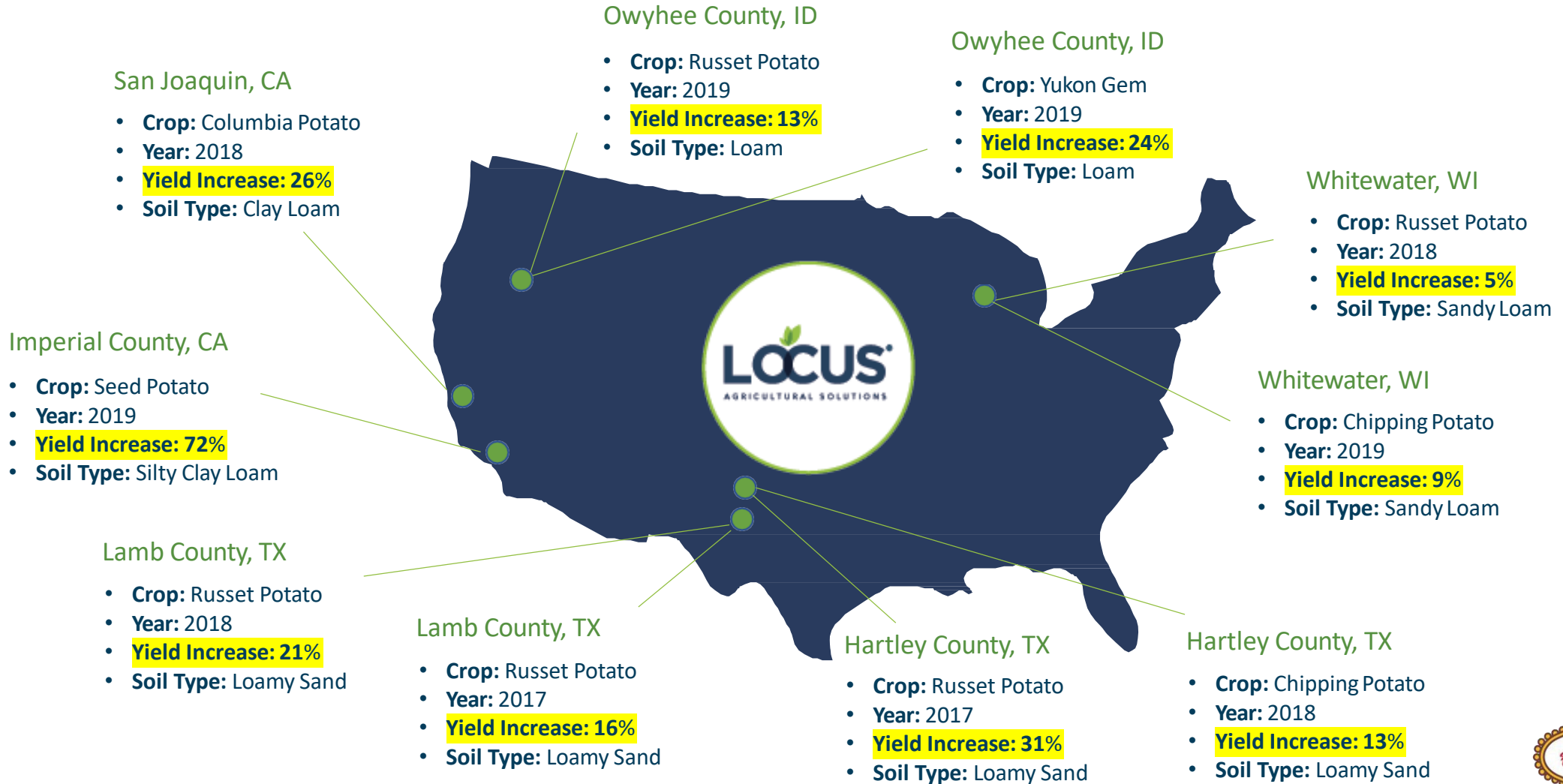


- = Total Yield
- Light color = >8oz
- Dark color = 2-8oz



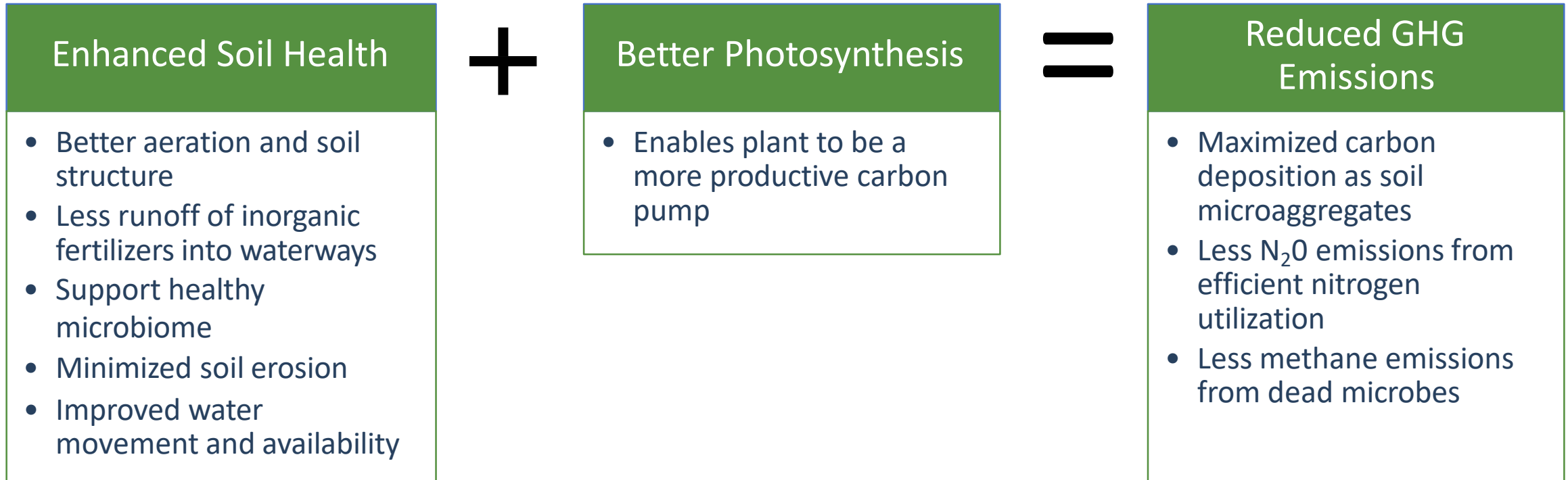
Field Trials Confirm Excellent Results Using Microbials

