Emerging Technologies and Autonomous Applications in Precision Agriculture

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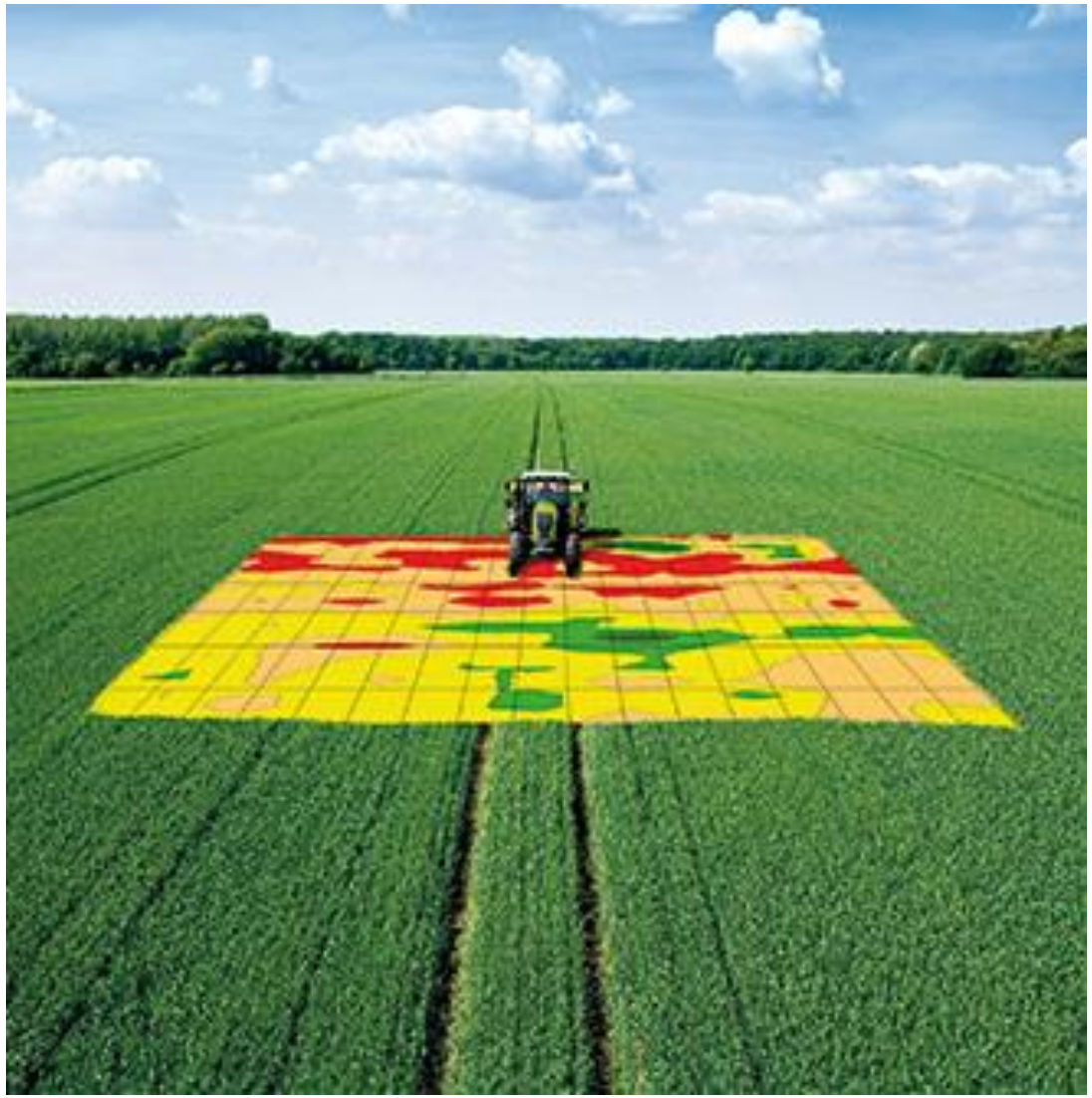
Precision Ag Technology Today

- **Basic PA technology is the Norm**
  - ✓ Auto-Guidance is standard
  - ✓ Section and Rate Control on Planters and Sprayers
  - ✓ Variable-Rate Application of crop inputs
  - ✓ Yield Monitor on Harvest Equipment
- **Growing with technology**
  - ➢ Telematics, Data Management & Drones
  - ➢ Smart Sensors, Connected Technology & Imagery
- **Future technology potential**
  - ❑ Robotics & Automation
  - ❑ Machinery Learning & Artificial Intelligence



