Innovative Technologies

That May Transform the Future of Agriculture and the Climate

Farm Foundation®

Remember: Round Table is off the record.

Ed Eggers

MODERATOR
MESA GROUP | SKYWAY FOODS

Cheri DeJong

AGRIVISION FARM MANAGEMENT

NATURAL PRAIRIE
DAIRY
™

What We Do

Natural Prairie Dairy produces **best-in-class, highest quality certified organic milk from family-run**, **sustainable farms** in Texas and Indiana.

Meet the De Jong's

Donald and Cheri started with 800 cows in the High Plains of Texas and dedicated 15 years to building the organization from the ground up. Now, NPD has over 15,000 certified organic cows and 250 team members, all dedicated to producing an exceptional product.

Milk Quality Standards & Certifications

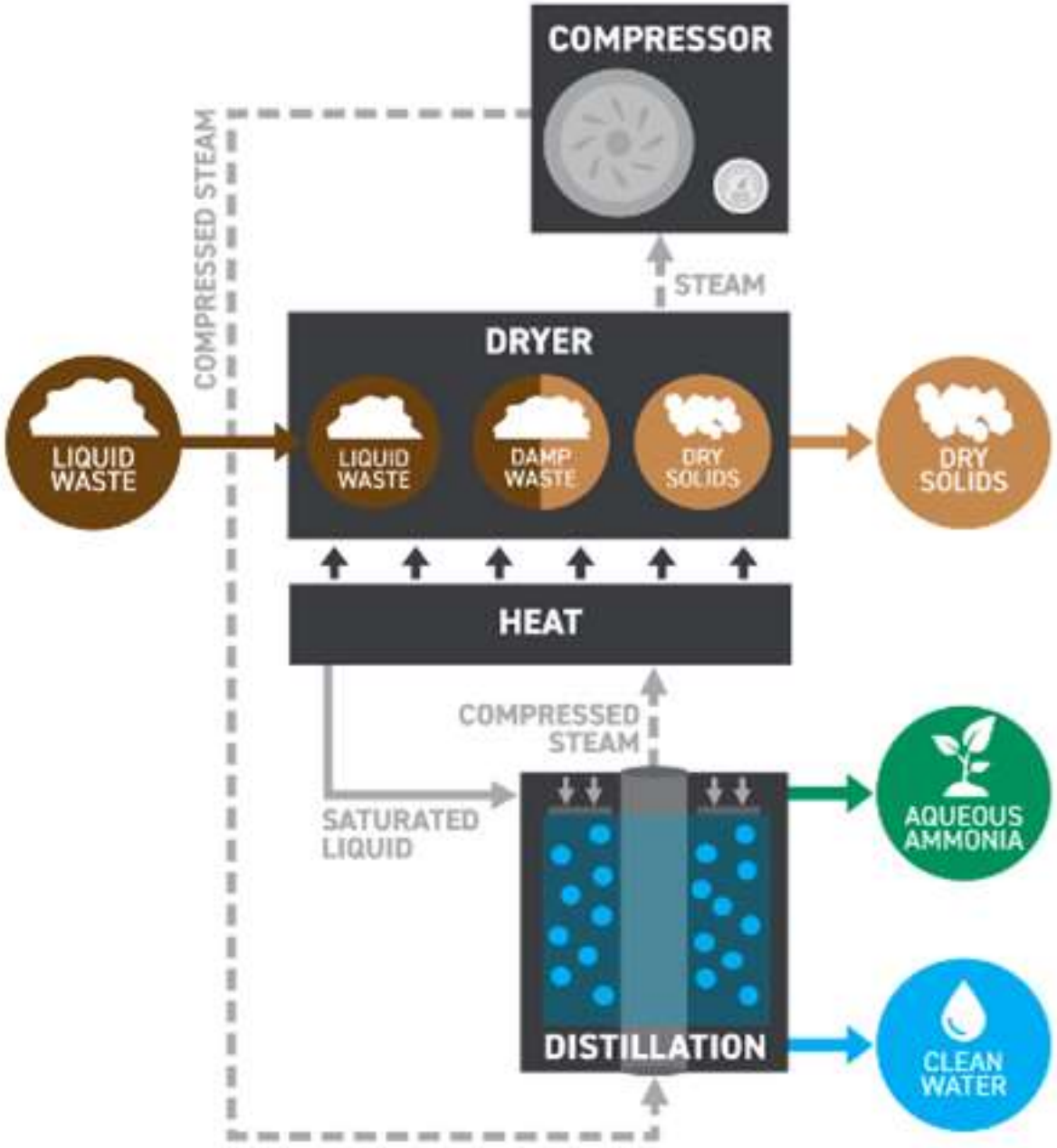
Our organic farms undergo an intense certification process.

21st Century Farming

We utilize the most **advanced technology** to help keep our process **efficient** and produce the best quality organic milk.

21st Century Farming

Our **newest innovation**, a manure management process called the ***Varcor***, **will transform animal agriculture for the better, forever.**



The Varcor solution:

- Helps a dairy operate as a **closed loop system** and **reduces the overall carbon footprint, helping to achieve net zero;**
- **May reduce the need for anaerobic ponds;**
- **Additional source of clean water to be applied to fields and/or fed to cows;**
- **Source of concentrated aqueous ammonia** that can be applied when and where needed;
- Opens doors to new **cost-saving and revenue producing opportunities, including** certified organic NPK that can be applied or sold to others.

Questions?

