



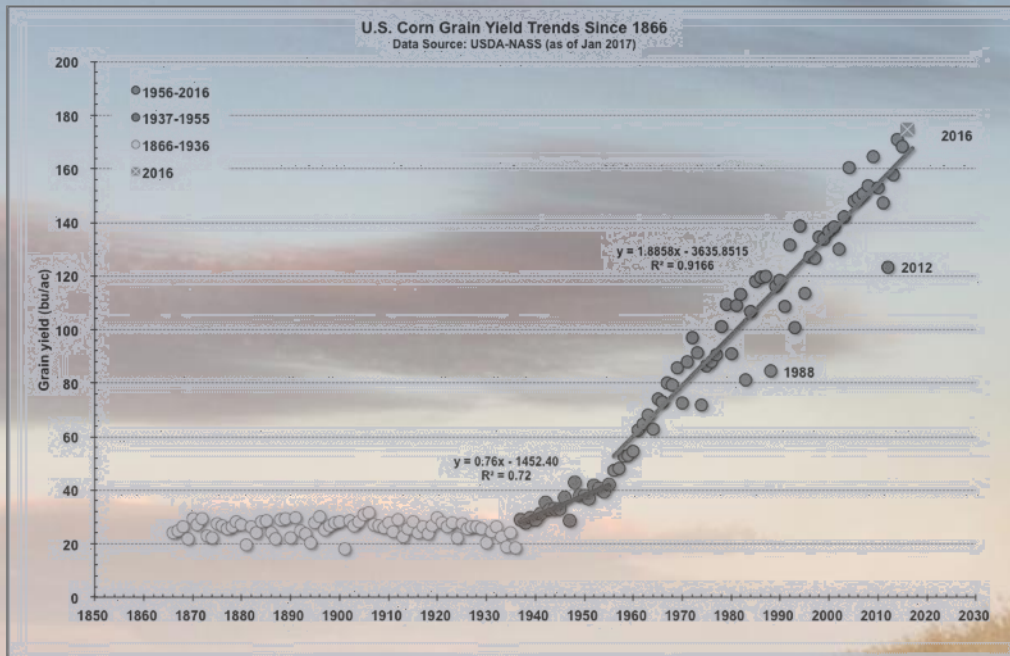
# Reimagining Crop Nutrition

Half of the global population depends on synthetic  
nitrogen fertilizer for food

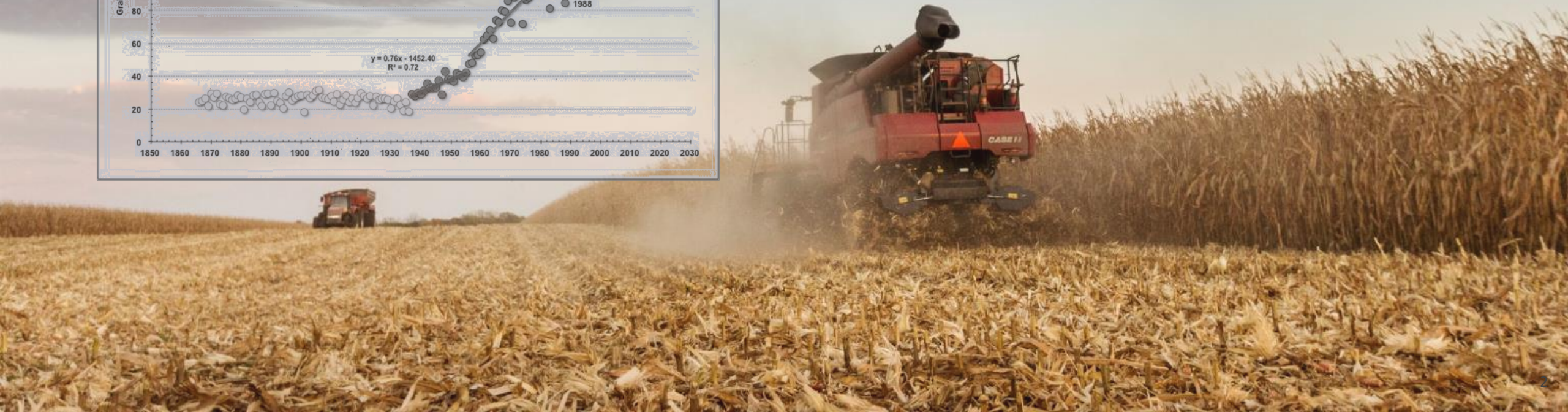
Ernie Sanders  
VP Product Development  
Pivot Bio



# Introduction of synthetic nitrogen fertilizer was a key factor in the green revolution



- Over 118 million metric tons of synthetic nitrogen is consumed worldwide
- Half is applied to corn, wheat and rice crops

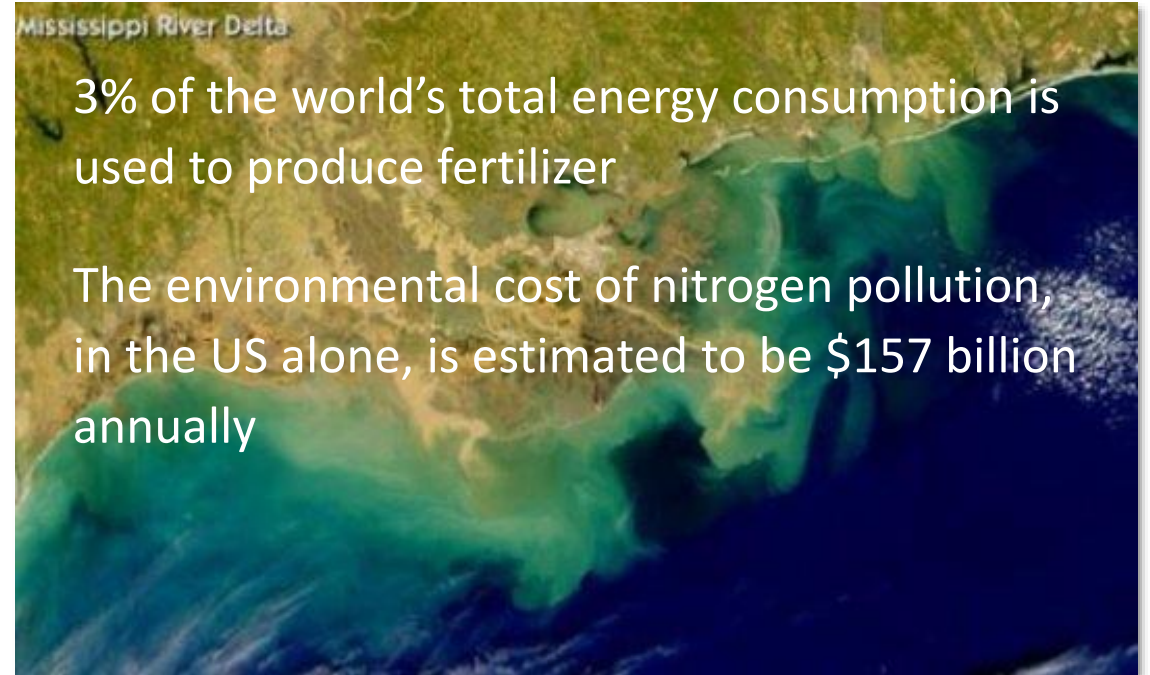


A century of synthetic fertilizer production has disrupted the earth's nitrogen cycle more dramatically than any event in 2.5 billion years



