Generating High-Definition As-Applied Maps for Pneumatic Fertilizer Application Equipment

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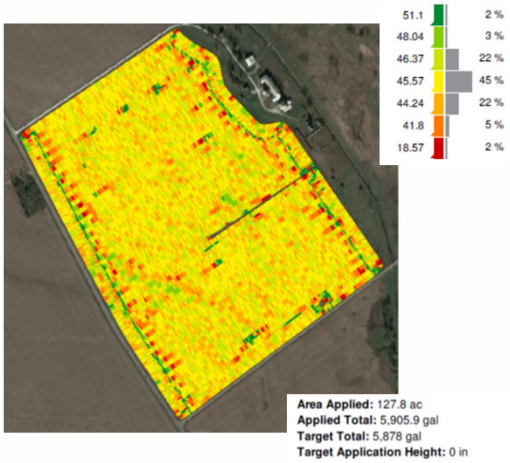
As-Applied / Coverage Maps



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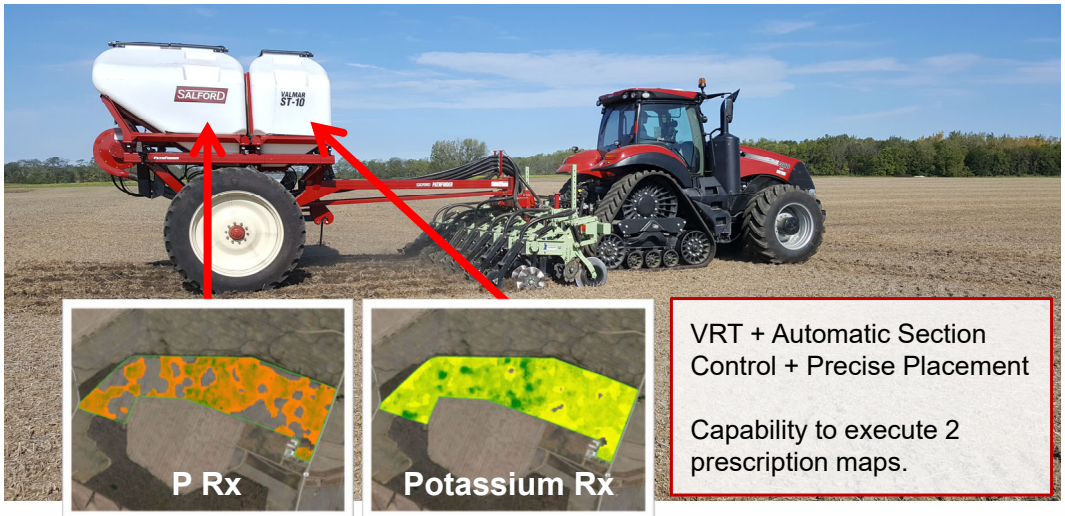
Precision Technology for Fertilizer Placement



VRT + Automatic Section Control + Precise Placement

Capability to execute 2 prescription maps.

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AS-APPLIED FERTILIZER MAPS

Critical data layer:

- Verify applied materials
- Support on-farm research
- Fertilizer response curves
- Record keeping

As-applied maps need to reflect the applied amount of product and application quality across a field.

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Study Objective

The objective of this work was to develop a sensor to measure mass flow of fertilizer particles for pneumatic based applicators for the generation of high resolution as-applied maps.

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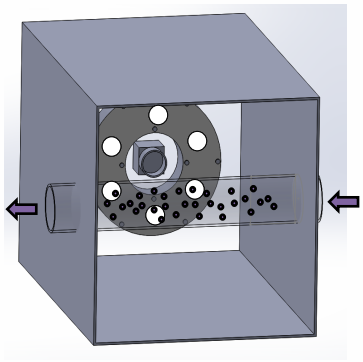
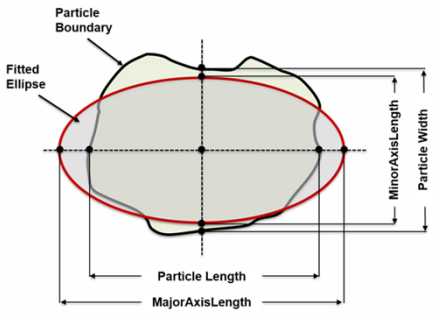
Imaging Technology

Camera
- 5 MP
- 36 fps
- Min. exposure time: 0.027-ms

High Performance Bright Field Ring Light
- 45,500 lux from 12”
- Pulse controlled – external camera signal



3D Particle Volume Estimates – ellipsoid model



Ellipsoidal model of a sensed particle used in this research. Adapted from Igathinathane et al. (2009).

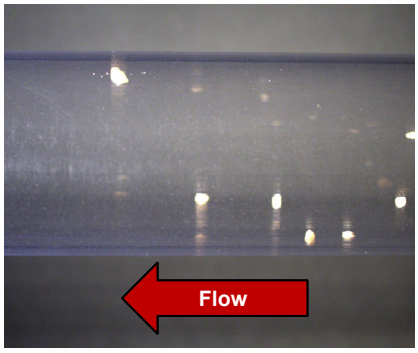
Imaging Environment

Flow Assessment

- Quantify amount of material flow for instance of time.

