Can planter sensors be used to improve NUE?

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Canopy Sensors and Regional Algorithms
Agronomic Metrics

- Hybrid
- Population
- Singulation
- Spacing
- Applied Downforce
- Downforce Margin
  - CEC
- Clean Furrow
- Furrow Moisture
- Organic Matter
- Soil Temperature
- Uniform Furrow
Precision Planting: SmartFirmer

- Moisture
- Temperature
- Organic Matter
- CEC
- Clean Furrow
- Furrow Uniformity
Research Questions

• Real-time Control

Sense

SmartFirmer
  • Organic Matter

Interpret

20|20 display

Control

Conceal
Research Questions

• How accurate are the estimated furrow properties?

Sense

SmartFirmer
• Organic Matter

Interpret

20|20 display

Control

Conceal
Research Questions

- Can we be confident in making real-time adjustments?

SmartFirmer
- Organic Matter

Sense

Interpret
- 20|20 display

Control
- Conceal
Soil properties driving EONR

**Loam**
- Well drained

**Loam**
- Poorly drained

**Clay loam**
- Well drained

Graphs showing the relationship between EONR (kg N ha⁻¹) and various soil properties such as percentage of soil organic matter, PAWC (soil water availability), and clay content.
How well can we predict organic matter?
How well can we predict organic matter?

Y = 2.5 + 0.024x

$R^2 = 0.25$

$RMSE = .23$
Grid Sample vs. Sensor-Based N Rates

MU Recommendation adjusted for OM and CEC

- Moisture
- Temperature
- Organic Matter
- CEC
- Clean Furrow
- Furrow Uniformity
Grid sampled based N rate

SmartFirmer based N rate

Soybean Yield (2018)

lb N/ac
- 260
- 255
- 250
- 245
- 240

lb N/ac
- 240
- 235
- 230
- 225
- 220

bu/ac
- 58 - 99
- 55 - 58
- 52 - 55
- 48 - 52
- 41 - 48
- 13 - 41
Can we capture soil spatial variability?

- Soil EC: “Gold Standard” for understanding soil variability
Soil Variability

The graph illustrates soil variability along a transect distance of 0 to 600 feet. The data points represent elevation and soil electrical conductivity (EC) at different locations: Summit, Backslope, and Footslope.

- **Elevation** is indicated by brown dots.
- **Soil EC** is shown by orange dots.

The graph shows a peak in elevation and soil EC at the Backslope, with a decrease towards the Footslope, indicating soil variability across the transect.
Soil Variability

Productivity Index

- Elevation
- Soil OM
- Soil EC

SmartFirmer
Organic Matter (%)

Deep Soil EC (0-3 ft, mS m⁻¹)

Summit
Backslope
Footslope

Transect Distance (ft)
Soil Variability
Current Status (July 25, 2019)

SmartFirmer OM

Drone Image (400ft)
Can Planter Sensors Improve NUE?

- Ability to detect soil spatial variability
  - Interpretation must be soil and year-specific
- Opportunity for fine-scale management if properly equipped