### Threats of nitrogen pollution

- Water quality
- Air quality
- Greenhouse gas balance
- Ecosystems and biodiversity
- Soil quality



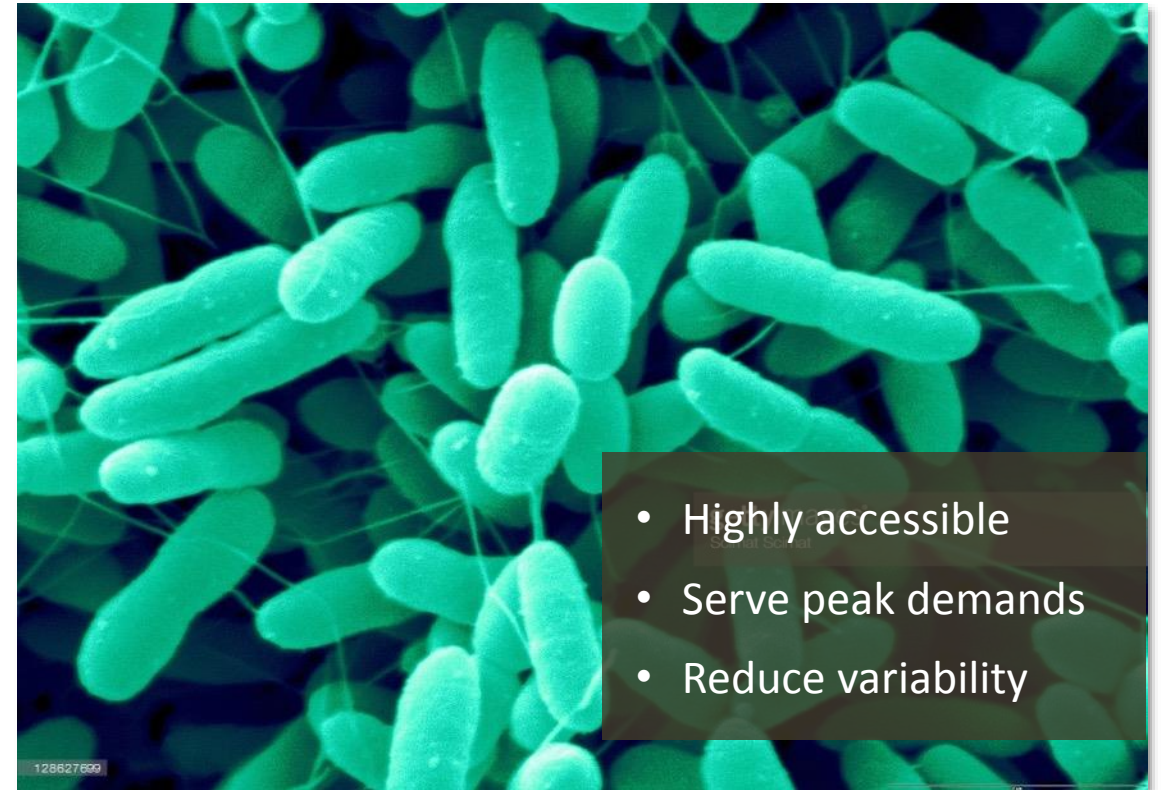
Source: Our Nutrient World (<http://nora.nerc.ac.uk/id/eprint/500700/1/N500700BK.pdf>)  
SCIENCE 8 January 2016 • Vol 351 Issue 6269