Precision Ag Technology Adoption Levels

Advanced

Intermediate

Basic

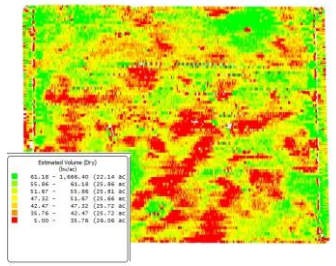
Auto-Steer
Section Control

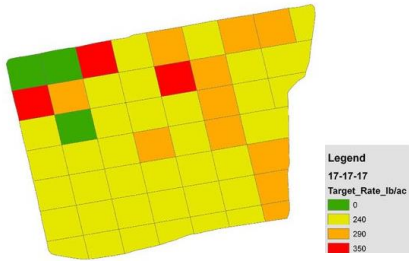
+

Yield Monitoring
Data Management
VR Application

+

Telematics
Data Analytics
Mobile Apps
Autonomous Vehicles

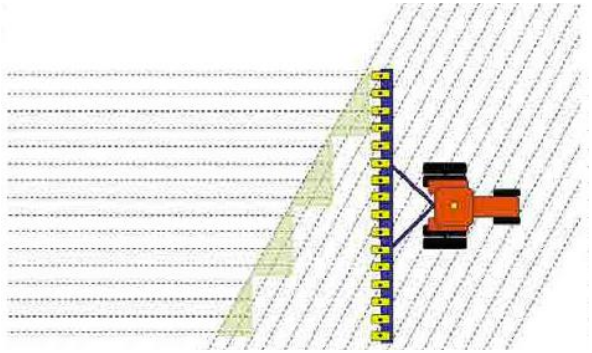


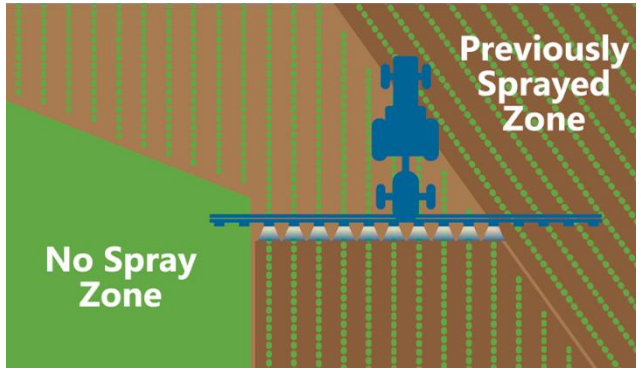


Basic Precision Ag Technologies

Guidance & Auto-Guidance Systems

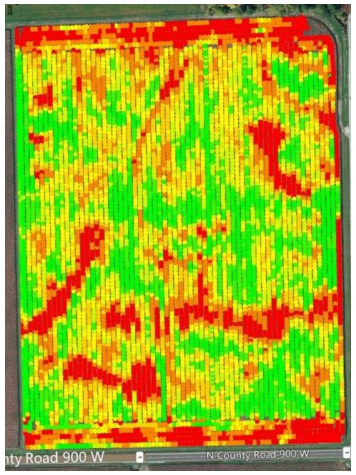
Section & Row Control on Sprayers and Planters