Anthony Atlas

CLIMATE AI

Black Boxes and Black Dirt:
Practical applications of AI in agriculture with ClimateAi

Anthony Atlas | Anthony@climate.ai

Leverage AI to win at business

- What it **is** – and what it **isn't**
- What **differentiates** ClimateAi
- **Specific use cases** where it matters

What AI is

Mat Velloso
@matvelloso
Difference between machine learning and AI:
If it is written in Python, it's probably machine learning
If it is written in PowerPoint, it's probably AI
5:25 PM · Nov 22, 2018 · Twitter Web Client
8,467 Retweets
875 Quote Tweets
23.8K Likes

What AI is

Artificial intelligence refers to systems that generate predictions from past correlations…

…and continue to update and improve upon those predictions as more data becomes available

Common benefits

- ✔ More complexity, nuance, and power than a simple regression
- ✔ Quickly and cheaply automate repetitive tasks
- ✔ More lightweight than a super-computer

What AI isn't

Easy to build

Resources needed to train a state-of-the-art AI model *has grown over 300,000x since 2012*, while the transistor count of NVIDIA GPUs has grown only ~4x

Automated

(At least to start)

Most AI models rely on a "human in the loop" to clean data and validate outputs

"All knowing"

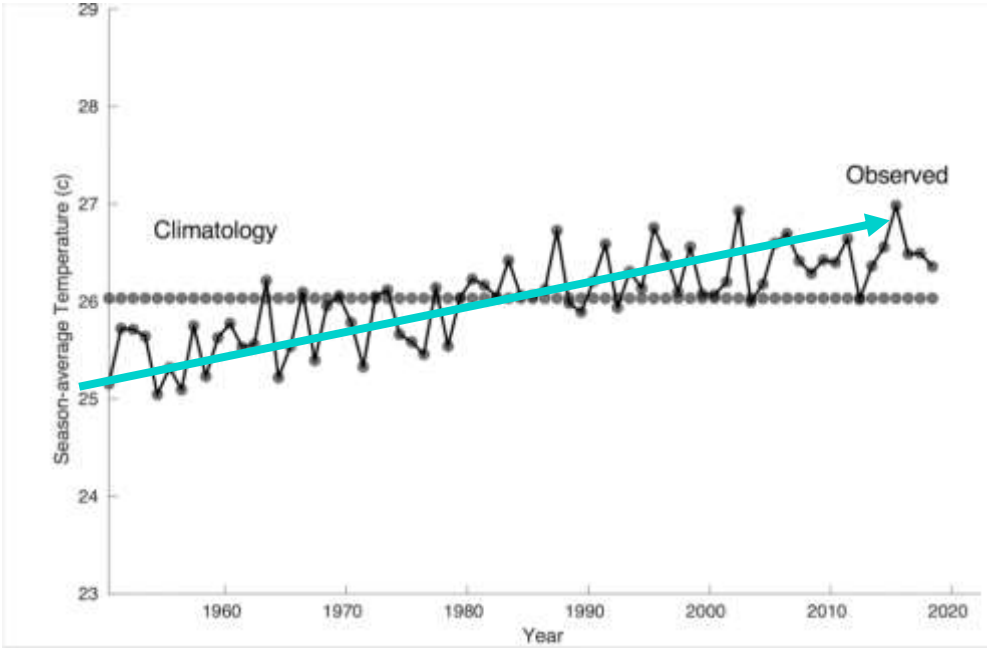
Edge cases are a consistent problem – an AI can't predict things it has never seen

Source: Andreessen Horowitz

The “average” is no longer average

Historical averages no match for increasing climate variability

Historical average-based planning shows increasing error…



..making an already difficult task (yield forecasting) harder than before

- Increased risk of **over production**: Negative price pressures or waste
- Increased risk of **under production:** Unable to fulfill contracts, or forced into unprofitable positions to keep customers happy

Leverage AI to win at business

- What it **is** – and what it **isn't**
- What **differentiates** ClimateAi
- **Specific use cases** where it matters

ClimateAi provides best-in-class predictive weather analytics to forecast the impact of climate change on crops

In a shifting climate....

Past performance is not indicative of future success

ClimateAi solution

Best-in-class climate forecasting provide daily, weekly, monthly, and decadal insights. From a regional down to a field level.

Access to proprietary data sets enables ClimateAi to have a deeper understanding of climate impacts on crops than anyone else

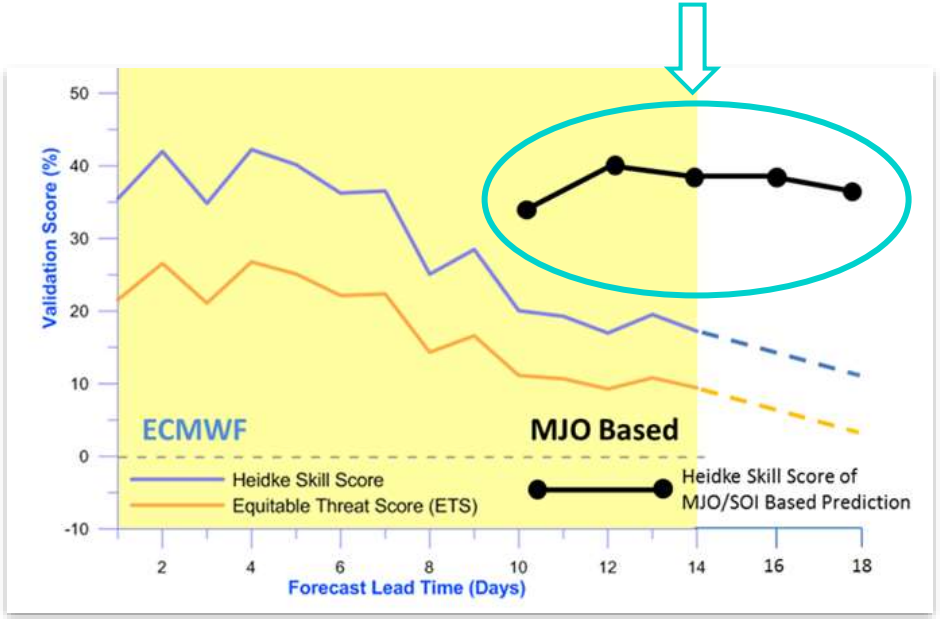
Analytics layer links forecasts to specific, actionable insights – what risks am I exposed to? How can I better manage those risks?