# Pivot Bio develops microbes that fertilize crops



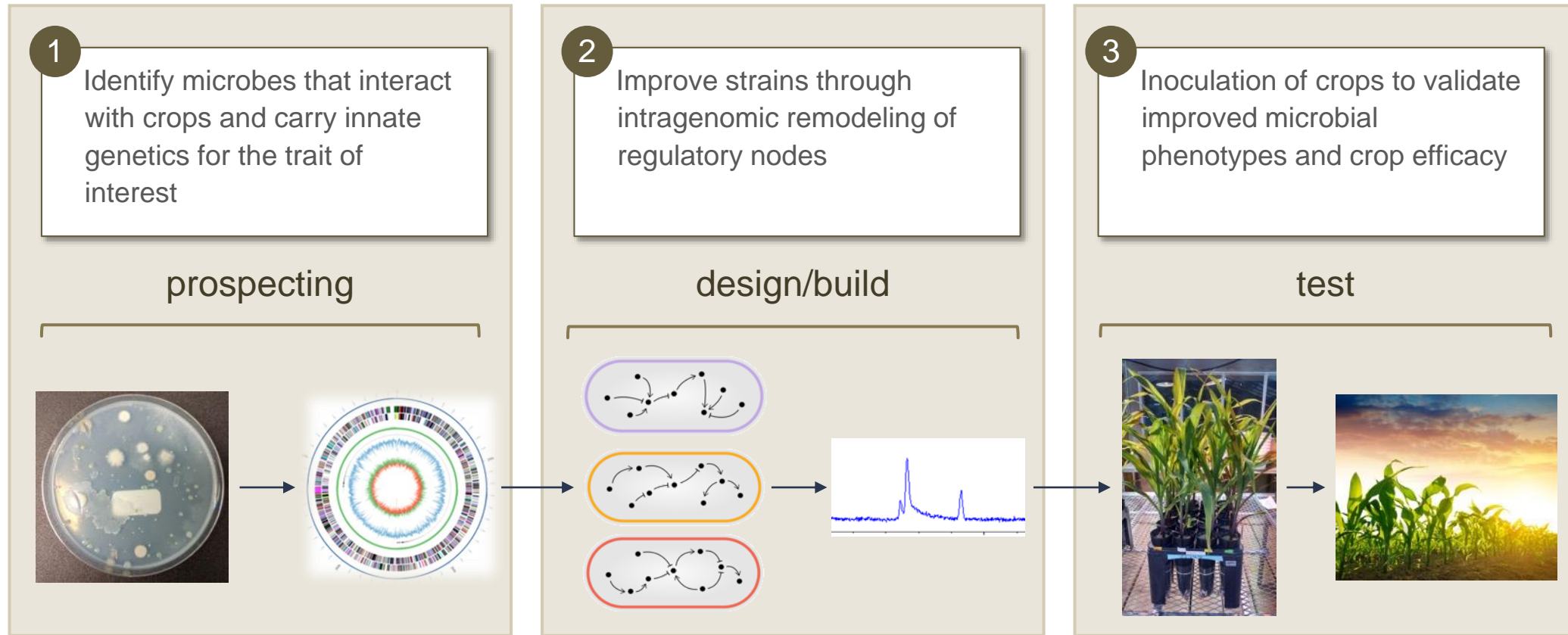
CHEMICALS ARE STATIC AND DEGRADE



- Highly accessible
- Serve peak demands
- Reduce variability

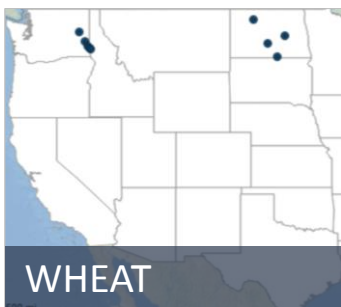
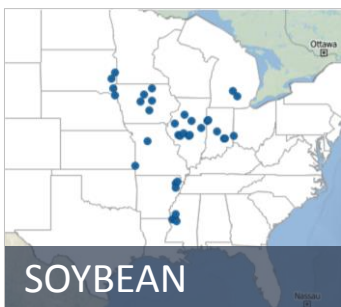
MICROBES INTERACT AND GROW

# Pivot Bio's approach to strain optimization



# Five seasons of field trials in >100 locations have been fruitful

## COMMERCIALLY APPROPRIATE LOCATIONS



- + Puerto Rico
- + Tulane University Nitrogen Challenge (Louisiana)
- + California (scientific trials)
- + Arkansas (isotopic trials)

## METHODOLOGICAL APPROACH

CAT Trials	How microbes interact with plants
Mechanism of Action	How microbes fix nitrogen, quantified at the molecular level
Small Plot Yield	Qualitative research enables rank-ordering of product candidates
Large Plot Yield	Quantitative impact on farming practice and economics (beta test with commercial products)

Summer 2018

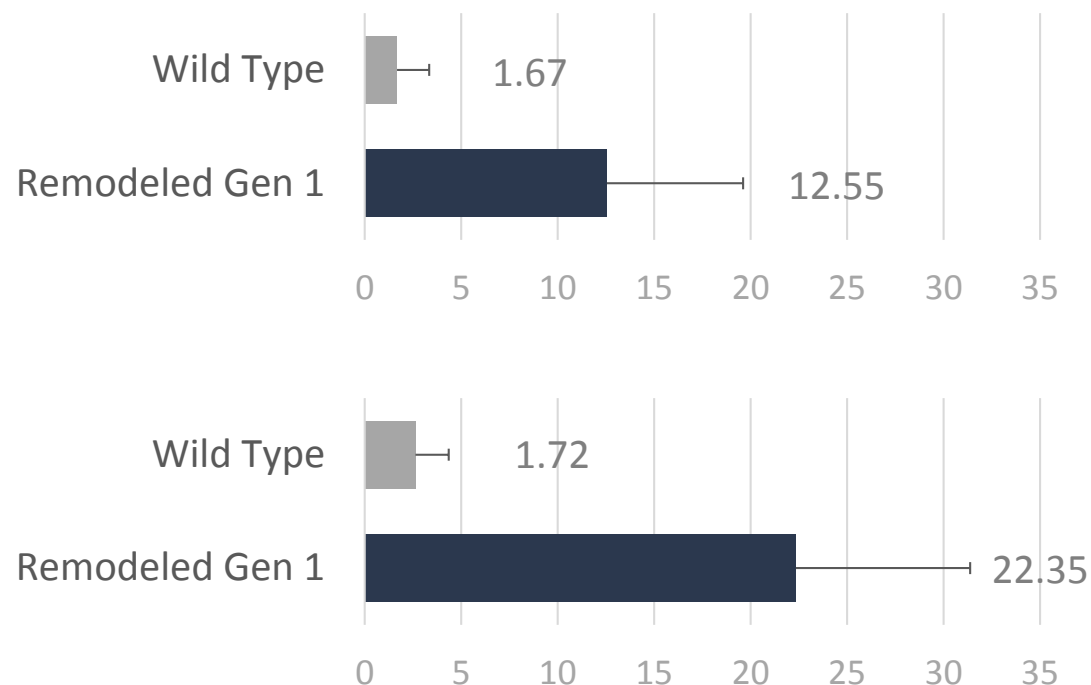
# 15-N field trials quantify Nitrogen uptake of Pivot microbes