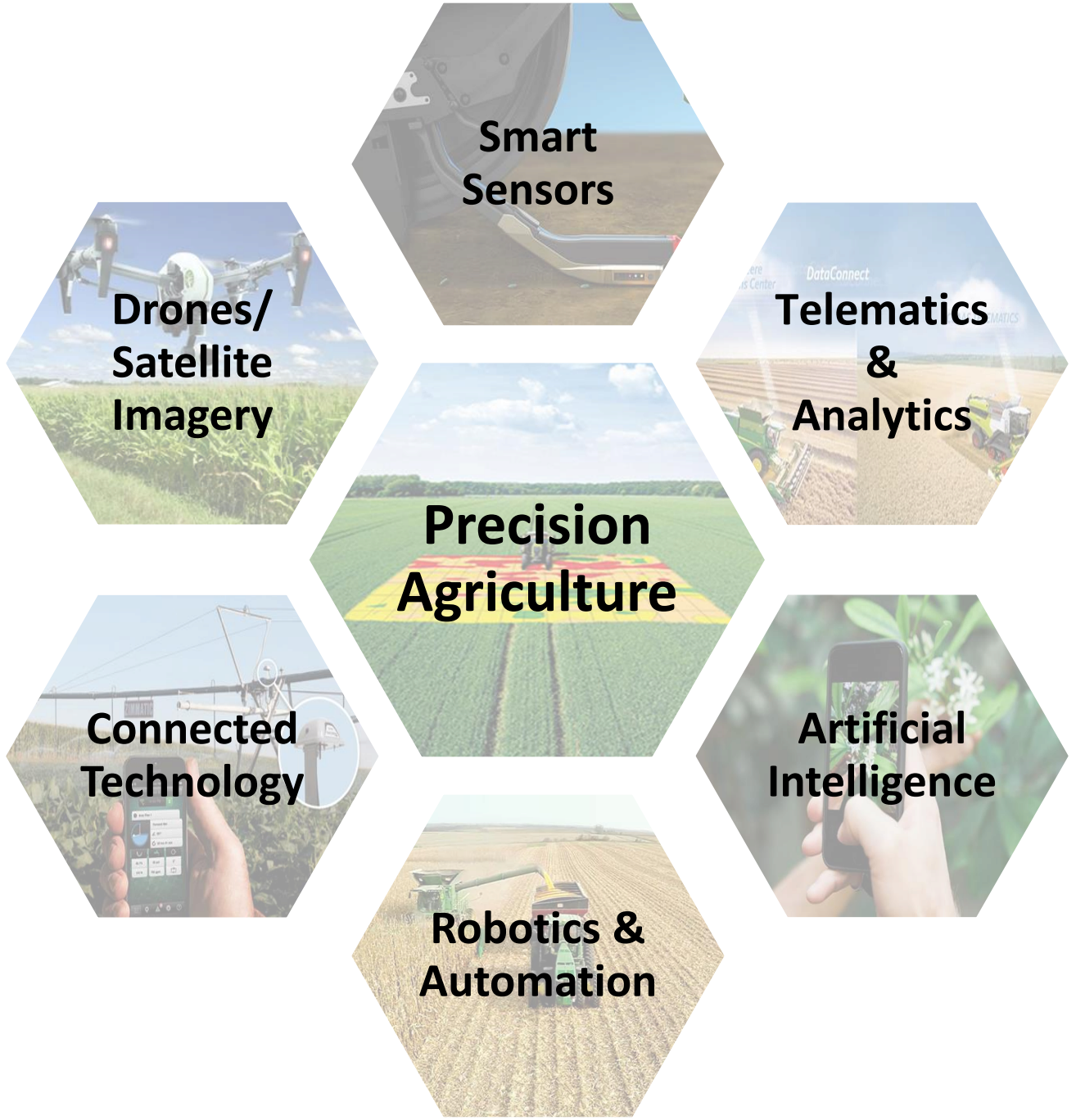


Variable-Rate Application – Fertilizer & Seed

Yield Mapping & Monitoring



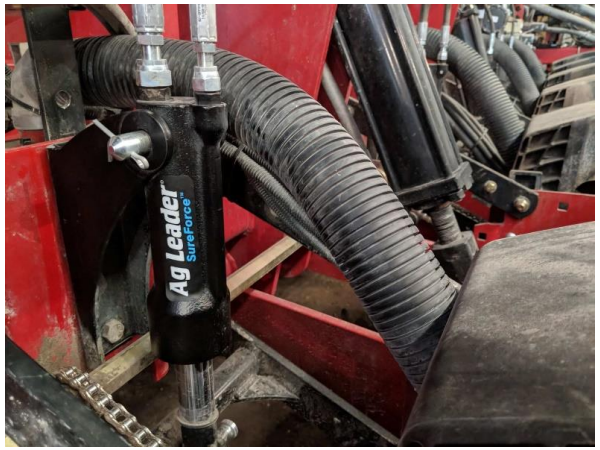
Emerging Technologies and Applications



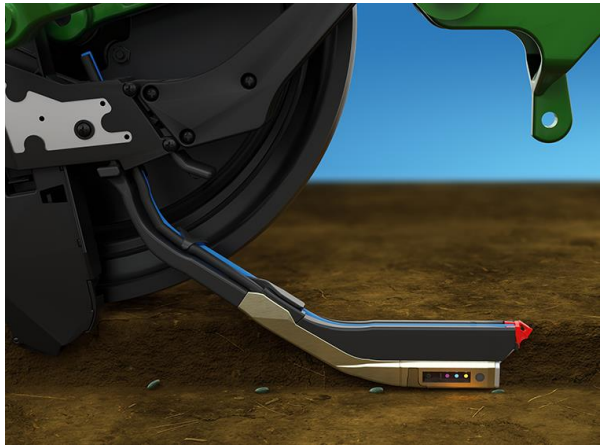
Smart Sensors

Seed Tube Sensor

Smart Sensors



Active Downforce



Precision Planting SmartFirmer

Common Nozzles used for Pest Management

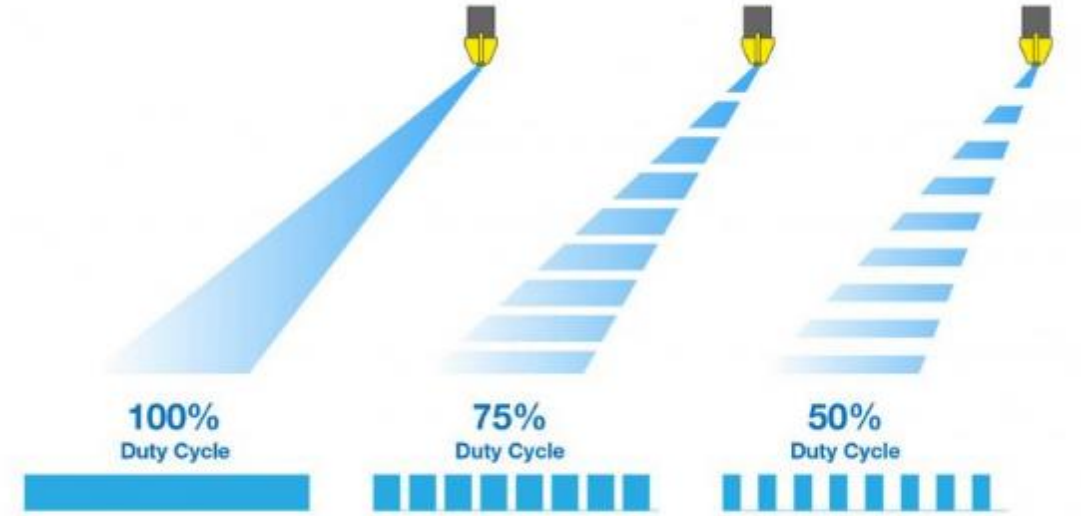
Standard Flat-Fan (XR)

Air-Induction (AIXR)

Dicamba Tip (TTI)