Made possible by patented physics-driven AI breakthroughs in forecasting extreme weather impacts

AI breakthroughs from Autonomous Vehicle industry

Science breakthroughs from **extreme weather forecasting for rocket launches**

Up to 105% improvement forecasting extreme precipitation 2-3 weeks out



$250K grant awarded to extend model to sub-seasonal timeframe

1. *6 patents filed on this tech- three granted already. Read about our tech in the patent here.*
2. *Please see the appendix for our accuracy benchmark with the best available alternatives*

Leverage AI to win at business

- What it **is** – and what it **isn't**
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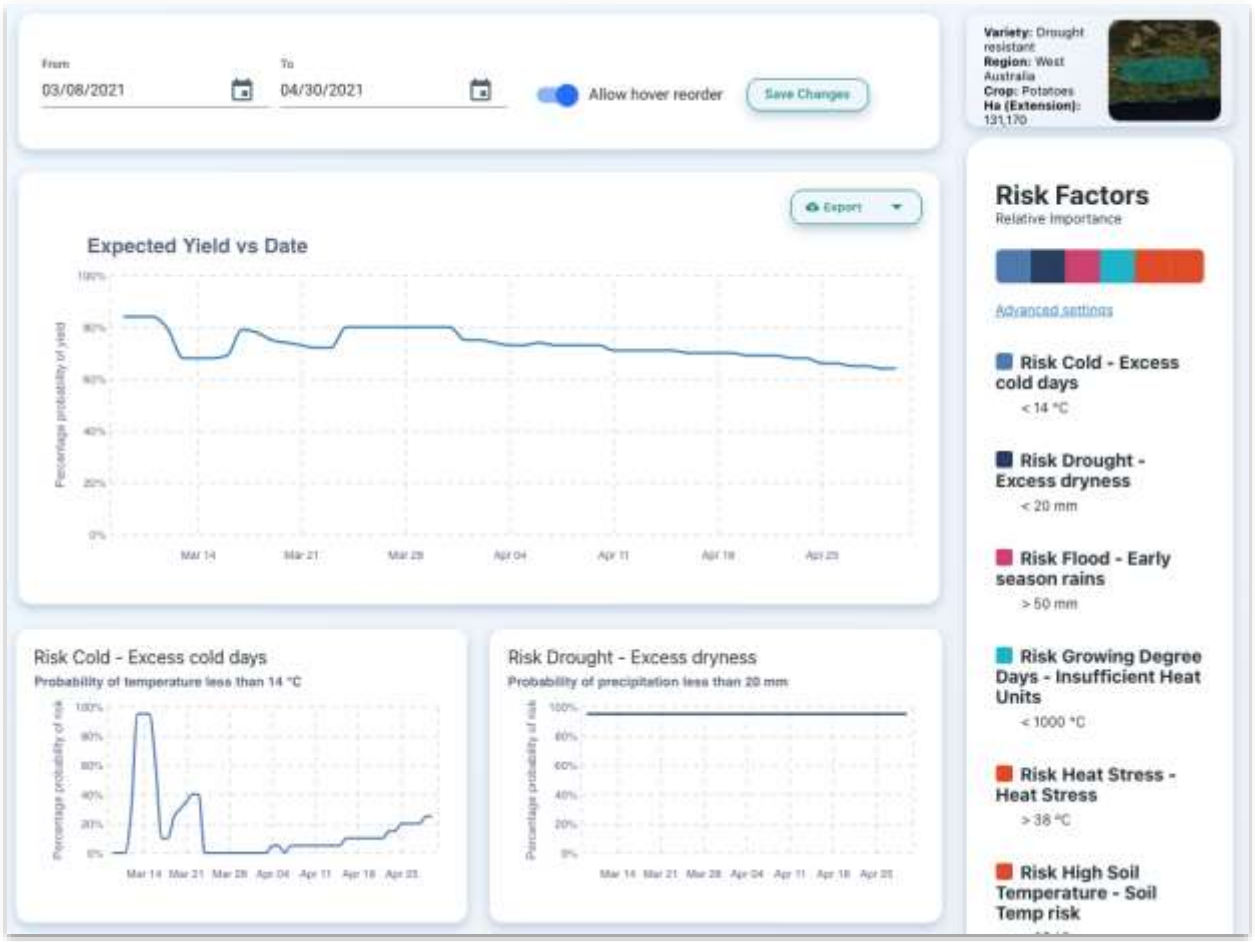
Optimize Timing: Weather-optimized decision tools