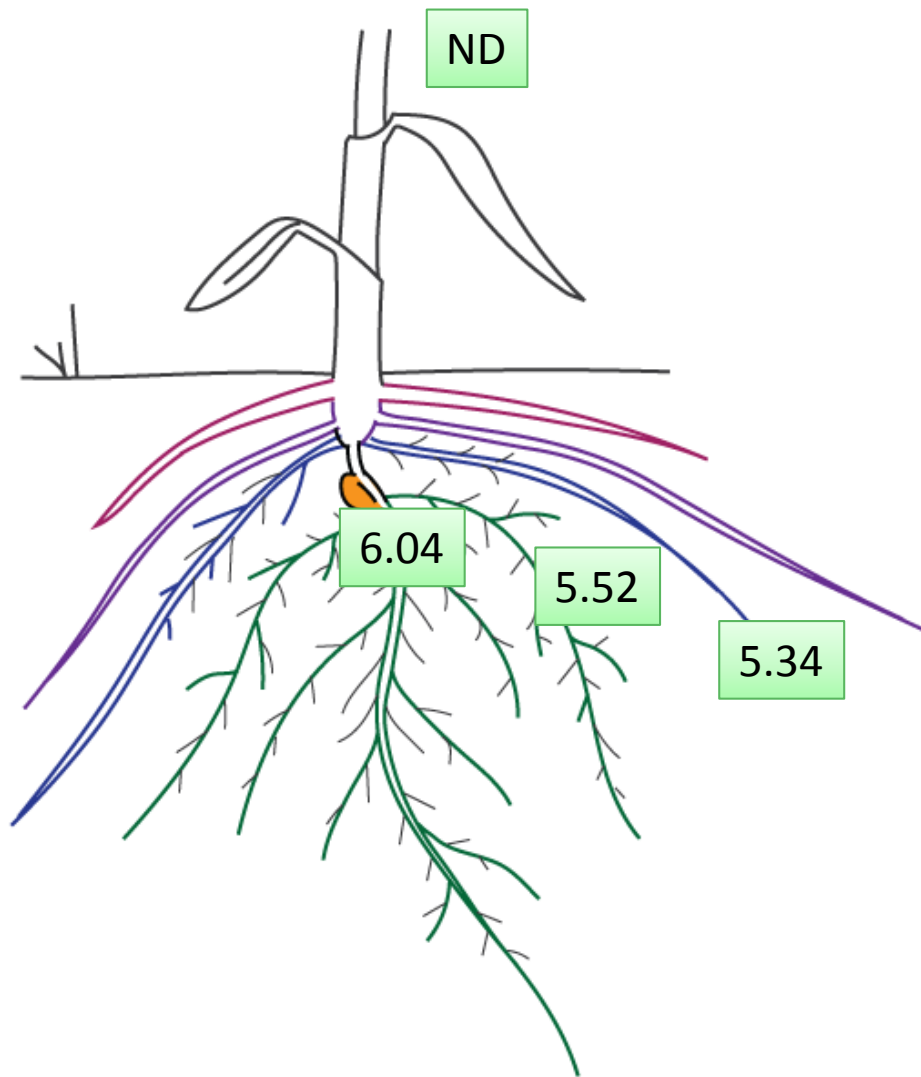
## MECHANISM OF ACTION STUDIES

N-15 isotope tracked molecular level N production in this real-world, field trial.

N-15 enriched fertilizer applied to whole field. Control plots within the field lacked remodeled Gen 1 microbe. Difference in N-15 concentration in these control plots vs. field reveals N production supplied by Remodeled Gen 1.

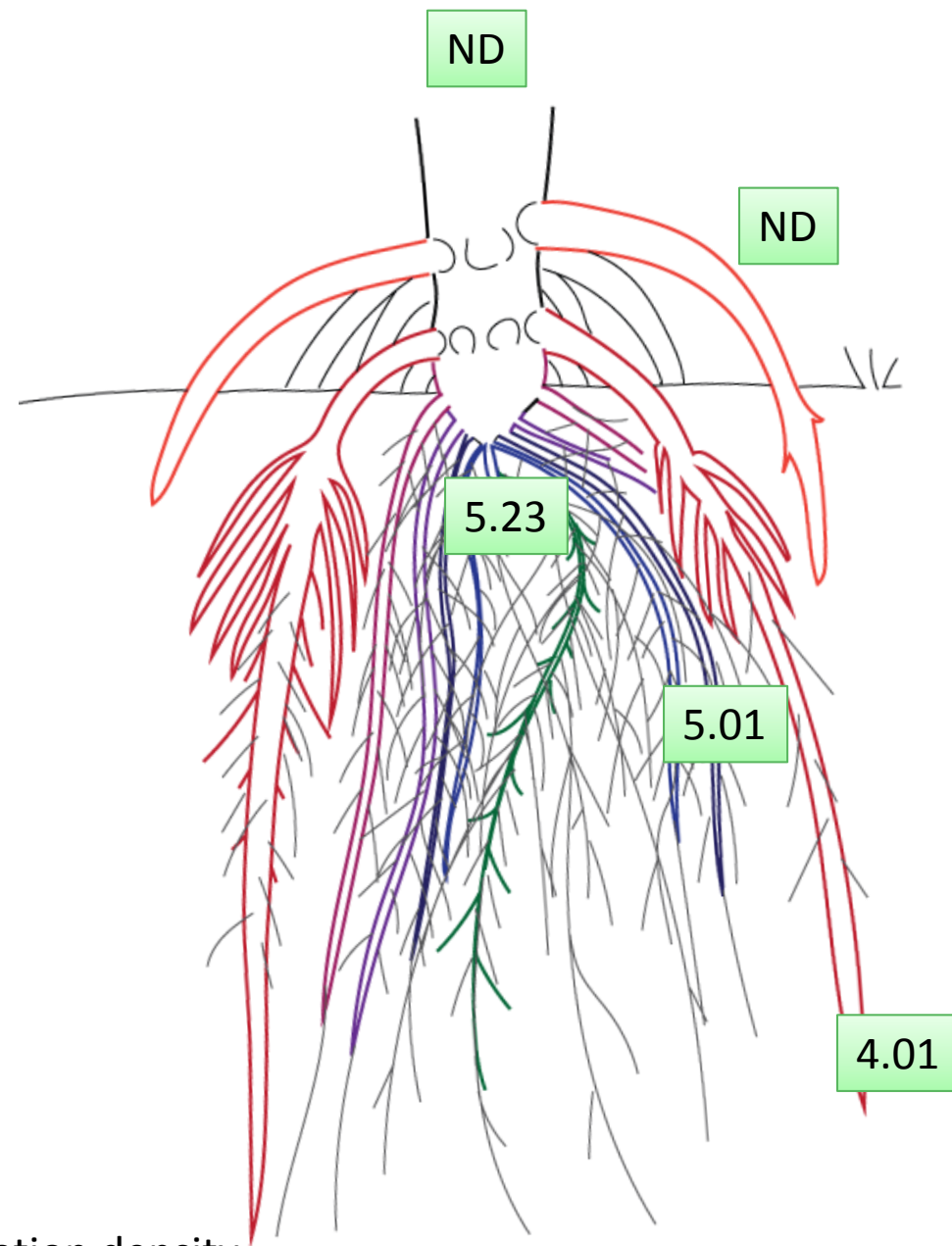
N produced (lb/acre)





V4

All numbers are colonization density  
expressed in log<sub>10</sub> CFU per gram root weight