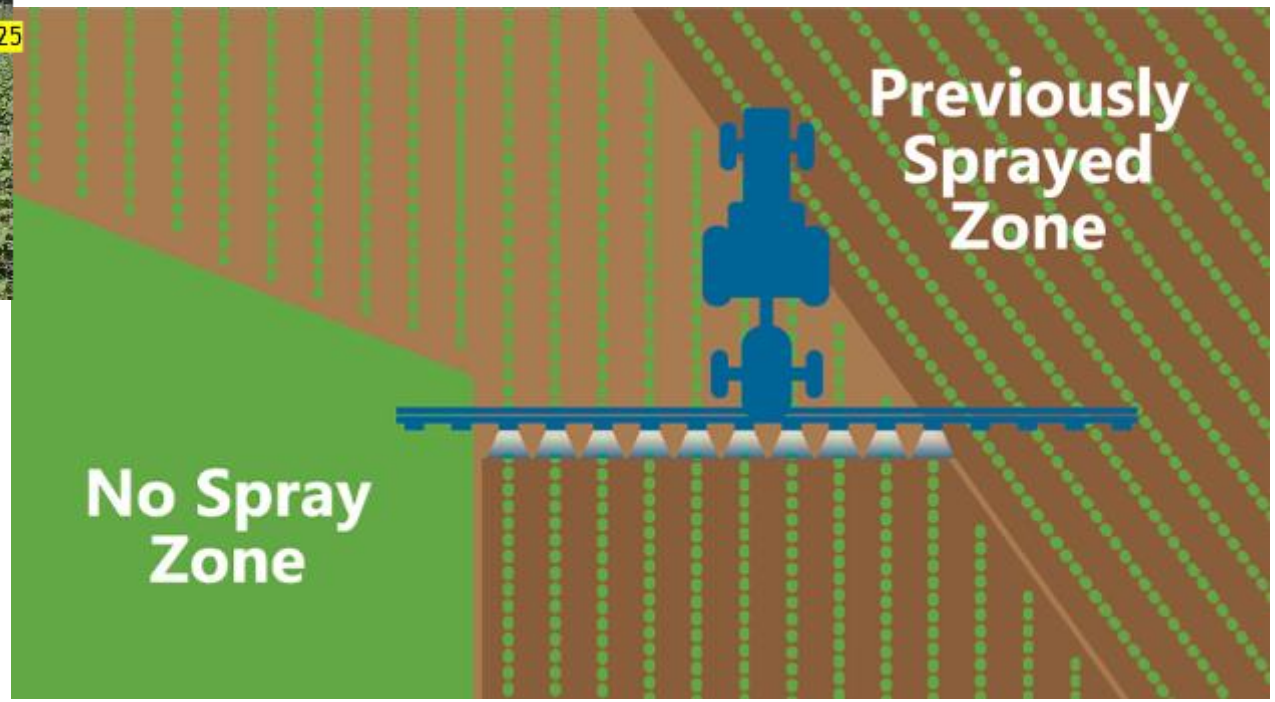
Precision Rate and Droplet Control - PWM Technology

- Constant spray pressure across the boom (droplet size control)
- Flow (rate) changes are accomplished by varying duty cycle



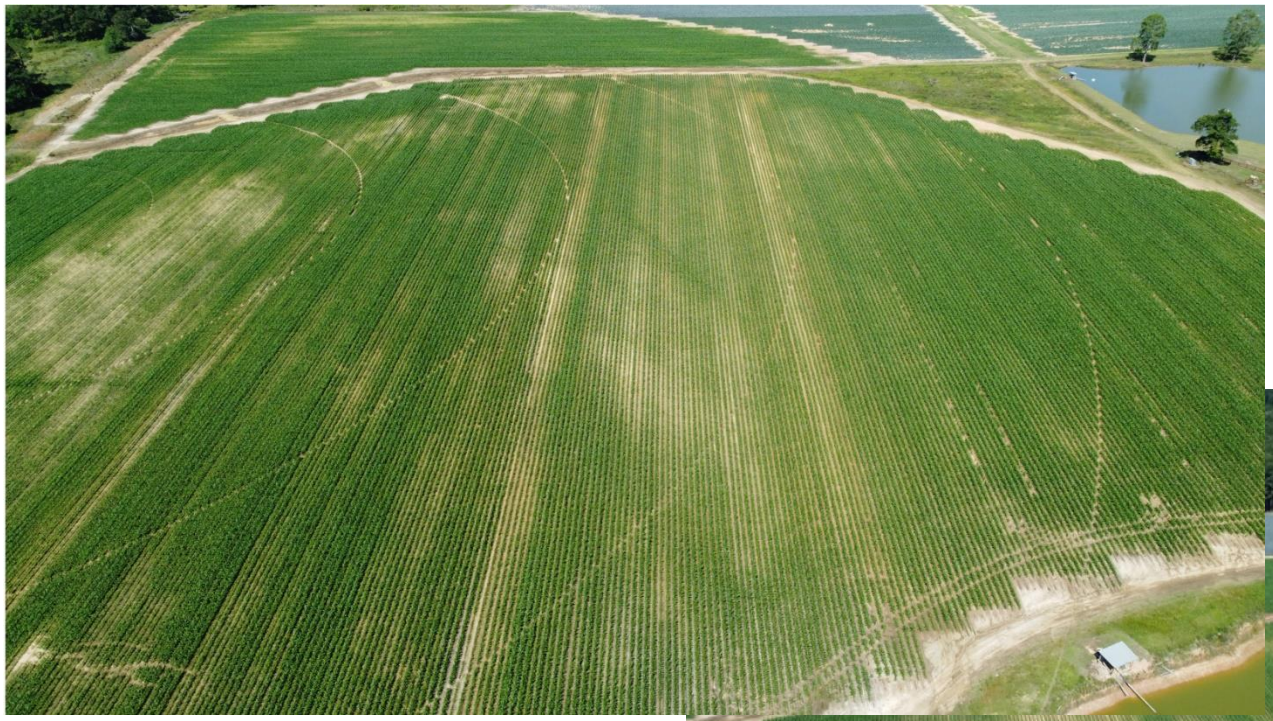
Individual Nozzle Control

- Individual nozzles can turn ON/OFF as they come out of spray and non-spray/already sprayed areas.



- Reduction in over-application and application in environmentally sensitive areas.