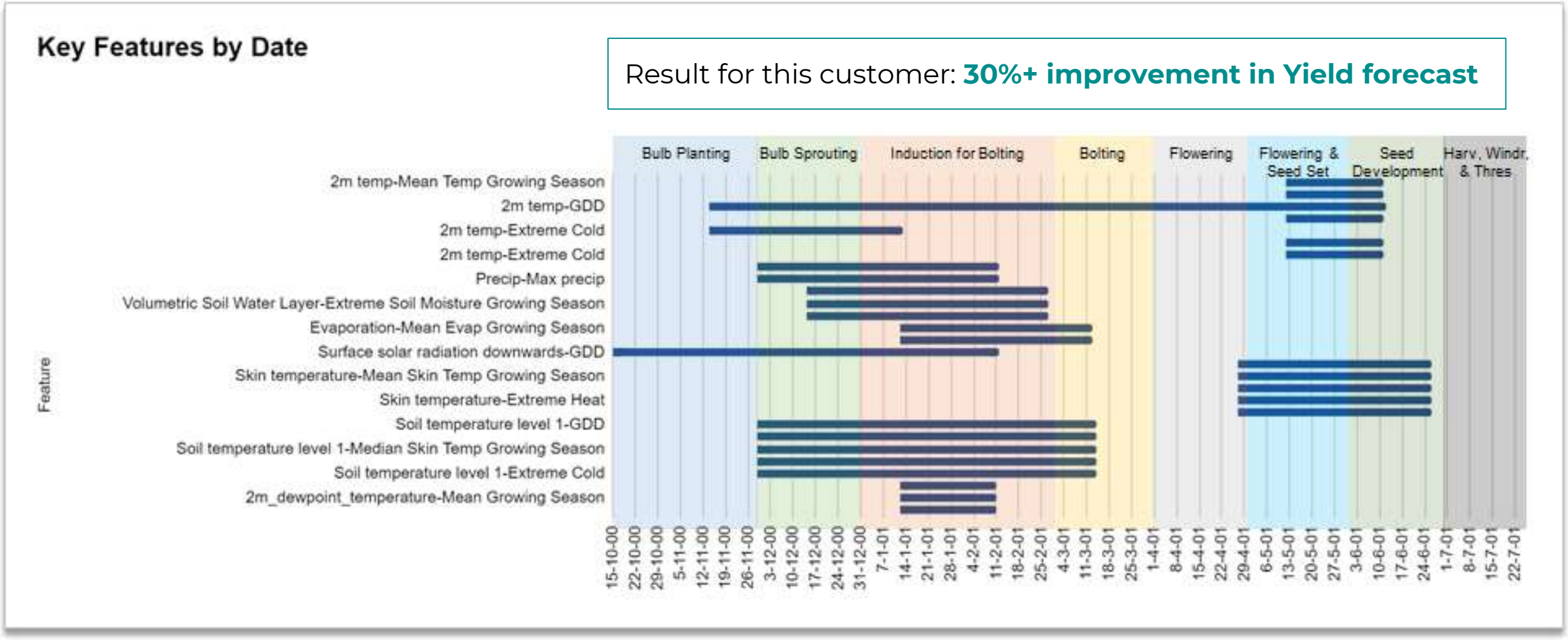
Partnered with Australian Seed Co. to identify optimal planting windows that maximized potential yields



How you can leverage these insights

- ✔ **Link forecast to key decisions** that matter at different times: Planting, Spraying, Harvesting, etc.
- ✔ **From reactive to proactive:** Advanced notice and forecast probabilities for any/all conditions of concern
- ✔ ***No data required*** to deliver insights

Forecast Yield: AI insights take the guesswork out of understanding drivers of yield & isolates what you can control

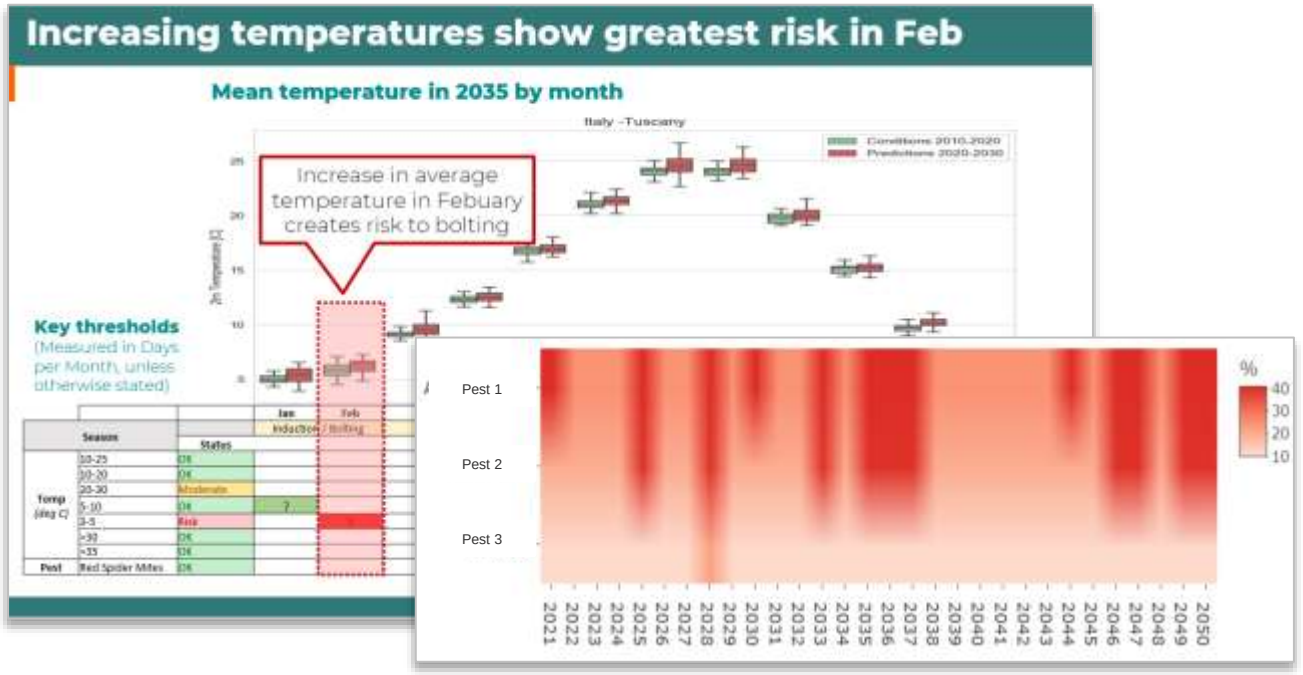


We can deliver a year end report enabling you to **benchmark crop managers**, adjusted for environmental factors

Climate Credit Score

Not just "warmer," but when, by how much, and what impact will it have

Case Study: Deep climate risk scrutiny to assess exposure



Identified specific risks and trends from climate change to assess specific production risk for global agri-chemical player

Value for Agribusiness

- ✔ **Deep-dive on growing season risks**, specific to region and crop
- ✔ Directly climate impacts on crop to **yield impacts** and potential credit worthiness
- ✔ Scale across portfolio and **integrate into siting criteria**

AI tools are powerful, available, and effective

The next step is to understand the use cases for *your* business, and develop the capabilities and partners to deploy

Contact me:
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Allen Van Deynze