Consistent Yield Increases and Attractive ROI Across Various Growing Environments, Soil Types, and Seasons



Environmental Benefits of Microbes

The agronomic benefits of microbial use result in additional environmental benefits:



Consistent performance across a variety of soil types and growing conditions should support the adoption of these technologies alongside existing practices



Microbial Ag Technology: A Growing Space

Interest and investment in the microbial ag tech space has grown significantly



Thank You

Alexander Fotsch

Locus Agricultural Solutions

Vice President of Agricultural Operations

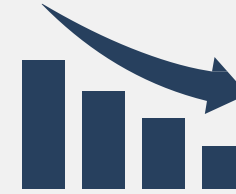
(440) 561-0800; 119

afotsch@locusfs.com



Significant Reduction in Soil Nitrous Oxide Emissions

Soil Nitrous Oxide emissions incur one of the **highest carbon intensity penalties**



Rhizolizer **decreases** Soil Nitrous Oxide (N₂O) emissions by:



75-85%
Corn



87%¹
Citrus



60%¹
Potatoes

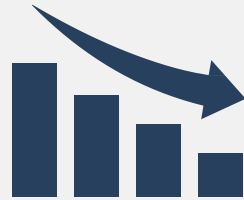
The decrease *is separate* from any nitrogen input reductions

¹Citrus and potato data collected and verified by researchers at Texas A&M University



Significant Reduction in Soil Nitrous Oxide Emissions

N₂O is a far more potent greenhouse gas (GHG) than CO₂ emissions (300x worse), and its soil emissions incur one of the **highest carbon intensity penalties**



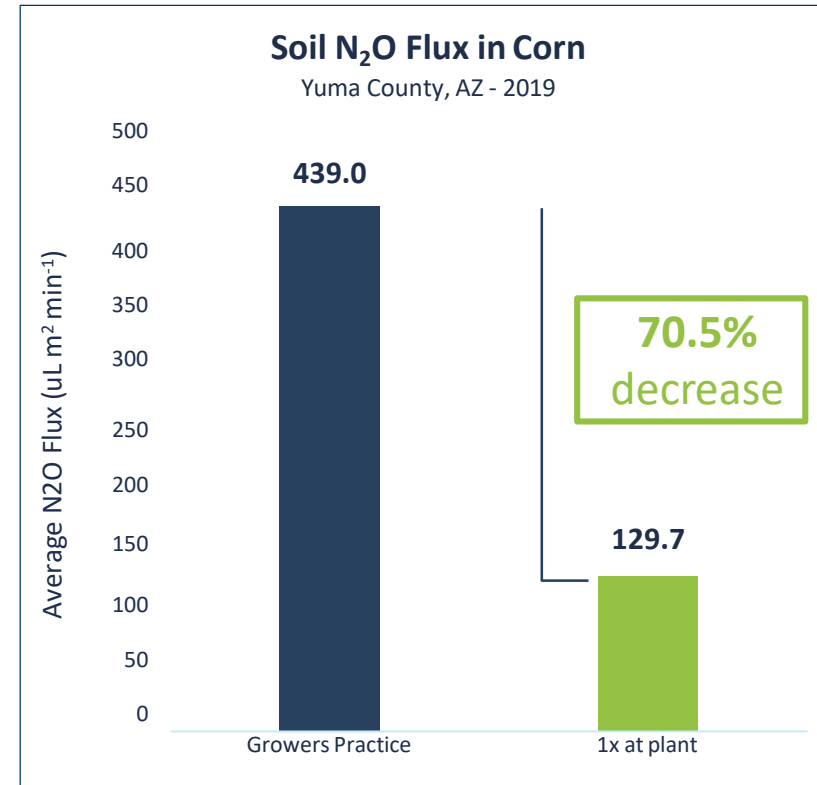
Rhizolizer **decreases** soil Nitrous Oxide (N₂O) emissions by:

70-85%



Corn

The decrease is **separate** from any nitrogen input reductions



Syngenta 0966 Sweet Corn
Rhizolizer 1x; 3.0 fl oz / acre
One application