Drones



- ***Scouting & Crop Monitoring***
- ***Insurance (crop loss claims, yield prediction….)***

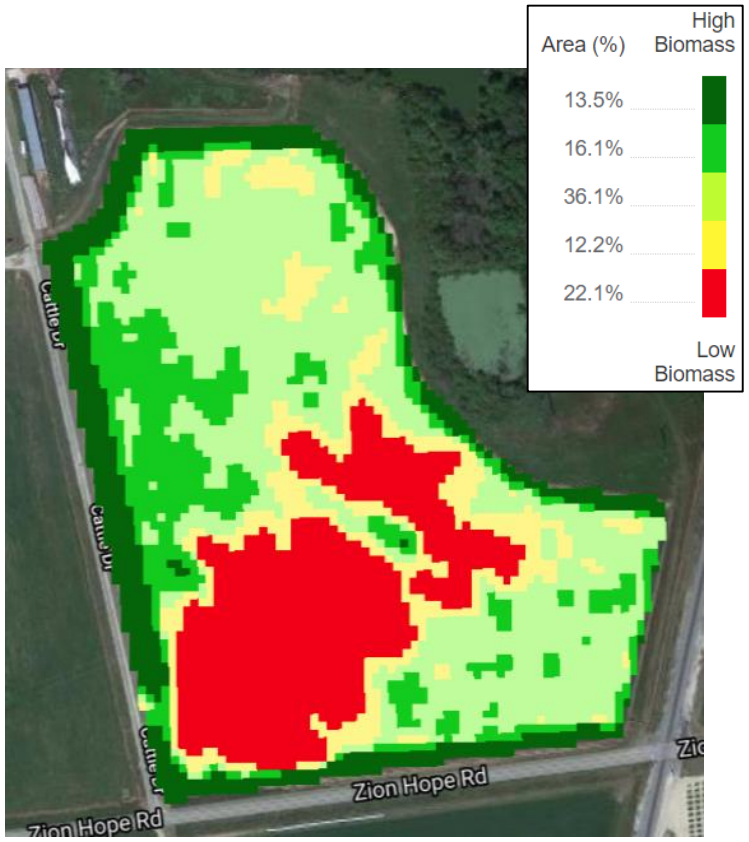
Satellite Imagery

December, 2007

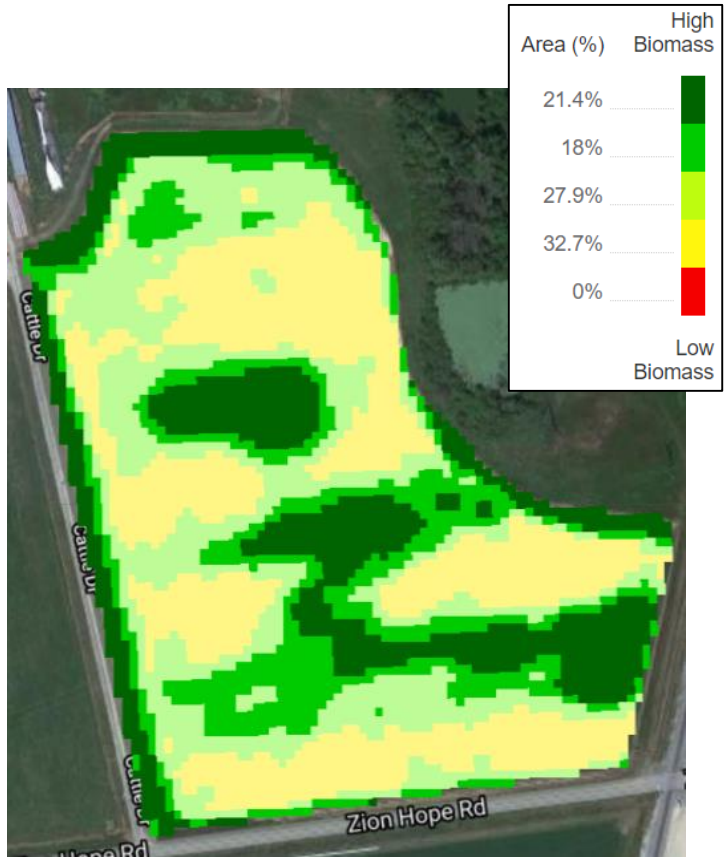
March 26, 2013

April 2, 2023

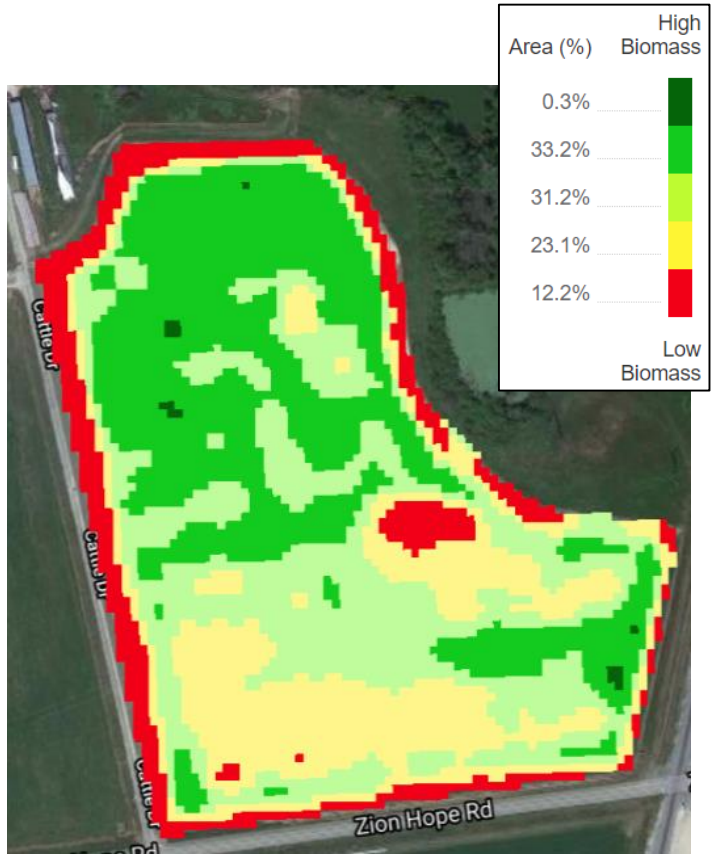
Aerial Imagery Driving In-Season Crop Management Decisions