UNIVERSITY OF CALIFORNIA, DAVIS

Nitrogen fixation in a landrace of maize is supported by a mucilage-associated diazotrophic microbiota

Allen Van Deynze

UCDAVIS

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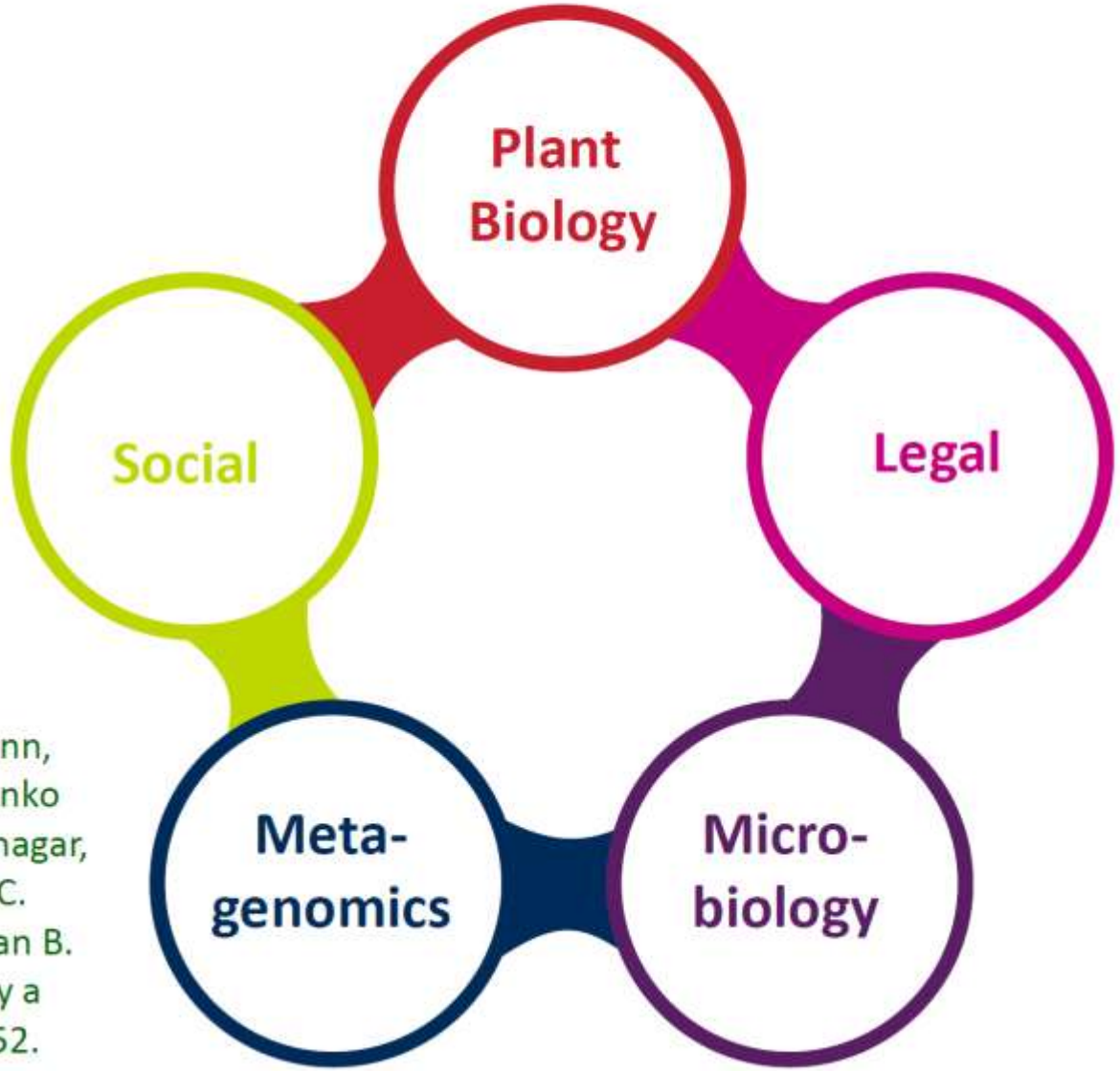
WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Nitrogen fixation in a landrace of maize is supported by a mucilage-associated diazotrophic microbiota



Allen Van Deynze, Pablo Zamora, Pierre-Marc Delaux, Cristobal Heitmann, Dhileepkumar Jayaraman, Shanmugam Rajasekar, Danielle Graham , Junko Maeda, Donald Gibson, Kevin D. Schwartz, Alison M. Berry, Srijak Bhatnagar, Guillaume Jospin, Aaron Darling, Richard Jeannotte, Javier Lopez, Bart C. Weimer, Jonathan A. Eisen, Howard-Yana Shapiro, Jean-Michel Ane, Alan B. Bennett. (2018) Nitrogen fixation in a landrace of maize is supported by a mucilage-associated diazotrophic microbiota. **PLoS Biol 16(**8): e2006352. https://doi. org/10.1371/journal.pbio.2006352

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Hypothesis: Indigenous landraces of corn may have co-evolved with microbiomes that contribute to plant performance

Soils	pH	CEC meq/100g	OM (%)	NO3-N (ppm)	Olsen-P (ppm)	X-K (ppm)
Field 3 2016				18.78		
Field 3 2017	5.11	4.22	12.18	5.29	8.65	191.17
Field 4 2016				51.10		
Field 4 2017	5.48	10.57	13.44	39.95	13.69	499.50
Field 5 2016				17.11		
Field 5 2017	4.98	7.03	9.66	31.91	7.88	319.13