V10



## 2018 field testing locations

CAT trials

How microbes interact with plants

Mechanism  
of action

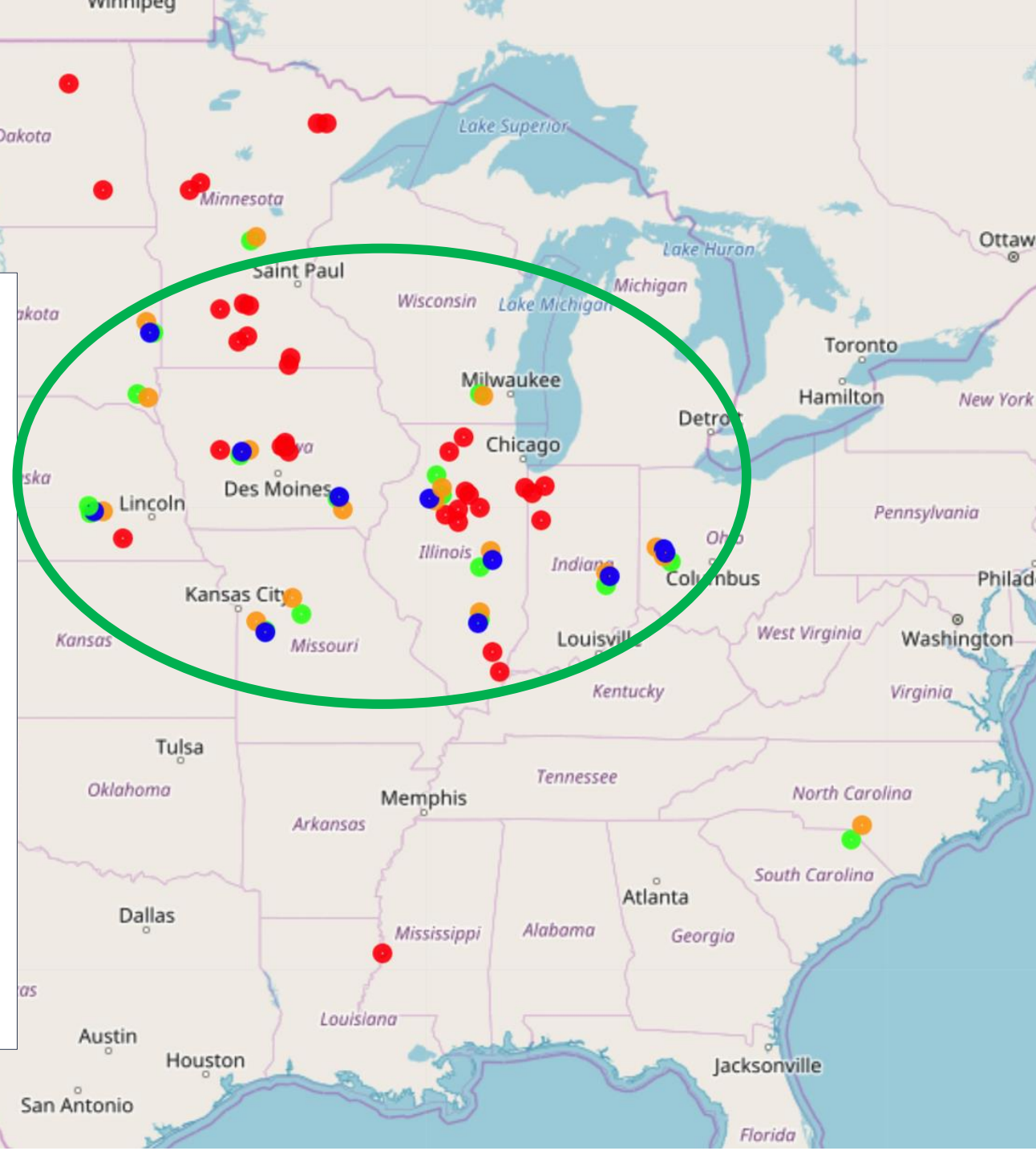
How microbes produce nitrogen,  
quantified at the molecular level