Challenges:

- 130 km/hr particle flow
- Small fertilizer particle sizes <3mm
- Illumination
- High frame rate required



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Summary of Results

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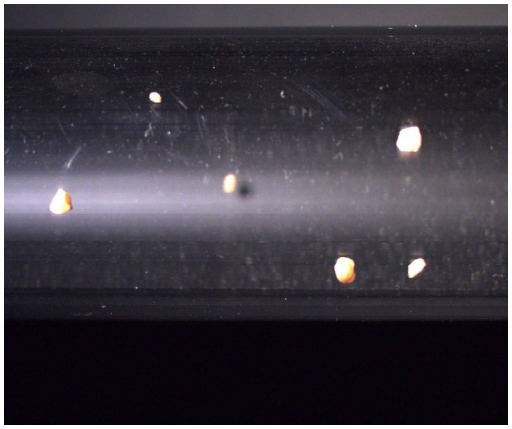
Image Processing Results

Applied Mass

- 2.2 m/s (5 MPH) for 0.76-m row spacing
- Particle speed 36 m/s (80 mph)
- Image value held constant for 1 sec.

Application Rate: 105 kg/ha



4.7 Grams of Potash

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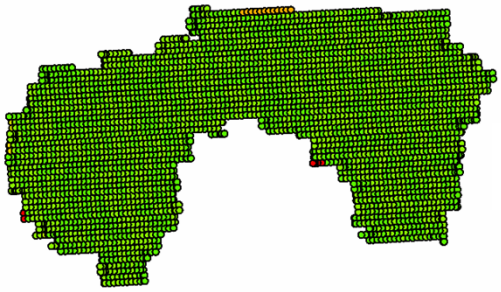
As-applied Coverage Map Comparison

Precision Ag In-cab Display



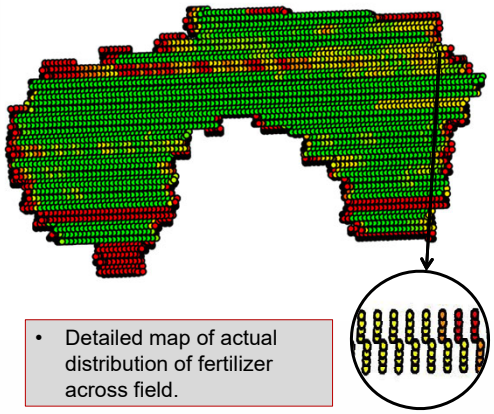
- Average across applicator
- Based on metering device RPM only.

versus

As-applied Rate (kg/ha)

0-150	200-210
150-160	210-220
160-170	220-230
170-180	230-240
190-200	240-250

OSU Flow Monitoring System



- Detailed map of actual distribution of fertilizer across field.

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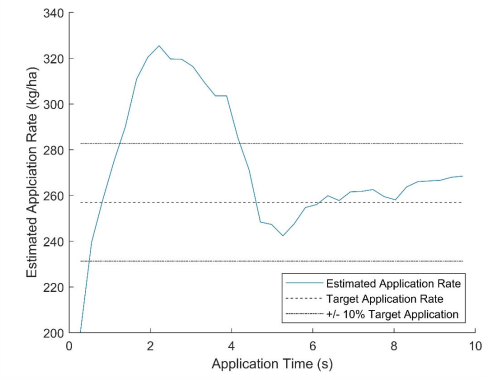
Rate response…



- "Tuned" / adjusted PWM valve under static conditions during calibration.
- The Ohio State technology was able to characterize rate response at the point of delivery.
  - A need for PWM metering valve tuning based on row-by-row sensor feedback.
  - Feedback opportunity to controller…

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Results

- Sensing technology performed well at application rates above 224 kg/ha but not as good at lower application rates.
- Field validation indicated the sensing technology was able to sense fertilizer flow on a row-by-row basis.
  - The HD as-applied map provided much more detail over current as-applied fertilizer maps generated by in-cab displays.
  - Able to detect low flow issues that occurred across the applicator during field operation.
  - Characterize rate response during VRT rate changes.
- Future work needed before commercialization

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Questions?

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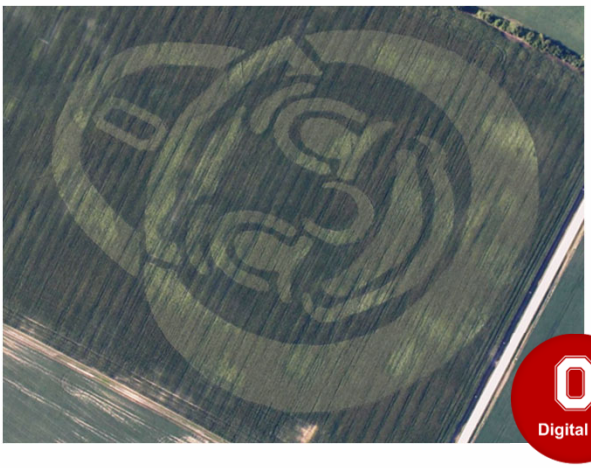

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