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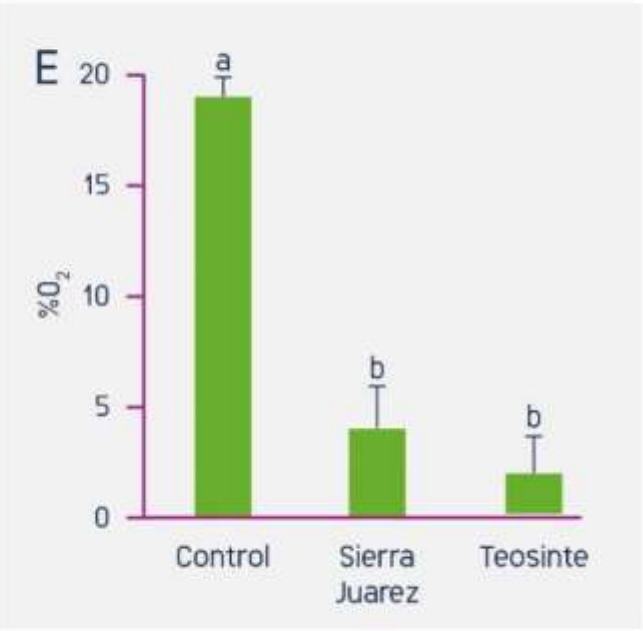
Sierra Mixe corn forms extensive aerial roots.
With extensive mucilage secretion.

Mucilage properties – Sugar-rich and Oxygen depleted

Residue	Weight (ug)[1]	mole%
Arabinose(Ara)	113.7	13.8
Ribose(Rib)	0.0	0.0
Rhamnose (Rha)	0.0	0.0
Fucose (Fuc)	377.0	41.8
Xylose (Xyl)	27.1	3.3
Glucuronic Acid(GlcUA)	28.6	2.7
Galacturonic acid (GalUA)	0.0	0.0
Mannose (Man)		
Galactose (Gal)		
Glucose (Glc)		
N Acetyl Galactosamine (GalN		
N Acetyl Glucosamine (GlcNA		
Heptose(Hep)		
3 Deoxy-2-manno-2 Octulsonic		
Sum		