Small plot  
research

Qualitative research enables rank-  
ordering of product candidates

Large plot  
demo

Intent to Pivot grower program



**17580 Colonization  
samples by State – 2018  
93% of all plots sampled**

312

801

585

1239

1722

2571

4184

1914

1955

2259

802

441

24

total

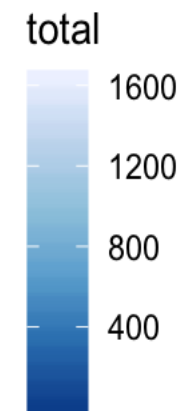
4000

3000

2000

1000

# 7664 yield plots by State – 2018



14

358

336

750

862

1634

766

770

594

1098

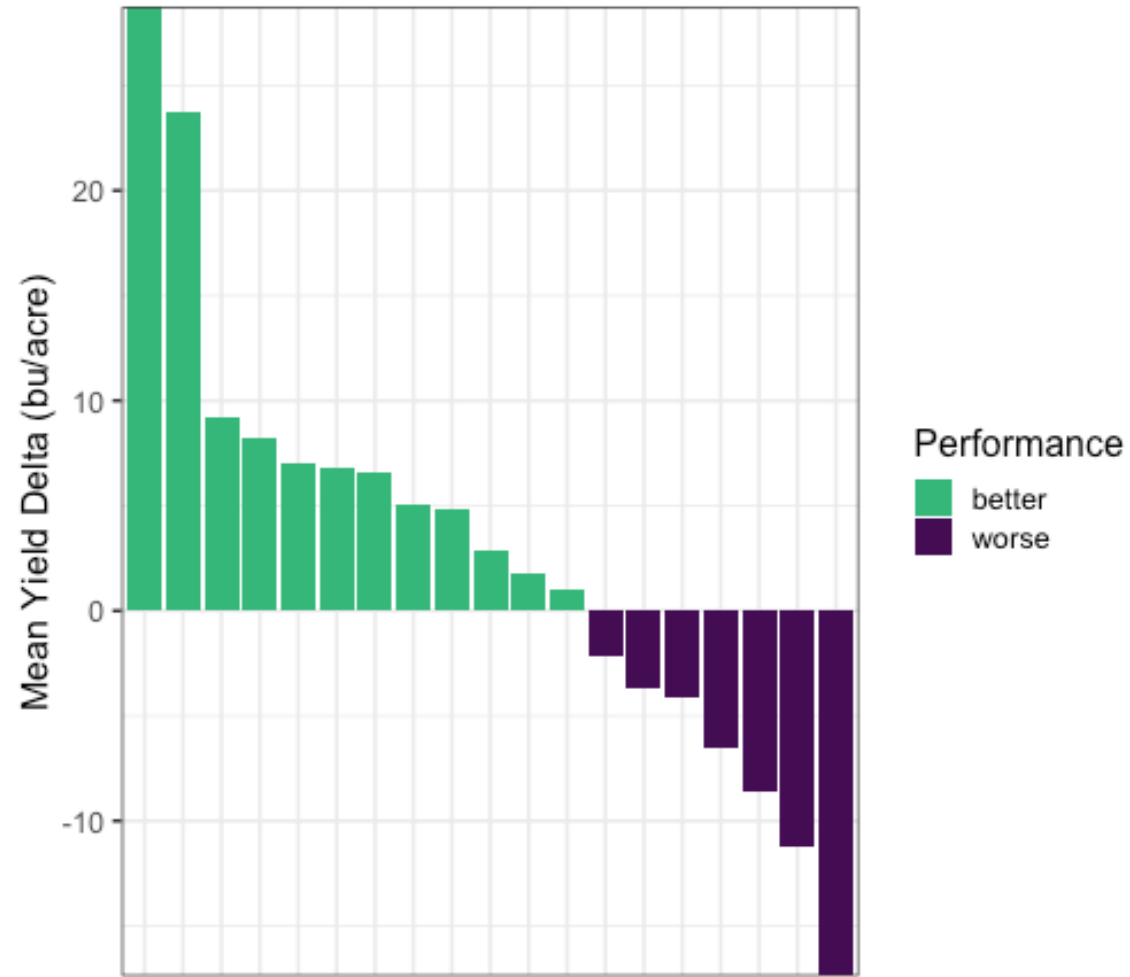
144

336

2

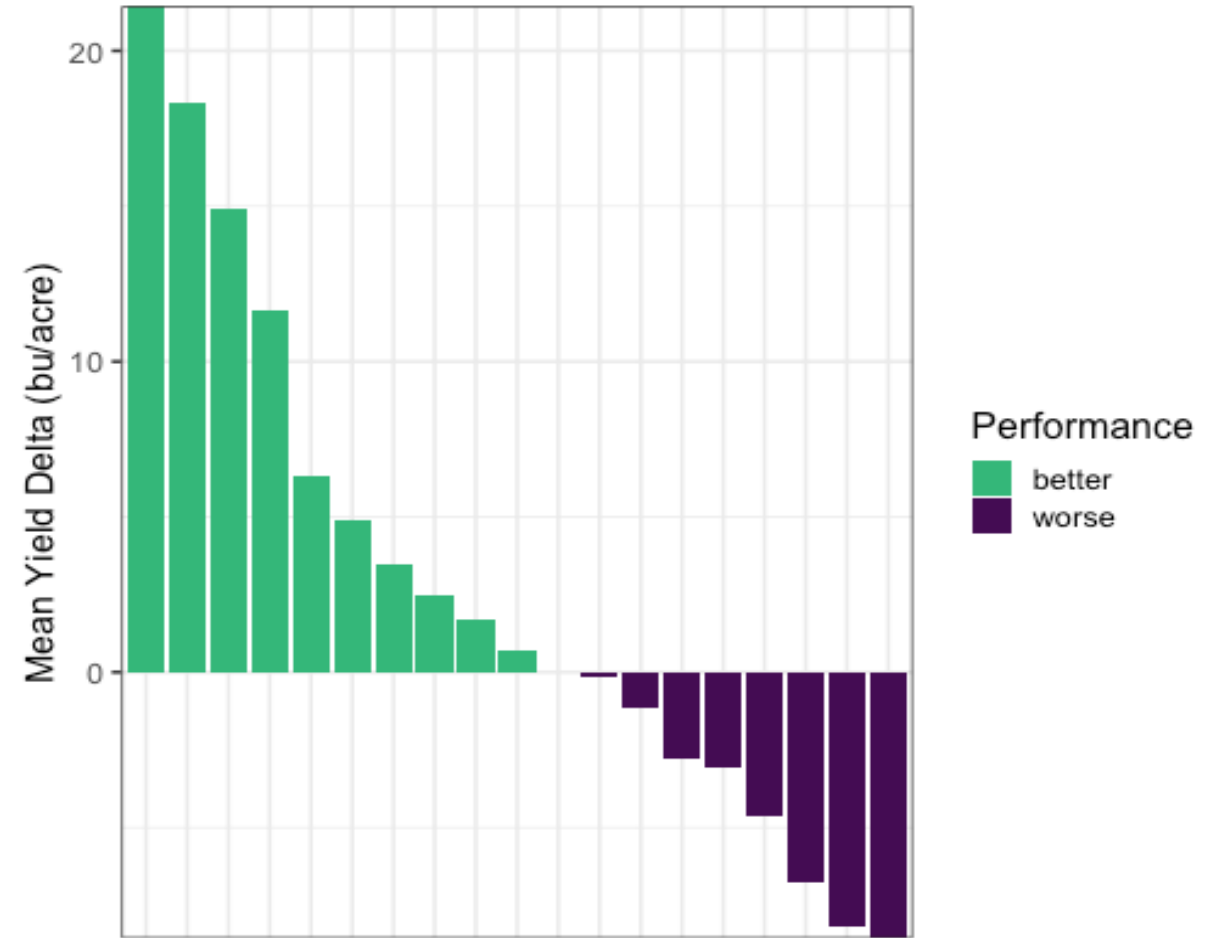


Strain = 137-1036, Nrate = 100%N-50



Each bar is a given FTR

Strain = 137-1036, Nrate = 100%N



Each bar is a given FTR

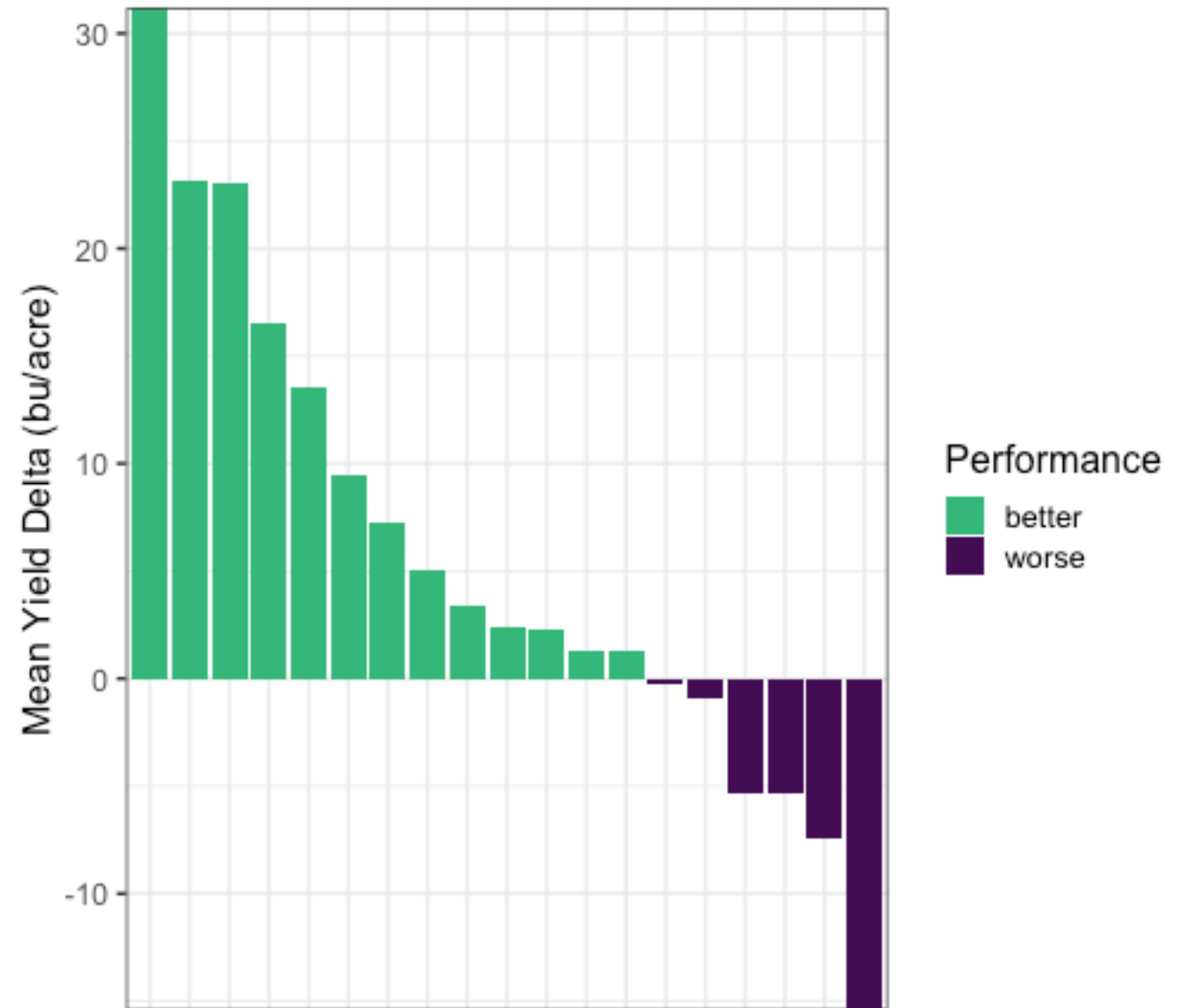
Small Plot Testing Program 2018  
65% win rate with average of 5 bu/acre improvement