June 10 – Before Planting



July 25 – After Planting

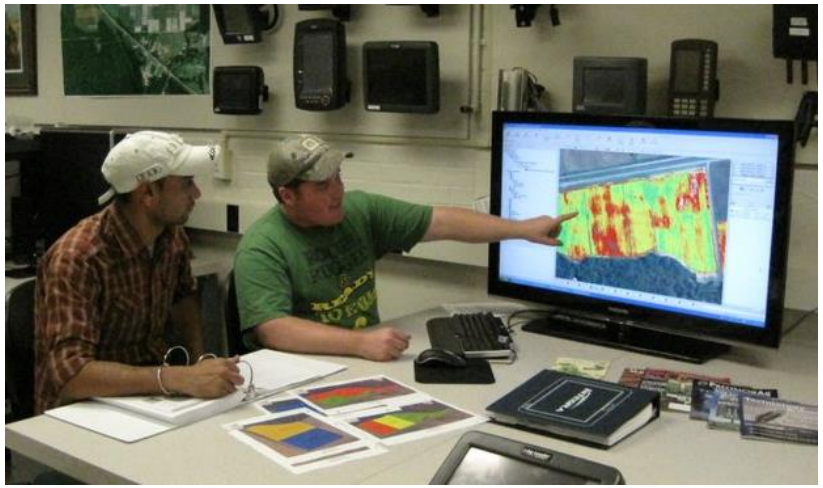


October 13 – Before Defoliation

Spray Drones

- **Spot-spray herbicide applications** – where it is efficient and economical to treat with a drone sprayer
- **Fungicide applications** – when a timely fungicide application with a ground sprayer or crop duster is not feasible
- **Awkward acres or small fields –** fields or parts of the fields that makes applications with ground and/or crop duster challenging

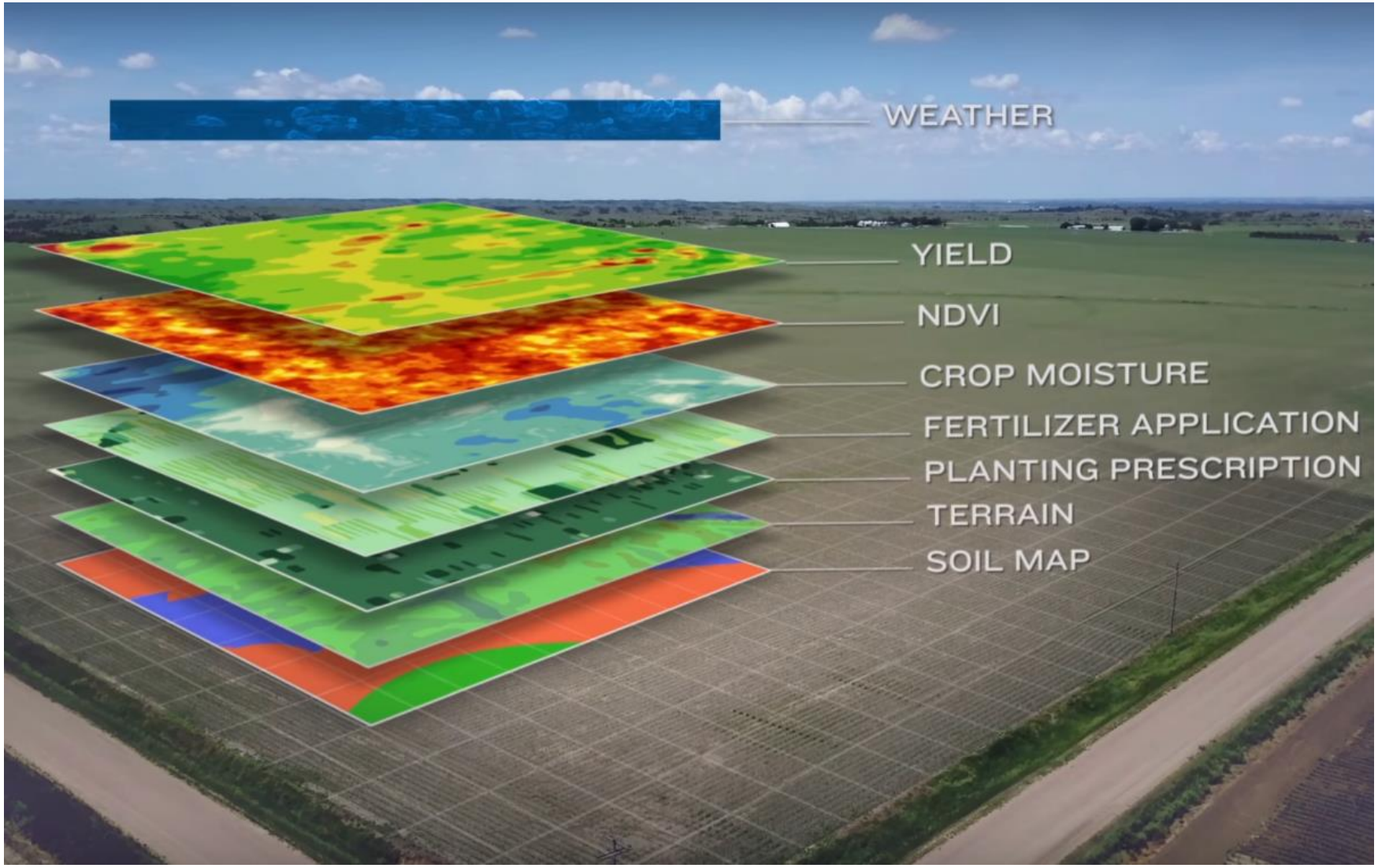
“Big Data” in Precision Ag



Planting Metrics: (20+)