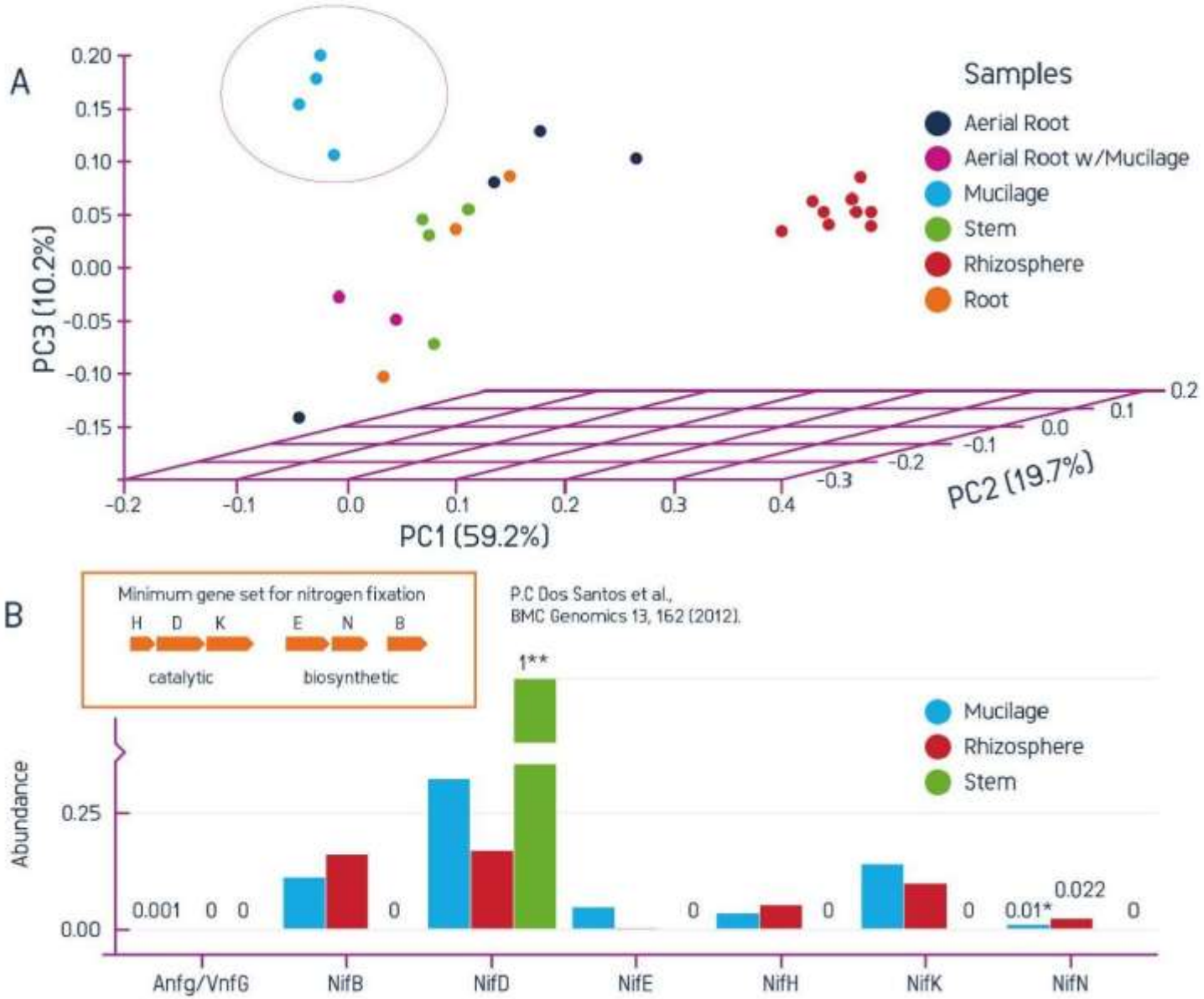
[1]Values are expressed as mole p

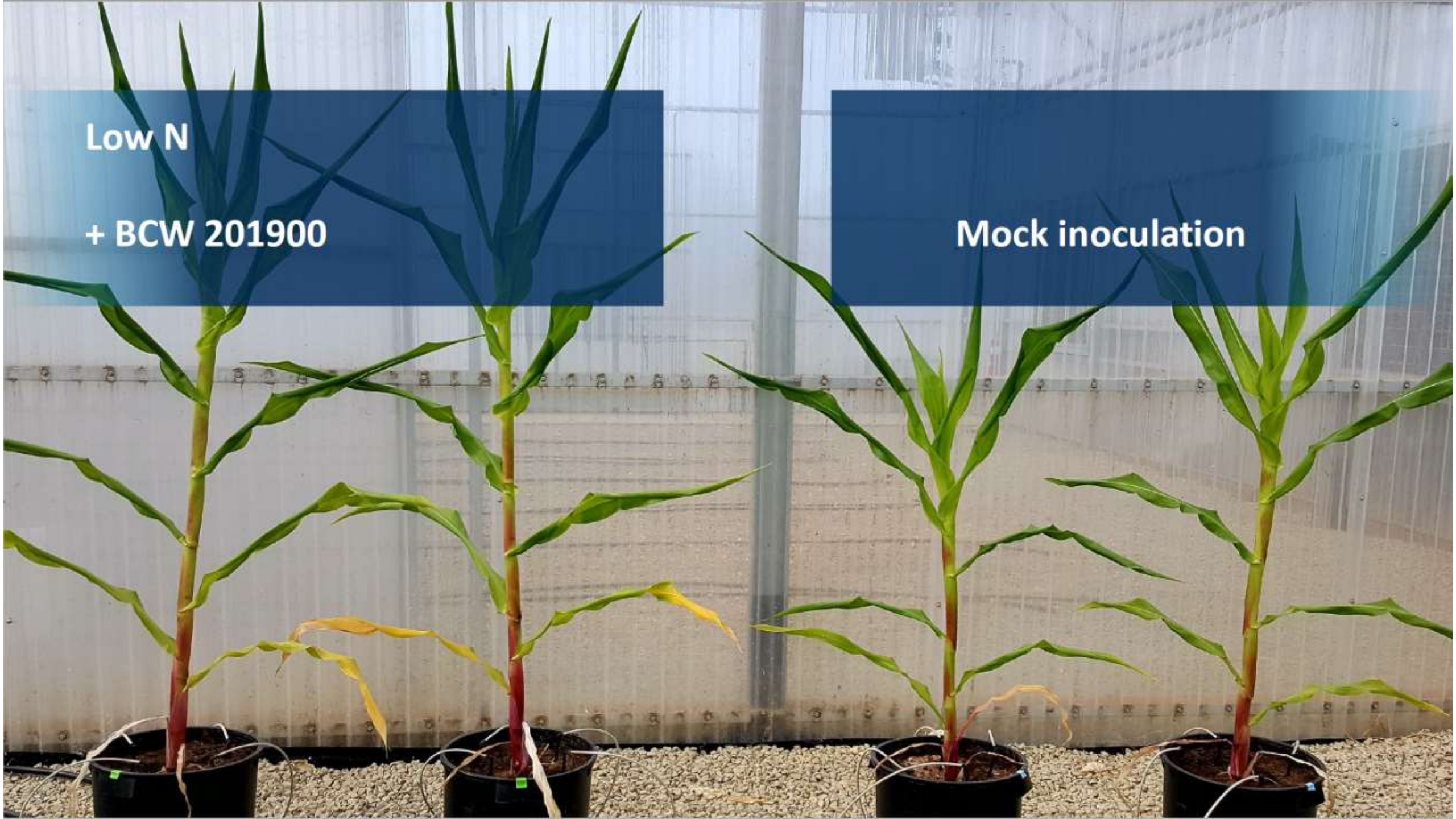


Does the mucilage play a role in supporting N_2 fixation activity?

N_2 fixation requires carbon source (energy) and low O_2.
Can mucilage provide this environment?