Strain = 137-2084, Nrate = 100%N

Exciting new strain from our pipeline

75% win rate

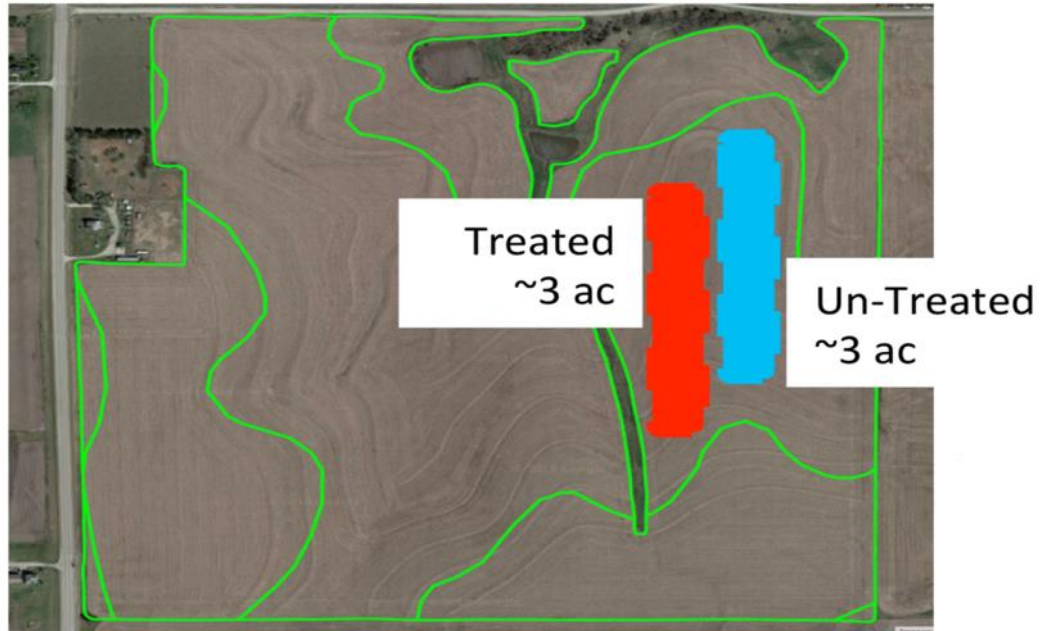
2019 will move to strip trials or grower demo plots



Each bar is a given FTR

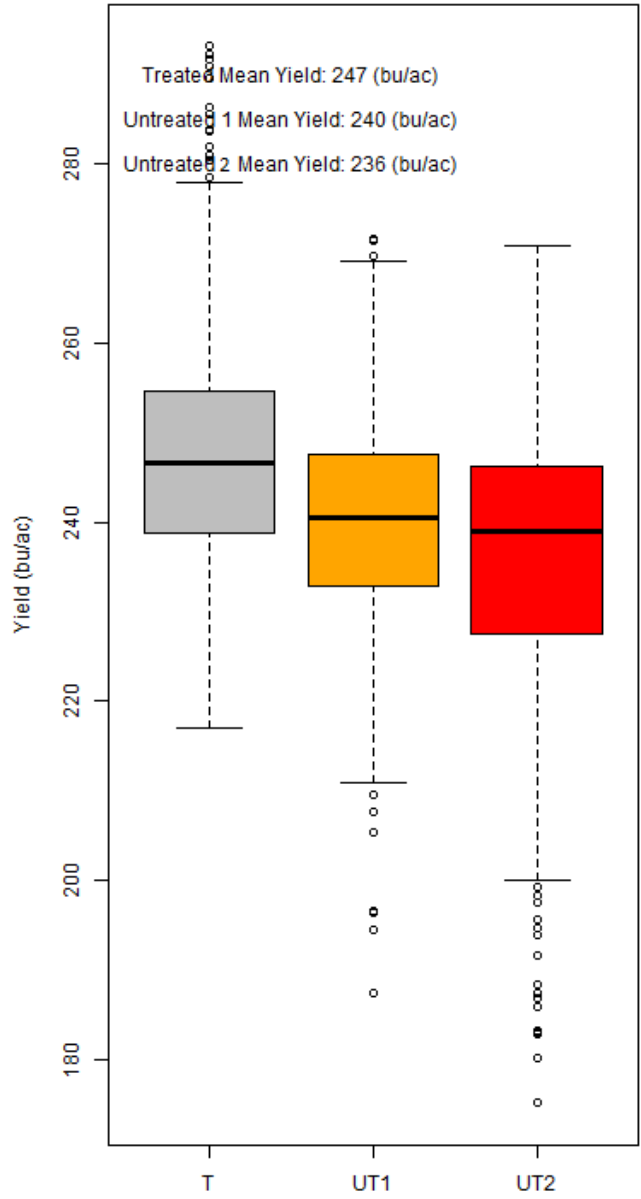
# U.S. corn growers are beta-testing our first product

- More than 25 leading U.S. corn growers known to be early adopters and influencers
- Integration into commercial fertility practice as an 'ecological side dress'