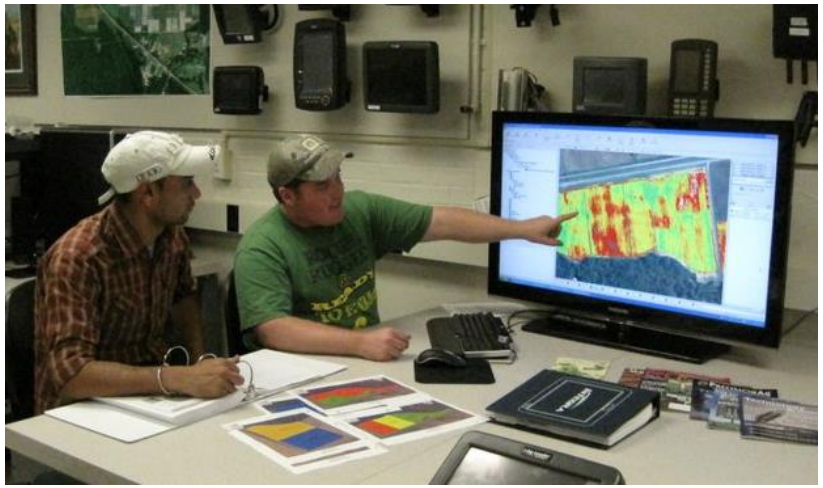
- *Population*
- *Singulation*
- *Furrow Quality*
- *Downforce*
- *Seed Spacing*
- *Ride Quality*
- *Closing Pressure*
- *Soil Moisture*
- *Soil Temperature*
- ……

“Big Data” in Precision Ag



A single field (~30 ac) can have up to 1 TB of data over the full season.

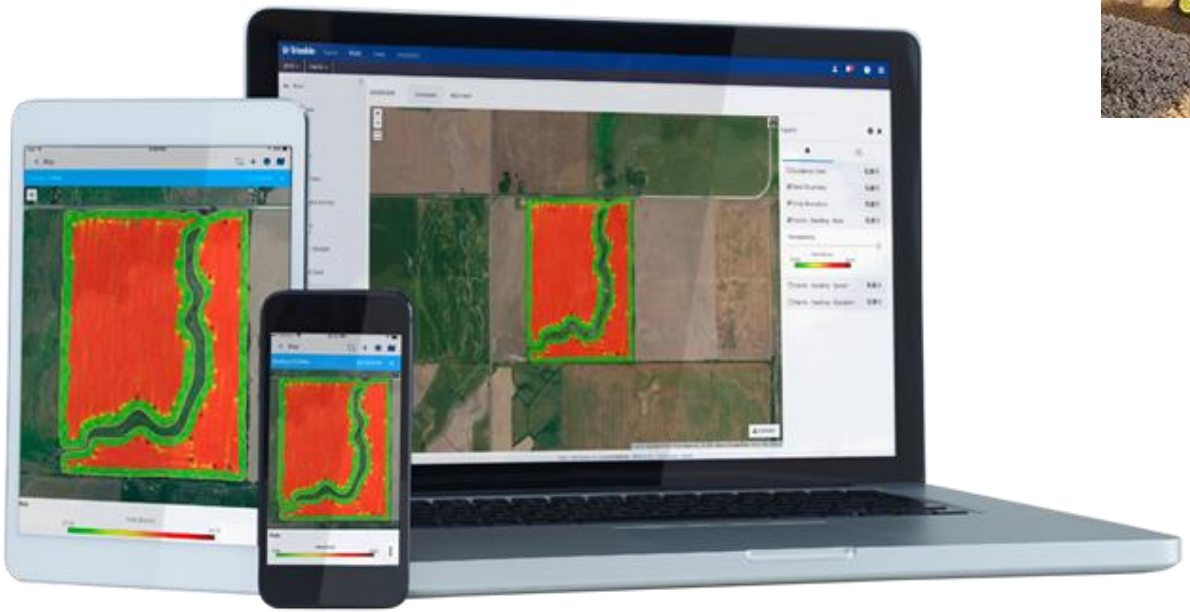
Telematics & Analytics



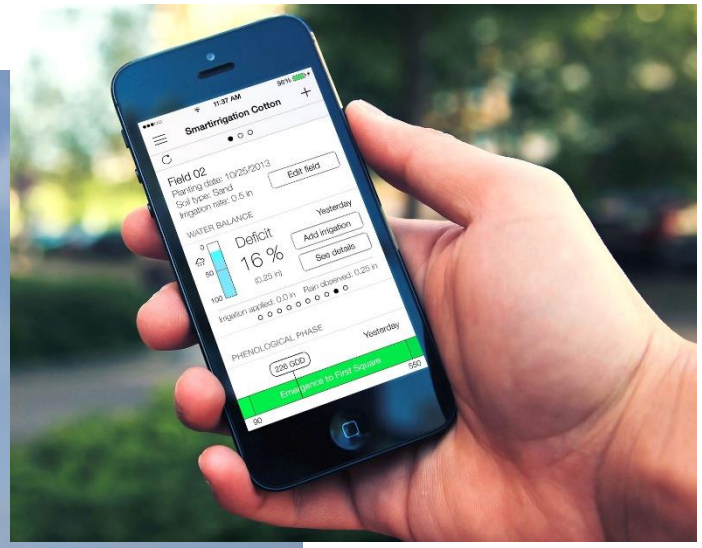
Wireless Data Transfer & Storage

Telematics & Data Analytics

Web-based and Online Data Management Software's

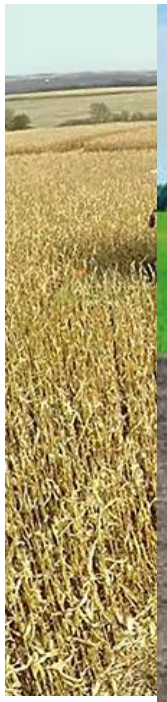


Connected Technology



Remotely control and monitor machine/equipment functions!