Unique microbial consortia enriched for nitrogen fixation found in mucilage

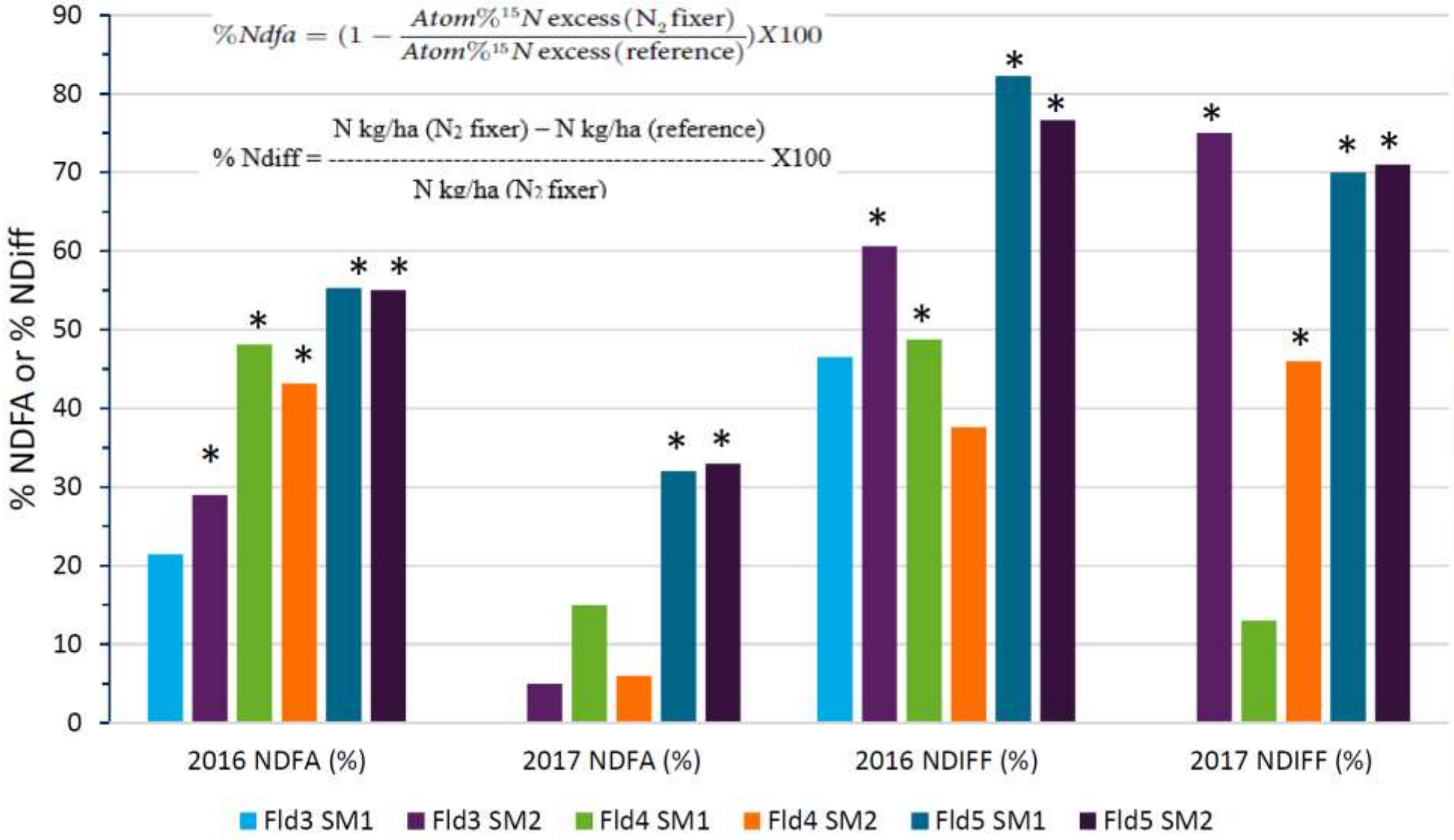



Low N
+ BCW 201900
Mock inoculation

%NDFA and %N difference of Sierra Mixe Maize

$$\%Ndfa = (1 - \frac{Atom\%^{15}N\ excess\ (N_2\ fixer)}{Atom\%^{15}N\ excess\ (reference)}) X100$$

$$\%\ Ndiff = \frac{N\ kg/ha\ (N_2\ fixer) - N\ kg/ha\ (reference)}{N\ kg/ha\ (N_2\ fixer)} X100$$



*Significantly different at P=0.05 from reference

Cris Heitmann

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Working in Sierra Mixe required a commitment to the community to share results and benefits and to contribute to their society.
Sharing knowledge and what the research is teaching about their world
Informed consent and benefit sharing
Social
Legal
long-term relationships built over decades created the possibility to work in Sierra Mixe

Acknowledgements

The Sierra Mixe Community

UC Davis

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University of Wisconsin

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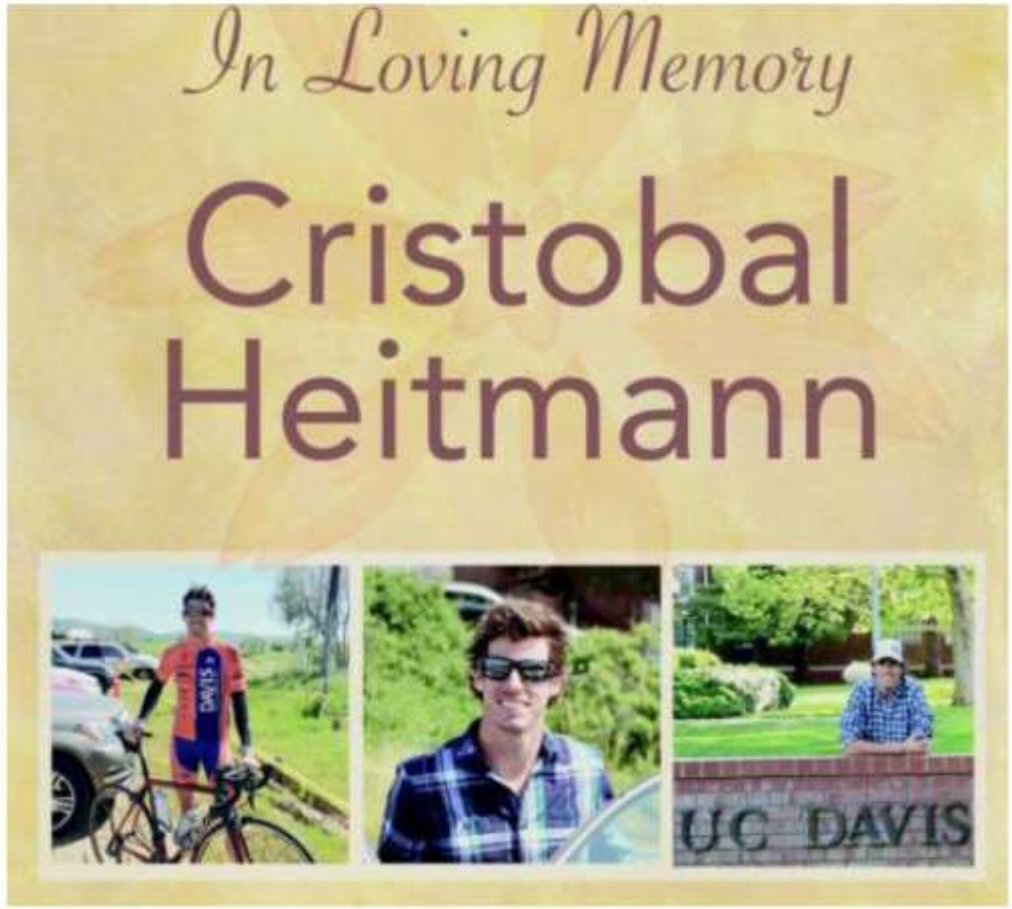
Mars Incorporated

Howard-Yana Shapiro

Harold Schmitz



Scholarship fund at sbc.ucdavis.edu

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