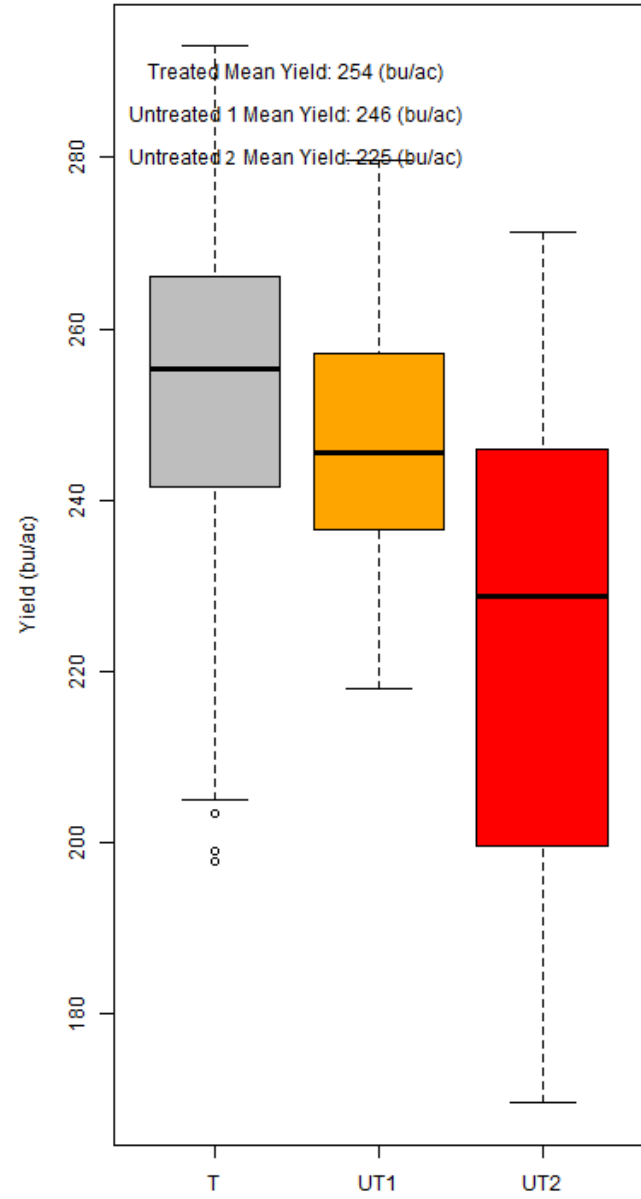


Yield Subset 2581112 | DKC45-64

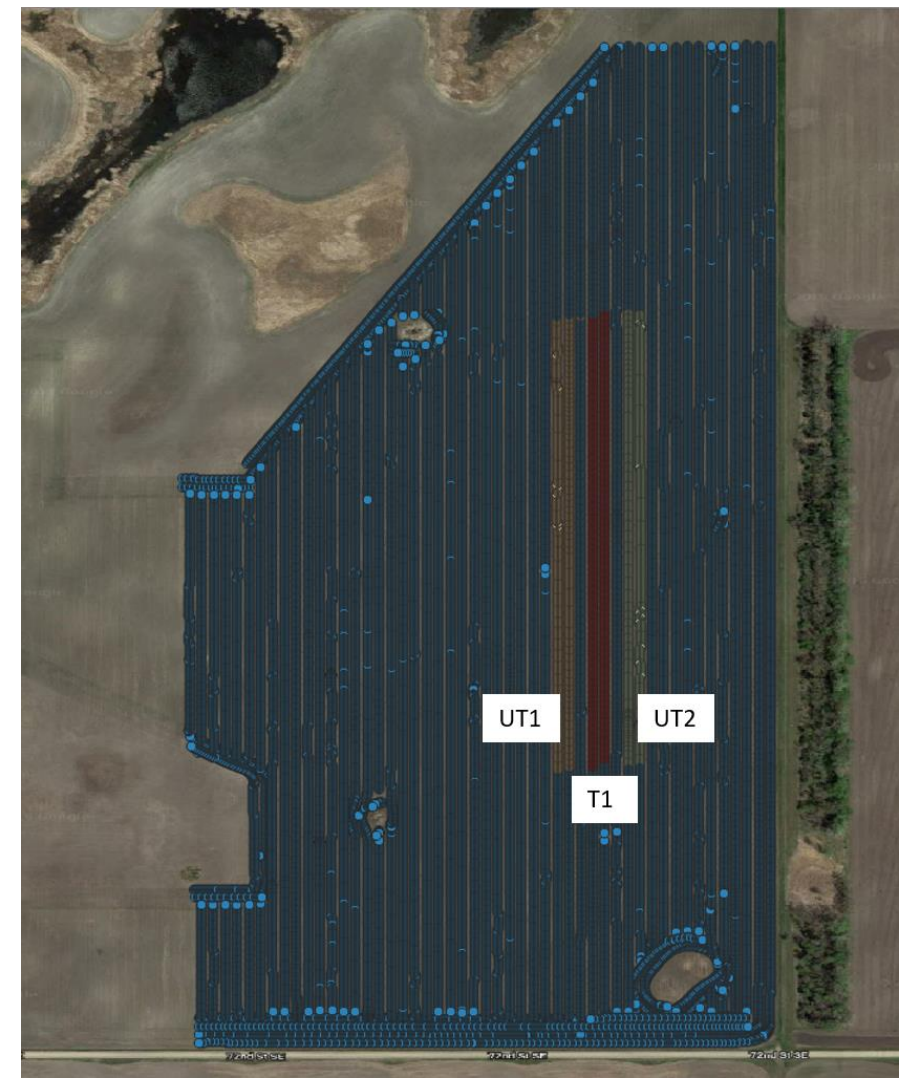


T | Treated UT | Untreated

Yield Subset 2581132 | DKC45-64



## Intent to Pivot Grower # 12





## Summary

- Advantage of PROVEN when added to a growers regular Nitrogen program
  - 88% win rate
  - Improvements in zones where N stress may be a factor indicated by soil zones differentiation
  - Intent to Pivot Trials - 6 Bushel Advantage to date
- PROVEN Performance advantage is highlighted in reduced Nitrogen Side-Dress trials
  - Reductions in Nitrogen Side dress has not impacted Yield where PROVEN has been applied
- ~50% more 2018 Intent to Pivot trials to be processed
  - Including multiple side dress evaluations

## Summary: 2018 data collected to date

- Protocols for testing of Pivot Bio microbes
  - Colonization testing program
  - Small plot testing program
  - Strip trial testing program
  - Intent to Pivot (3 ac testing program)
- Small plot shows repeat of 3-7 bu/ac advantage seen in 2017
- Reduced N plots + Pivot Bio PROVEN => yield compared to full N plots





# PIVOT BIO

**Thank you for your time**

[Pivotbio.com](https://Pivotbio.com)