Robotics & Automation



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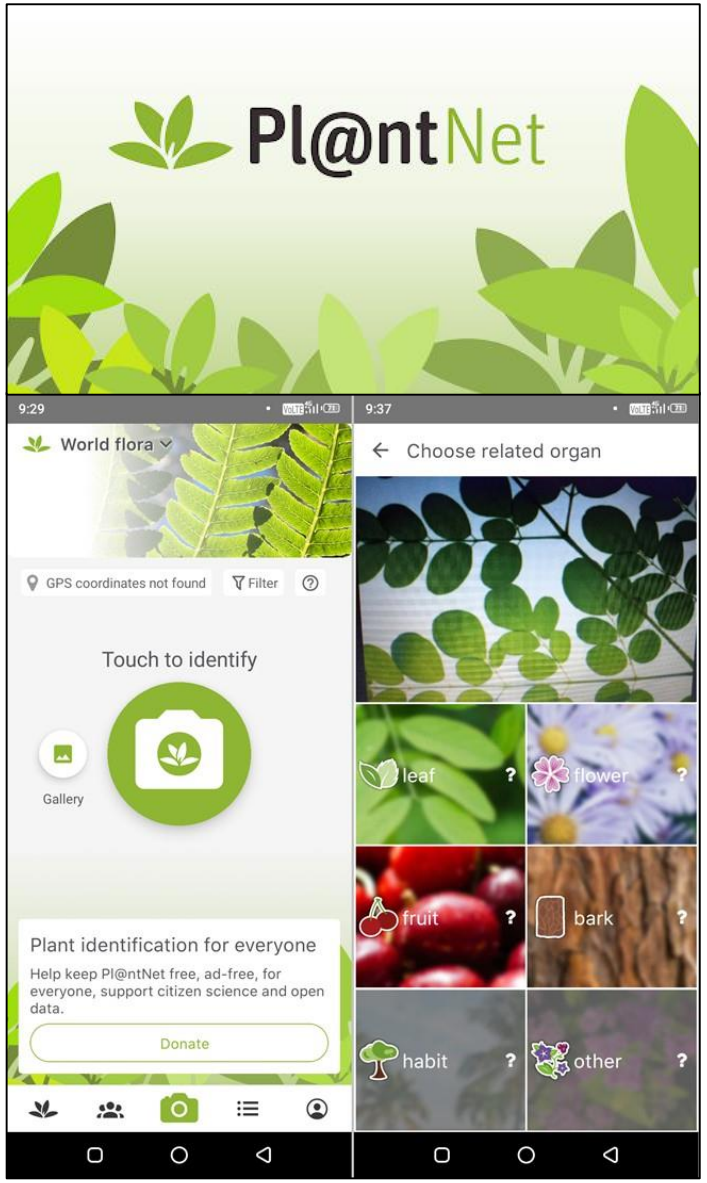
Machine Learning & Artificial Intelligence



See & Spray Select: Broadcast and targeted spray on fallow ground (green-on-brown)

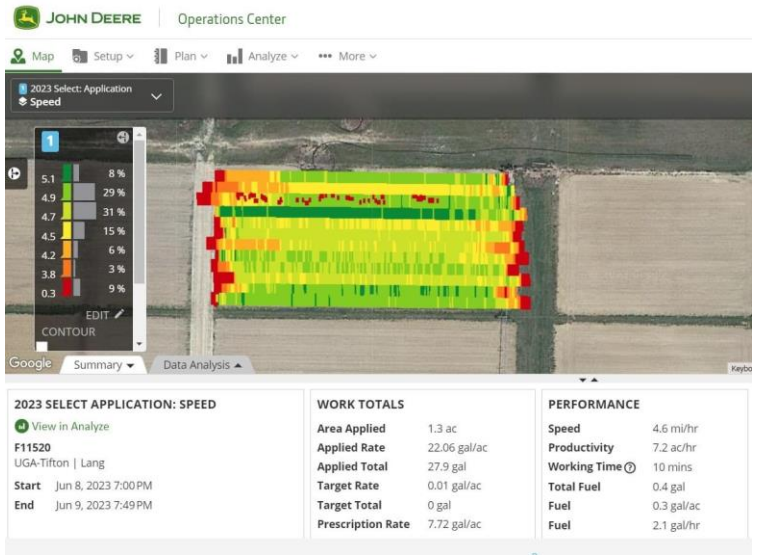
See & Spray Ultimate: Targeted spray in the crop (corn, soybean and cotton; green-on-green)

What we can expect in next 3-5 years?

- **More (small and medium-scale) growers adopting technology**
  - Interest in precision application of crop inputs
  - Need to catch up with technology (late adopters)
  - Technology already integrated into the new machinery
- **More sensors, technology and data on agricultural machinery**
  - More precise crop input applications
  - Automating machine functions with more connected technology
  - In-field data driving application decisions

Research Centers & Experiment Stations……

We must adopt and utilize technologies to stay relevant!



Thanks!

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